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#THE NEW VOLUMES

OF THE

ENCYCLOPÆDIA BRITANNICA

THE

NEW VOLUMES

OF THE

ENCYCLOPÆDIA BRITANNICA

CONSTITUTING, IN COMBINATION WITH THE EXISTING VOLUMES OF THE NINTH EDITION,

THE TENTH EDITION

OF THAT WORK, AND ALSO SUPPLYING

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PREFATORY ESSAY.

MODERN CONDITIONS OF LITERARY PRODUCTION.

By Augustine Birrell, K.C.

LITERATURE in its widest sense is as large as human life, and has been produced after some fashion or another at all times and in all places, though happily not yet *ab omnibus*. Before pens and ink were invented men had found means to commentate upon their environment, and to record their history "with quipo-threads, with feather-pictures, with wampum-belts, still oftener with earth-mounds and monumental stone-heaps, whether as pyramid or cairn." But the conditions under which literature has been produced have ever been changeable, and still continue to change; and being subjected as they are to all the influences that mould society and alter manners, any history of them that aimed at completeness would resolve itself into a record of that vast, mysterious, fascinating, perplexing movement, which is sometimes called Progress, sometimes Evolution, and sometimes Destiny.

The purpose of this essay is more modest, namely, to call attention to a few of the more obvious changes that have occurred in the last half of the 19th century in the production and distribution of printed matter. Error lies in wait at the portals of the humblest Inquiry, eager to take the outspread hands of the anxious inquirer, and personally to conduct him by the pleasant paths of Hasty Generalization to the resting-place of False Conclusions. As we step cautiously into the arena of the book market, our ears are deafened with the roar of its Niagara, its tremendous output, and straightway are excited within us feelings of amazement, admiration, or dismay. The newspapers of a single week, piled one on the top of another, would make a decent hill in a flat country, whilst monthly magazines issue forth in crowds. The spread of what Goethe shudderingly called "half culture" is noticeable everywhere. Even polite learning has not wholly escaped the taint of trade. Parnassus is undoubtedly a very noisy mountain, where publishers shout their wares, and authors seek to gain popularity by the doubtful device of exhibiting their photographs. A commercial spirit pervades the atmosphere. And no wonder! Fortunes stockbrokers might envy await the few who can succeed in winning and retaining, though it be but a short while, the ear of some or other of the "publics," into which the book-readers of the world are divided. There it is, the great restless, swaying crowd, peopling whole continents, waiting to be amused, to be excited, to be inflamed, to be taken out of themselves; who would not reach it, teach it,—tax it, if he could? That very risible farce, *Charley's Aunt*, has made more money than is represented by the united fortunes of Scott, Thackeray, and Dickens. Had there been American copyright a generation earlier, the clever authoress of *East Lynne*, or her publishers, must have drawn at least £50,000 from trans-Atlantic readers. It is a pleasant thing, let critics say what they may, to spin a snug family-fortune out of the inventions of your brain.

Considerations of this kind, however, lie merely on the surface, and though they may lend themselves to a sardonic humour, or supply an outlet for the spleen of authors whose books do not command fortunes, or readily convert themselves into neat villas, they carry us a very little way in our investigation. There is nothing new under the sun, except the conditions under which men go forth to their labour or their folly. The booksellers of the 17th and 18th centuries were every bit as anxious to make money for themselves and their families as any publisher to-day can be. An excellent account of our early booksellers is to be found in John Dunton's *Life and Errors*, first published in 1705. A few of these men were rogues, others of very doubtful virtue, but some were good fellows; and as for the authors, they did the best they could for themselves. Some of the worst of them made a great deal of money, and some of the best of them very little, and people complained then just as they do now of the degeneracy of the times and the vulgarity of the age. Indeed, before the age of printing, and when "the trade" was engaged in selling manuscripts, employing in Paris and Orleans alone ten thousand copyists, doleful cries resounded in University and Church circles as to the evil consequences of cheap learning and unlicensed reading. The movable types did not create, though they greatly helped to promote, what is called the Revival of Learning, *i.e.*, the spirit of inquiry. Nor will any one who has any general acquaintance with the literature of the Renaissance marvel at this outcry. To confine your attention to masterpieces is not the best way to appreciate the tone and temper of the period that produced them.

I will take as my point of departure the 1st of July 1842, when the Copyright Act for Books, which is still in force, first came into operation. About this Act itself one or two things are significant. First note the old-world simplicity of its preamble, "Whereas it is expedient to amend the law relating to copyright, and to afford greater encouragement to the production of literary works of lasting benefit to the world." In some dim, undefined way it was supposed that the monopoly called "copyright" could only be justified if it were confined to literature of the highest class; and certainly Macaulay in his famous speech in Parliament dealt only with great examples, and the orator would have been very much put out had he been told to say something about the tradesmen's catalogues and stockbrokers' price-lists, which the judges have decided are as much entitled to the benefit of the Act as Darwin's *Origin of Species* or Macaulay's own *History*. There is no good reason known to me why catalogues and price-lists should not be protected, for the eighth commandment, "Thou shalt not steal," is or ought to be a law of universal obligation, but it is interesting to notice how a monopoly that was with great difficulty, and after long delay, wrung from the Legislature in favour of "literary works of lasting benefit," was willingly, though in violence to the spirit of the Act of Parliament, extended by the judges in favour of the trading community.

Another thing to notice about the Act is its innocence of the British colonies. In 1842 nobody thought about them—indeed, it was in the course of the speech already referred to, that Macaulay made the observation, "There is none of us who would lay down £5 for a whole province in the heart of the Australian continent." The Act, though imperial in its scope, including as it did "all parts of the East and West Indies, and all the colonies, settlements, and possessions of the Crown which now are or hereafter may be acquired," was purely insular in its methods, since its provisions involved publication within Great Britain or Ireland of the book that was to be protected. It never occurred to any one that a Canadian or an Australian author might publish a book in Montreal or Sydney. In those days we English had the homely wits of home-staying men.

Passing away from the Copyright Act of 1842, but keeping its date in mind, the first altered condition, and one the most worthy of notice, to which I would call attention, is that of Population. Between a country containing less than sixteen millions of inhabitants (the population of England and Wales in 1842) and the same country containing thirty millions, great must be the difference. It is difficult to be isolated in the England of to-day. The pressure of the environment is enormous. The contagion of the crowd is quickly propagated. Uniformity is produced. Oddities, quaintnesses, humoursome prejudices, local peculiarities, dialect, persistent individualities, "characters" are disappearing from English life as rapidly and as irrevocably as so much that was picturesque and lovely in English landscape. There is a passion for equality in externals that is born of numbers. To dress like your neighbour, to live under the same kind of roof, and to eat at the same hours as he does, to share his tastes, to repeat the same catchwords—all this seems natural and desirable in thickly-populated districts.

When once a book or a paper can be introduced to the notice of such homogeneous compounds, its fortune is made, for it rages among them like an epidemic. This contagion of the crowd powerfully influences the supply and demand of books and newspapers.

In a great population animated by democratic notions, recognizing no external authority in matters of faith or taste, with a growing passion for equality and a greedy desire to handle the good things of this world, as recommended by the modes and methods of life of the wealthy and luxurious, it would be irrational to expect to discover any general refinement or delicacy of thought or feeling. We may rejoice if we are able to observe prevailing signs of a dominant healthy manhood in our recreation grounds, theatres, music halls, factories, regiments, and wherever else our vast populations lead their lives. To expect too much of the human race is the ancient error of moralists and the sin of the satirist. In his lecture on "Numbers," delivered in the United States, Mr Matthew Arnold illustrated by quotations from Plato and Isaiah the truth that it is always the remnant that saves a nation or a race, and the advantage of a big country and a great population is that the remnant has at least a chance of being a good large one. A country that has left off breeding has abandoned hope.

Next in importance to the growth of population in the last half-century is the extension of popular Education, which cannot be overlooked when considering the changes that have taken place in the production of literature. The great object of popular education is or ought to be to teach the people to read with perfect ease, and as much intelligence as can be mustered. Unless they can read with ease ninety-nine men out of a hundred will never read at all. The real University, said Carlyle, is a Collection of Books. I cannot admit this to be precisely true, since the function of the University is to teach, but unless books are within your reach physically and mentally, there can be no teaching for you, and primary education must fail to effect its purpose. In 1842 people in England were an unlettered race, a large percentage of the population being unable to read or write. The only public money devoted in that year to the work of primary education was a Parliamentary grant amounting to £29,618, 5s. 10d. In rates and taxes the annual expenditure solely directed to the same end amounted in 1902 to (at least) £16,000,000 sterling. 1842 is a melancholy date in the unhappy history of English education, for it was that year that witnessed the defeat (owing to ecclesiastical squabbles in which neither the parents nor the children had the faintest interest or concern) of a considerable measure of National Education. What a picture is that drawn by the master hand of Dickens, himself one of the greatest popular educators of the age, of little "Jo" moving about among the hieroglyphics of the London streets !—

> It must be a strange state to be like Jo! To shuffle through the streets unfamiliar with the shapes, and in utter darkness as to the meaning of those mysterious symbols, so abundant over the shops, and at the corners of streets, and in the doors, and in the windows! To see people read, and to see people write, and to see the postman deliver letters, and not to have the least idea of all that language—to be to every scrap of it stone blind and dumb! It must be very puzzling to see the good company going to the churches on Sundays with their books in their hands, and to think what does it all mean, and if it means anything to anybody, how comes it that it means nothing to me? To be hustled and jostled and moved on; and really to feel that it would appear to be perfectly true that I have no business here, or there, or anywhere; and yet to be perplexed by the consideration that I am here, somehow, too. Jo's ideas of a criminal trial, or a judge, or a bishop, or a government, or that inestimable jewel to him (if he only knew it) the constitution, should be strange. His whole material and immaterial life is wonderfully strange; his death, the strangest thing of all.

"Jo" had to wait from 1842 to 1870 for his education, but he has got it now; for although it cannot, and probably never will be said of Englishmen that they are a reading people, they have at least become a people who can read.

The immediate result of these changes in Great Britain, both in numbers and intellectual qualifications, has been the multiplication of cheap periodical prints, for to call them generally "newspapers" would be inaccurate. The vastness of the public who can read, the marvellous plenitude of copper coins, the cheapening (though the price varies very much) of paper, the extraordinary perfection of the printing-press, and the many processes for producing pictures, have both tempted and enabled those traders who are concerned in such matters to put upon the market day by day and week by week the most bewildering number of "papers" (as they are called) for men, women, and children—some with pretentious pictures, others with drawings and cuts, which appear to find ready purchasers in the streets. In these papers is to be found a great variety of matter. Amidst a little that is positively bad, and much that is distressingly trivial and vulgar, occasionally may be noted a touch of elevation, chiefly conveyed by means of quotations, which are at least capable of awakening a response in minds attuned to better things.

The activity of the press is not confined to the production and distribution of newspapers and periodicals. It also turns out, by the million, popular books at democratic prices. This cheapening of books is one of the great facts of the age. For a penny apiece may be bought no inconsiderable number of books, and among them are included some of the most famous in the world; whilst any one who is prepared to give sixpence a copy may include in his library almost everything that is really worth reading in the English tongue, whether grave or gay, in verse or prose.

To measure the effect upon the population of this amazing output is impossible. Cheap books have their drawbacks. A twopenny Bible is not treated with much deference. Still, the sale of a million copies of such a book as Charles Kingsley's *Westward Ho!* at fourpence-halfpenny a copy means something. Cheap books disseminate the habit of reading, circulate the knowledge that there is pleasure to be got out of books, stimulate the desire of a wider range of study, contribute to the refinement of the race, and so affect the conditions under which books are produced and distributed.

Here, again, I must be permitted to interpolate the remark that it is the size and reading-power of the crowd that have changed rather than its character, for there has been for many a long year a market for cheap books in England. Long before 1842 enterprising and not always over-scrupulous cheap booksellers had the wit to see that money was to be made out of the masses by providing them with books no less than with gin and beer. Book-stall hunters still see perched on their upper shelf the editions of these pioneers of popular education—ill-printed it may be, but handy for the pocket—*Tom Jones*, *The Vicar of Wakefield*, *Tristram Shandy*, all our British poets, and many another volume of delight; what is more, these cheap booksellers made large fortunes.

There have always been readers among all classes in England. *The Pilgrim's Progress* and *Robinson Crusoe* were from the first the favourites of the populace, whilst chap-books, prophecies, like those of "red-faced Nixon" (named in *Pickwick*), ballads, and tales, have proved more profitable to their printers than heavier works have done. But the crowd was a small crowd and an ill-educated one; now it is a larger crowd, and can read. To expect this crowd to devote its scanty leisure, gained after hours of exacting labour or distressing tedium, to the perusal of masterpieces is unreasonable. To hard-working men and women, and, unfortunately we must add, to hard-working children, reading can never be more than a pastime competing with many other pastimes. The newspaper and the story-book are not likely to be dethroned until the conditions of human life undergo greater alterations even than those that have been witnessed during the last half-century.

In the class above what are commonly called the working class a great change is noticeable in the style and character of their books and reading. We hear complaints loud and long in England about Secondary Education, and they are mostly just complaints, but it is sheer ignorance to suppose that the Act of 1870, and the splendid work of the best School Boards, although confined to what is called "Primary Education," have not had a great effect upon the intelligence of the middle classes, who, finding themselves left out of the national calculations, have taken their culture into their own hands. In this undertaking they have been greatly assisted by the publishers and printers, who have sent forth an ever-increasing number of good books, cheap in price, and in many cases carefully edited. It is the fashion of middle-class people to abuse the middle classes, to call them Puritans and Philistines, tasteless and "suburban," but no inconsiderable portion of this class have had the good sense to profit by this abuse, and have gone steadily on their way, reading good books, attending lectures, making notes, curing their defects, enlarging their horizons, and purifying their tastes, until, far short as they still may be of perfection, they can hardly be said to be far behind their critics, who indeed are usually the more impecunious members of their own households.

In proof of this improvement I can appeal to the private libraries of the land. In the 'forties and 'fifties of the last century the books in too many middle-class homes were a doleful crew, and unless the heads of the family were closely identified with some religious body of publishing proclivities, few in number. A badly-printed Shakespeare was to be found somewhere, and Robertson's Histories, and Josephus in one volume. Hervey's *Meditations among the Tombs* and Zimmerman on *Solitude* were in the best bedrooms, and perhaps John Newton's *Cardiphonia*. These latter are now scarce books. With good luck you might hap upon Pope's *Homer* and the *Essay on Man*, or some odd volumes of the *Spectator* and a tiny *Rasselas*. For poetry there was Thomson's *Seasons*, Cowper's *Task*, and Longfellow alone of the moderns.

Now the blessed change! In countless households scattered up and down the country intelligent students are to be found of Chaucer, of Spencer, of Shakespeare. Modern editions of Bacon's *Essays*, the *Anatomy of Melancholy*, of Walton's *Angler* and *Lives*, of Sir Thomas Browne's *Religio Medici*, of Montaigne's *Essays*, of Jeremy Taylor's masterpieces, of Milton's prose, are as plentiful as blackberries in September. Miss Austen rules with a mild sceptre over a thousand homes, and little Miss Burney once more has her admirers. The Waverley Novels take the field almost every year in some fresh guise. Galt's *Provost* and *Annals of the Parish* give rise to many a quiet chuckle; Charles Lamb is among the Lares and Penates of Great Britain; Hazlitt has come to life again. It is no exaggeration to say that the whole capacious field of English literature has been ransacked and rifled of its choicest treasures in order to place them in good type, on good paper, and at a low price within the reach of almost every one who has any true feeling for books and reading.

It is an age of cheap reprints and collected editions and literary appreciations. It is easy to sneer at cheap culture, and crude admiration, and University Extension Lectures. It is not given to many to enter into the soul of any literature. The best judges often make great mistakes, and it cannot be expected that good taste should be universal; but among our middle class there has sprung up, of late years, an honest love of literature. England is now full of good editions of good books, and the demand for them increases. This is one of the conditions under which literature is produced to-day.

Midway between the Newspaper and the Book stands the Magazine—a now almost venerable form of literature. How many an author has been able to recall, as the great "Boz" loved to do, his emotions on reading his first "article" in a magazine! Dr Johnson wrote for a magazine. Sir Walter Scott was a diligent contributor to periodicals. Lamb, Hazlitt, De Quincey, Carlyle, Thackeray, Dickens, Froude, Matthew Arnold, were all "magazine" men, and their collected contributions, torn from their first birthplaces, now make famous books in their own right. Magazines have played no mean part in disseminating literature and encouraging literary ambitions, and have helped to increase the numbers of those who are on the look-out for books on all the varied subjects of interest with which magazines concern themselves. Almost every subject has its own magazine; nothing is too old or too new—one member of a family is mad about motor cars, another cares for butterflies, a third for folk-lore and early religions, a fourth for pedigrees and book-plates, a fifth for prints and ivories; each has his pet magazine. All this endless inquiry promotes and stimulates the book market to an extent which would make old "Sylvanus Urban," and good Mr Bowyer and his biographer, Mr John Nichols, stare and gasp.

Another powerful influence of the time is the spread of public and proprietary libraries throughout the land. There are four kinds of libraries—the Private Library, the Public or Free Library, the Proprietary Library, and the Circulating Library. To the private library reference has already been made. I am well persuaded, despite the grumblings of the booksellers, who sell new books and have their great difficulty about discounts, that the private libraries of the land, if so important a word may without offence be applied to small collections, go on steadily improving in England. Scotland in this matter lags behind. Public or Free Libraries have, of course, enormously increased in number, being not only the pet objects of two well-known money-givers,—Mr Passmore Edwards and Mr Carnegie,—but, if a popular vote can be obtained (not always an easy matter), they can be supported, to a limited extent, out of the rates. In almost all the large English towns, and in not a few villages, free libraries rear their heads. The contents of free libraries vary very much, but there they are, bringing knowledge and pleasure within the reach of nearly everybody. Tired men and women, imperfectly educated, will not frequent public libraries in large numbers to read history, philosophy, or science; they will prefer to turn over the back numbers of illustrated papers, or to read some stirring tale or romantic adventure, nor is their taste in these matters likely to be a cultivated one. But the habit of reading is generated, strengthened, and possibly transmitted; and besides this, it is surely a comfortable thought, that assuming a child to have genius or capacity, the desire for knowledge, or the craving after perfection, no longer can chill penury shut him out from the accumulated wisdom of the race to which he belongs. The waste of a free library is nothing to the waste of Nature. The Proprietary Libraries which supply their members and subscribers with books, and as it were keep a library for them, have done more than the Universities to spread a love of reading among the middle classes. In most large towns such libraries exist on a considerable scale, and have been, and are, true centres of education. Lyceums, Athenæums, and other high-sounding names, describe places to which many of us owe much. Of the Circulating Library it is unnecessary to speak, for all are acquainted with its beneficent operations.

The booksellers eye all these public and semi-public establishments with disfavour, thinking that they dissuade people from buying books. I doubt this being so. Speaking generally, the more people read the more books will they have about them; the fact that there are now collected in public, proprietary, and circulating libraries, many millions of books, and that these places of resort are daily visited by thousands and thousands of readers, must have some effect in promoting the demand for literature.[1]

The habit of travelling by rail, now so general, is thought by some observers to have increased the disposition to read on the part of an otherwise sluggishly-minded population. The railway book-stall has perhaps played some part in education; if so, it has been but an obscure part, for except in the matter of newspapers and the most advertised novel of the moment, it cannot be said even to respect the average intelligence of the travelling public. A reformed railway book-stall is a dream of the future; but perhaps railways themselves may have become a memory of the past before this dream has even a chance of realization.

Let us go farther afield. What is to be said of those vast multitudes all the world over who read English as their native tongue? In 1842 the white population of the United States of America was a very little over fourteen millions—it was in 1902 more than sixty-seven millions. The population of Canada increased from a million and a half to five and a half millions, whilst the Australian Colonies, with but a quarter of a million in 1842, contained in 1902 more than three and a half millions of inhabitants. All these good people, or such of them at least as are not infants, read books; and though settlers in new countries are not great readers, having other things to do, still signs are not wanting to indicate that the Colonial book market will soon be a busy one. It is, however, the growth of the population in the United States that is the most important factor in the case, for in the States are to be found (to use Mr Arnold's word) a "remnant" great in numbers, even though it be but a minority of the whole population, who both think and read, and pursue with unresting energy and an amazing seriousness a thousand fancies and phantoms of the brain. The American Copyright Acts of 1891–95, by conferring the monopoly of reproduction on all books printed and published within the States (following in this respect the British Copyright Statute of 1842), have gone a long way to unite the British Islands and America into a Book-Union. There is a complete reciprocity of authors; and though many American-bred authors find a great sale in their native land, and hardly any in the United Kingdom, and many British authors who are, in the vile phrase of the trade, "much esteemed" at home, count for next to nothing in the States, still the tendency is, and must be, to throw all English-writing authors into hotch-pot, to find their readers wherever they can. London publishers have very close connexions with New York. A popular author in England is quite as likely to receive a call from an American as from an English agent. The sermons of a popular divine, the last story of a popular novelist, the new drama of a popular playwright, circulate freely on both sides of the Atlantic; whilst for the graver work of the theologian, the philosopher, moral or political, and the historian, there is the same well-tempered enthusiasm in Boston as in London, and in London as in Boston. The reading public of both countries is now equally within the reach of every English-writing author. It is indeed an enormous public. When St Augustine wrote his *City of God* he too had a great public, and his famous treatise, copied though it had to be by hand, soon spread itself over Europe; but what was Augustine's public in numbers compared with that of an author of to-day, who catches the fancy of both England and America?

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[1] In the free libraries of eight British towns there are gathered together more than a million volumes.

Under these conditions it is not surprising that there should be an enormous output of books, and particularly of books which do not demand of those who produce them any great store of acquired learning. The novel lies to anybody's hand. Anybody, so it is said, can write a dozen bad novels or one good one. It is easier to believe the first part of this saying than the second. Fortunately everybody does not try, although the temptation to do so must be great, for this huge possible public is divided into many markets, each quite distinct from the other, and to gain a reputation in any one of these markets is to succeed—not necessarily as an artist, but as a family man. Nobody knows with any degree of precision all the markets. The late Mr James Payn knew many things about books, but he did not know the *John Inglesant* market, or, at all events, he had not watched its growth. There are indeed many markets where a lively trade is done in books and papers, for fiction is only one of the fields now cultivated with an almost nervous activity. In almost every department of Belles Lettres—including in that phrase the popular aspects of theology—in popularized science, and in Philosophy, the labourers are many. Little books are written about big books; and big books are written about little men; essays, monographs, appreciations abound. It is debated whether our living poets are to be counted by tens or scores. Book-making goes on all round. We can almost hear the clicking of the type-writer. The commercial spirit has never been absent from literature, but in earlier times the author was in the background. All he had to sell was his manuscript—this he did, if he could, to a member of the Stationers' Company, who straightway registered it as his own "copy." To-day authors take the front seats, or try to do so, and as they are a numerous body they necessarily make a great deal of noise. Women, too, in large numbers, have joined their ranks. The feminine note is predominant in some departments of Literature.

We are thus forced to contemplate three great crowds—one of readers, one of producers, and a third of distributors. Here is where the conditions have altered—in the size and intellectual equipment of the reading public, and consequently in the numbers of those engaged in the work of supplying, fostering, and stimulating its unceasing and increasing demand for something to read. To expect delicacy and distinction to be characteristics of such a roaring mart as this would be irrational. On the other hand a tendency would be expected, and has in fact occurred, to produce numbers of books of practical utility,—primers of science, history, literature,—volumes making knowledge easy and easily accessible. This is particularly the case in America, where the people at large began to "want to know" much earlier than the corresponding public in England.

A noticeable incident of the time, and one significant of much change in the conditions of the book-market, is the disposition to combine which authors have lately exhibited. This is a new thing, for, as a rule, authors have hitherto taken small pleasure in each other's society. It is mainly a trade feeling that has brought them together, although no doubt the instincts of the journalist—and how many writers of books are journalists!—have always been gregarious. The combination of authors has done a good deal to improve their condition commercially, and it may some day do something to destroy the cruel delusions that there is a market for every kind of paper-staining, and that anybody who has ever written anything has a claim upon the consideration of his fellow-men, and a right to find a publisher ready to employ both capital and labour in palming off upon the public a new book.

One other powerful influence of the time must not pass unnoticed—the influence upon the minds, both of authors and readers, of foreign literatures made generally known by means of translations. Never before since the days of Elizabeth has the ordinary English reader been so familiarized with foreign books. Tolstoy is one of the spirits of our age. No English author since Dickens has so powerfully moved so many English people, whilst there are at least a dozen French authors, chiefly novelists, whose influence upon British writers has been enormous. Nor can Ibsen and Maeterlinck be counted for little. Cosmopolitanism in literature may be expected. The whole western world is pervious to the same ideas. Though in statecraft the tendency may be for the consolidation of kindred states and the isolation of dominant races, in the realms of science, thought, and imagination a counter influence will more and more assert itself. International copyright is the first law which can with pardonable exaggeration be described as having been passed in the Parliament of Europe. With a few exceptions it is now true that a European author enjoys in every country in Europe the same property rights in the works of his brain as the law of his own country confers upon its native-born writers.

The change is indeed great since the days when Madame de Staël, being banished from France, first introduced Germany to the notice of polite Europe; since 1834, when Carlyle, striving and crying in the pages of *Fraser's Magazine*, besought his countrymen, who had not then learnt to endure his style, "to close their Byron and open their Goethe"; and when none but a few pale students knew more of the Literature of Italy than was contained in a canto of the *Inferno*, a sonnet of Filicaia's, and the novel of Manzoni.

Now that the *Fumée*, the *Pères et Enfants* and the *Étranges Histoires* of Tourguéneff, the *Anna Karénine* and *Résurrection* of Tolstoy, and *Le Crime et le Châtiment* of Dostoieffsky have made dumb Russia speak at last, it is not too much to say that all Europe contributes to a general fund or stock of ideas available for the common use.

And what is more, there are many English and American readers who take more kindly and sympathetically to the ideals and thought-tendencies of foreign authors—even when read, as they generally have to be, in translations—than to those of their native authors. Nor is this always due to the superior genius of the foreigner; it may be partially accounted for by his freedom from literary restraints that have grown stale and by the freshness of his imagery and novelty of atmosphere. Nor will this disposition of mind be destroyed by ridicule. *Wilhelm Meister* has survived the unseemly merriment of De Quincey, nor have the shafts of Mr Anstey's admirable humour injured the permanency of Ibsen's reputation.

But whilst we cannot fail to notice from what widely different quarters, from what strange sources and far-off countries, the "reading public" now derives its sustenance, and how completely our mental ports are thrown open to the literary goods of the foreigner, it would be rash to attempt even to name the rival influences that visit our shores in these strange times, and either contend with those of native manufacture for mastery over us, or at least imperatively demand the rights of expression and free circulation. Never before were so many influences at work upon men's minds, seeking to mould and control them, as now. If it would be difficult to name these influences, to seek to estimate their several strengths would be clearly impossible.

Whether the minds of men are more readily moved to important issues by the force of great events or of great thoughts is hard to determine. The French Revolution—though of course itself the result of a thought-movement—had a more obvious effect upon the current of men's thinking than have most of the great books of the world. This probably is what was in Michelet's mind when, if Mr Lewes is to be believed, he once began a lecture as follows: "Messieurs, dans ce monde il y a deux nations. Ces deux nations, messieurs, sont les Juifs et les Français. Ces deux nations, messieurs, ont deux livres, seulement deux. Les Juifs, messieurs, ont la Bible; les Français ont la Révolution."

For present purposes it is enough here to note the expansion of the Englishman's Library. The old, famous, homespun names which have so long reigned over our shelves, with no competitors save the Delphine Classics, have not indeed been forced to abdicate—for supreme they will probably ever remain within these Realms—but, in future, they must be content to brook with foreign rivals very near their thrones.

To attempt to state in exact language the results that have followed these changed conditions in the production of modern literature would be impossible, but one of those results is particularly noticeable. Modern literature is singularly sensitive, and reflects almost instantaneously the humours and sentiments of the hour. Owing to our numbers, our great populations living closely together, and the general spread of education, ideas are now most infectious, and run through the land with amazing agility. We act and react upon each other. A particular spirit or tendency evokes an author, and the author generates with velocity the spirit that begot him. As examples of what I mean may be cited two writers, Captain Mahan and Mr Rudyard Kipling. It is but the other day that these two men began to write, each in his own different way, and yet what an impression they have already made, what an influence they have exerted! Their thoughts and arguments, their tricks of speech, are recognizable everywhere—have become to a greater or less extent part and parcel of the intellectual output of the average man. Never before surely was this contagiousness of ideas so noticeable.

When once an idea or notion has taken root, a whole host of ready writers grab hold of it, and with loud cries and exclamations carry it into every quarter. They popularize it, they vulgarize it, they mix it with their cheap spirits or their cold water, but in one way or another they fit it for every palate. It does not matter what the notion may be,—imperialism, federalism, evolution, sacramentarianism, or only a particular kind of humour, or a mode of narrative; if it has any popular virtue within it, it will be caught hold of and carried in triumph into every book market of Great Britain. The imitators, who sometimes are skilful men, and sometimes gross and clumsy personators, are often more prosperous than the originators—if indeed any one is entitled to be called an original. The doctored article is usually more to the taste of the many than the true manufacture, which is apt to have a certain pungency, sternness, and reticence almost certain to be "caviare to the general." This characteristic of the time is naturally pleasing to those observers who share the prevailing sentiment, and not so agreeable to those who remain either unconscious of its claim or suspicious of its tendency. When the crowd is on your side you regard its rude horse-play with benevolence; if it is against you, with disgust. Moods will vary, opinions change, "no altar standeth whole," but this responsiveness of the public mood to the prevalent spirit of the time will probably grow quicker and keener with the growth of population and the spread of popular education. An age of widespread diffusion of knowledge can hardly present a romantic aspect. A dungeon is more romantic than a school. Large masses of people, necessarily very imperfectly educated, but with a great conceit of themselves, all eager to know and discuss results, and to experience new sensations, are not likely at first to throw their influence on the side of the things that are "quiet, wise, and good." Dwellers in great cities and in populous and half-educated countries must learn to put up with a great deal of noise of all kinds. It is absurd to be too sensitive. Everything runs its course. After contemplating the changed conditions of modern literature, we may congratulate ourselves that wherever we look we see all the symptoms of life and activity in a people striving to get quit of the clogs of ignorance, and to enter upon the glorious inheritance that belongs by right to every cultivated intelligence.

ENCYCLOPÆDIA BRITANNICA.

(NEW VOLUMES.)

Kabadian, a bekdom of south Bokhara, Hissar region, situated on the right bank of the Amu river, between the lower courses of its two tributaries, Vaksh and Surkhan. It is also watered by the Kafirnagan, another tributary of the Amu. The population consists mainly of Uzbegs, whose chief occupation is agriculture, silkworm culture, and gathering of pistachio nuts. The chief town, of the same name, is a walled town, built on an island formed by two branches of the Kafirnagan, 30 miles above its junction with the Amu and 268 miles south-east of Bokhara.

Kabansk, a village of Russia, East Siberia, province of Transbaikalia, district of Verkhneudinsk, 275 miles west of Chita, on the lower Selenga. Owing to its position on the Amur highway, it became a wealthy spot, the inhabitants of which were engaged in the transport of tea and other goods. Population, 5000.

Kabardia, a territory of Russia, occupying the southern middle portion of North Caucasia, now part of the province of Terek. It is divided into Great and Small Kabardia, and covers about 3800 square miles, on the northern slopes of the main Caucasus range (from Mount Elbruz to Passis-mta), including the Black Mountains and the high plains on the northern slope of the latter. Before the Russian conquest it extended as far as the Sea of Azov. Its population is now about 75,000. One-fourth of the territory is owned by the aristocracy, organized in a feudal fashion, and the remainder (874,000 acres) is divided among the *auls* or villagers. A great portion is under permanent pasture, and part under forests and perpetual snow. Excellent breeds of horses are reared, and the peasants are in possession of about 117,000 horned cattle and 246,000 small cattle. The land is well cultivated in the lower parts, the chief crops being millet, Indian corn, wheat, and oats. Bee-keeping is widely spread, and Kabardian honey is in repute. Wood-cutting and the manufacture of various wooden goods, the making of *búrkas* (felt and fur cloaks), and saddlery are very general. A school for the mountaineers is kept at Nalchik, which is the chief town.

The Kabardians are a branch of the Adyghe (Tcherkess). The Russians met them very early in their advance into Caucasia and the policy of Russia was always to be friendly with the Kabardian aristocracy, who were possessed of feudal rights over the Ossets, the Ingushes, the Abhazes, and the mountain Tatars, and had the command of the passages leading to Transcaucasia. John the Terrible took Kabardia under his protection. Later, Russian influence was balanced by that of the Crimea khans, but the Kabardian nobles nevertheless supported Peter I. during his Caucasian campaign. In 1739 Kabardia was recognized as free, or rather as being under the double protectorate of Russia and Turkey, but thirty-five years later it was definitively annexed to Russia, and several risings of the population in 1804 and 1822 were violently and cruelly suppressed. Russia carefully maintained the old feudal organization under which the people were governed by the *mekhemes*, or councils composed of the nobles, under the presidency of the oldest prince, who was also a *vali* (judge). But after the revolts the organization was definitively abolished in 1866, when all servile dependency of the people was terminated, and the *auls*, as well as the nobles, received regular land allotments. Besides this land there is also a reserve land, which was confiscated, but returned to the Kabardians in 1864, to form, with its revenues, "the reserve capital of the Kabardian people." Kabardia is still considered as a school of good manners in Caucasia; the Kabardian dress is the fashion of all the mountaineers. Kabardians constitute the best detachment of the personal Imperial Guards at St Petersburg. A short grammar of the Kabardian language and a Russian-Kabardian dictionary, by Lopatinsky, were published in *Sbornik Materialov dla opisaniya Kavkaza*, vol. xii. Tiflis, 1891. Fragments of the poem "Sosyruko," some Persian tales, and the rules of Musulman religion were printed in Kabardian, in 1864, by Kazi Atazhoukin and Shardanoff. The common law of the Kabardians has been studied by Professors Maxim Kovalevsky and Vsevolod Miller. (P. A. K.)

Kabul.—The city of Kabul, the capital of Afghanistan, stands at an elevation of 6900 feet above the sea in 34° 32′ N. and 69° 14′ E., as determined by the surveys of the Afghan campaign of 1879–80. It lies close under the low spurs of hills to the west (the heights of Asmai, Sher Darwaza, &c.), which run to 400 feet in altitude above the city, dominating it completely, and shutting off the plains of Chardeh which stretch to the foothills of the Hindu Kush. Through these hills the Kabul river passes by the Deh Mozang gorge; and this gorge now forms the best highway to Chardeh and Maidan. To the north, intersected by lines of low ridges and hills, are the fertile plains of the Koh Daman (reaching to Charikar) and of the Kabul river, which winds through them to a sudden descent from the eastern edge above Butkak. South of Kabul are the rugged hills which form the western buttresses of the Safed Koh range; athwart them are the narrow valleys leading to Charasia and Logar. The ancient history of Kabul and of its dynasties of Hindu and Mahommedan rulers belongs to the story of Afghanistan. Its importance as the key to northern India—as the base from which, for countless ages, invasions have been projected and carried to a successful issue, and through which irruptions from central Asia have often swept—is proved by the story of India. In the strategical geography of Asia Kabul must always have held a prominent place. It is therefore somewhat remarkable that there should be so few allusions to it by classical writers under any recognized name.

Of late years Kabul has been visited by many Europeans, some of whom have resided there for years, and have exercised definite influence in shaping the progress, and possibly the destinies, of the city. After the accession of the Amir Abdur Rahman in 1880 it underwent great changes. In 1880, when the city was still occupied by British troops, there was not much to record which differs materially from the description given by Yule in the earlier volumes (ninth edition) of this work. The Bala Hissar (the Ortospana of Alexander) was then destroyed and has never since been entirely rebuilt, and a fortified cantonment at Sherpur (one side of which was represented by the historic Bemaru ridge) has taken the place of the old earthworks of the British occupation of 1842 which were constructed on nearly the same site. The city streets were as narrow and evil-smelling, the surrounding gardens as picturesque and attractive, and the wealth of fruit was as great, as they had been fifty years previously.

The Amir, however, proved himself to be an enlightened ruler in all matters pertaining to the improvement of his capital, excepting only as regards railways and telegraphs, or any other scientific development which might lead to the introduction of a European population. He projected many roads, so that Kabul is now connected by well-planned and metalled roads with Afghan Turkestan on the west, with the Oxus and Bokhara on the north, and with India on the east. The road to India was first made by British and is now maintained by Afghan engineers. The road southwards to Ghazni and Kandahar was always naturally excellent and has probably needed little engineering, but the general principle of road-making in support of a military advance has always been consistently maintained, and the expeditions of Kabul troops to Kafiristan have been supported by a very well graded and substantially constructed road up the Kunar valley from Jalalabad to Asmar, and onwards to the Bashgal valley of Kafiristan. This road may yet find its terminus in Badakhshan. The city ways have been improved until it has become possible for wheeled vehicles to pass, and the various local roads connecting the suburbs and the city are always efficiently maintained. A purely local railway has also been introduced, to assist in transporting building material. The buildings erected by the Amir were pretentious, but unmarked by any originality in design and hardly worthy representations of the beauty and dignity of Mahommedan architecture. They included a new palace and a durbar hall, a bridge across the river and embankment, a pavilion and garden laid out around the site of Babar's tomb overlooking the Chardeh valley; and many other buildings of public utility connected with stud arrangements, the manufacture of small arms and ammunition, and the requirements of what may be termed a wholesale shop under European direction, besides hospitals, dispensaries, bazaars, &c. The new palace is within an entrenchment just outside the city. It is enclosed in a fine garden, well planted with trees, where the harem serai (or ladies' apartments) occupies a considerable space. The public portions of the buildings comprise an ornamental and lofty pavilion with entrances on each side, and a high-domed octagonal room in the centre, beautifully fitted and appointed, where public receptions take place. The durbar hall, which is a separate building, is 60 yards long by 20 broad, with a painted roof supported by two rows of pillars. But the arrangement of terraced gardens and the lightly-constructed pavilion which graces the western slopes of the hills overlooking Chardeh are by far the most attractive of these innovations. Here, on a summer's day, with the scent of roses pervading the heated air, the cool refreshment of the passing breezes and of splashing fountains may be enjoyed by the officials of the Kabul Court, whilst they look across the beauty of the thickly-planted plains of Chardeh to the rugged outlines of Paghman and the snows of the Hindu Kush. The artistic taste of the landscape gardening is excellent, and the mountain scenery is not unworthy of Kashmir. It is pleasant to record that the graveyard of those officers who fell in the Kabul campaign of 1879–80, which lies at the northern end of the Bemaru ridge, is not uncared for. If the graves are not actually restored from time to time, they are at least protected.

Trade was apparently decreasing at the end of the century. This was doubtless due to the prohibitive transit duties levied on the Afghan frontier. Between Kabul and India in 1896–97 the exports were 151½ lakhs, and the imports 303 lakhs, showing a drop of about one-third and one-half their values respectively during the previous five years. Statistics as to population are not trustworthy, but it has been estimated at about 140,000 (1901).

See C. YATE. *Northern Afghanistan.* London, 1888.—GRAY. *At the Court of the Amir.* London, 1895. (T. H. H*.)

Kadiak (pronounced *Kad-yak'*), the largest island of Western Alaska, and also the post-office name for the chief settlement, St Paul, on Chiniak Bay, in 57° 48′ N. and 152° 22′ W. The name is derived from that of the Kaniak Eskimo, the original inhabitants. The settlement originated with the Russian fur-traders in 1784, and was only established by Shelikoff after severe fighting. It was the headquarters of the Russian American Company until their transfer to Sitka about 1806. St Paul is the centre of the fur trade and traffic for this district, and has a considerable commerce. Settlements on Woody Island, Afognak (the only native reservation in western Alaska), Uyak Bay with extensive salmon canneries, and Karluk, the greatest salmon fishery in the world, where more than 3,000,000 salmon have been canned in one season, employing some 1500 hands, all pay tribute in some degree to the central settlement. Ice was formerly exported to San Francisco from Woody Island, and one of the growing industries on the small islands is the rearing of foxes for their fur. The mean temperature of Kadiak is 43·3° F. The summers are warmer and more sunny, and the winters colder than at Sitka. The yearly rainfall averages 73·0 inches. The total population (1900) of St Paul and its tributary settlements is 1146 whites and 624 natives, chiefly of Eskimo stock. The wooded coast region of Alaska reaches its western limit near St Paul, the coast and islands westwards and northwards being treeless. (W. H. D.)

Kaffraria, Kaffres.—Although possessing no official value (*Ency. Brit.* vol. xiii. p. 816), the term

Kaffraria or Kaffreland is not yet quite obsolete as a geographical expression, while it still obtains currency in popular language. But the former distinction between *British Kaffraria* and *Kaffraria Proper* ceased to have any meaning after the year 1894, when the whole region became British territory by the incorporation with Cape Colony of that portion of Pondoland which had till then enjoyed a measure of self-government. In consequence of this annexation, which had been necessitated by the constant feuds and bloodshed caused by the rivalries of native chiefs, Kaffraria now comprises the whole of the region lying between the Great Kei and Umzimkulu rivers; that is, between Cape Colony proper and Natal. For administrative purposes it is constituted in four main divisions, with areas and populations as under:—

	Area in sq. miles.	Population (1891).		
		Whites.	Natives.	Total.
Griqualand East .	7,600	4,150	148,470	152,620
Tembuland . .	4,120	5,180	175,240	180,420
Transkei . .	2,550	1,020	152,550	153,570
Pondoland . .	4,040	...	166,000	166,000
Total . .	18,310	10,350	642,260	652,610

Griqualand East, so called to distinguish it from *Griqualand West*, which lies north of the Orange river and consequently never formed part of Kaffraria, comprises the whole of the debateable region formerly called *Noman's Land*, and afterwards named *Adam Kok's Land* from the Griqua chief who occupied it in 1862 with the consent of the British authorities. But these Griquas, from whom the district takes its present designation, are disposing of their lands to the white settlers, and are thus disappearing amongst the labouring classes. The great majority of the inhabitants are in fact no longer Griquas, but Basutos and Kaffres (Pondomisi, Ama-Baka, and other tribes). Since its annexation to Cape Colony Griqualand East has made rapid progress, and is now traversed by good roads and even telegraph lines, while the population rose from 121,000 in 1881 to over 152,000 in 1891. Stock-breeding on the uplands, tillage on the lower slopes of the Drakenberg, are the chief industries. On these slopes and uplands the climate is delightful and well suited for the European constitution.

Tembuland, which lies south-west of Griqualand East and comprises the districts of *Tembuland* proper, *Emigrant Tembuland*, and *Bomvaniland*, takes its name from the Ama-Tembu nation, popularly called Tambookies, who are one of the most powerful of all the Kaffre groups, and still number probably over 120,000 souls. In the national genealogies they hold an honourable position, being traditionally descended from Tembu, elder brother of Xosa, from whom most of the other Kaffres claim descent. Tembuland is also flourishing, and the coalfields, which appear to be extensive and easily worked, have already attracted a considerable mining population. The inhabitants, amongst whom are several thousand white settlers, increased from 160,000 to 180,000 in the decade ending 1891.

Transkei, or the *Transkei Territories*, had been completely incorporated with Cape Colony by 1885, a few years after the close of the Kaffre wars. It comprises the districts of *Fingoland*, the *Idutywa Reserve*, and *Galekaland*, this last being named from the renowned Galeka nation, who claim to be the senior branch of the Xosa family. They still form the chief element of the population, which rose from 136,000 in 1881 to nearly 154,000 in 1891. Here are some prosperous missionary stations, where the natives are taught agriculture, several mechanical industries, and even a knowledge of letters. They appear to be happy and contented under their British magistrates, who administer justice in accordance with the Native Territories Penal Code. The heroic deeds of Hinza, Kreli, and the other famous chiefs in the Kaffre wars are still remembered in the local traditions; but all desire to emulate their achievements, or to revive the superstitions associated with witchcraft, rain-making, and other pagan practices, seems to have died out.

Even more advanced in all social respects are the formerly degraded but now respected and civilized Fingos or Fengus, who give their name to the district of *Fingoland*, and also form the bulk of the population in the *Idutywa Reserve*. They have adapted themselves to Western culture almost as thoroughly as the Japanese, wearing European clothes, supporting their schools by voluntary contributions, editing newspapers, translating English poetry, setting their national songs to correct music, and on the whole conforming their lives to their Christian professions.

Since 1887 the several administrative divisions constituted out of the Transkeian Territories enjoy the franchise, with the right of returning representatives to the Cape Parliament.

See G. M'Call Theal. *History of South Africa*, 1887–91.—S. W. Silver. *Handbook of South Africa*, 1891.—A. H. Keane. *Africa*, vol. ii. 1895. (A. H. K.)

Kafiristan.—Very little of this country was known with accuracy and nothing at first hand until the late General Sir W. (then Colonel) Lockhart headed a mission to examine the passes of the Hindu Kush range in 1885–86. He penetrated into the upper part of the Bashgal valley, but after a few days he found himself compelled to return to Chitral. Previously Major Tanner, R.A., had sought to enter Kafiristan from Jalalabad, but sudden severe illness cut short his enterprise. M'Nair, the famous explorer of the Indian Survey department, believed that he had actually visited this little-known land during an adventurous journey which he made from India and through Chitral in disguise; but the internal evidence of his reports shows that he mistook the Kalash district of Chitral, with its debased and idolatrous population, for the true Kafiristan of his hopes. In 1889 Mr G. S. Robertson (afterwards Sir George Robertson, K.C.S.I.) was sent on a mission to Kafiristan. He only remained a few days, but a year later he revisited the country, staying amongst the Kafirs for nearly a year. Although his movements were hampered, his presence in the country being regarded with suspicion, he was able to study the people, and, in spite of intertribal jealousy, to meet members of many of the tribes. The facts observed and the information collected by him during his sojourn in eastern Kafiristan, and during short expeditions to the inner valleys, are the most trustworthy foundations of our knowledge of this interesting country.

Kafiristan, which literally means "the land of the infidel," is the name given to a tract of country enclosed between Chitral and Afghan territory. It was formerly peopled by pagan mountaineers, who maintained a wild independence until 1895, when they were finally subdued by Abdur Rahman, the Amir of Kabul, who also compelled them to accept the religion of Islam. The territory thus ill named is included between 34° 30′ and 36° N., and from about 70° to 71° 30′ E. As the western and northern boundaries are imperfectly known, its size cannot be estimated with any certainty. Its greatest extent is from east to west at 35° 10′ N.; its greatest breadth is probably about 71° E. The total area approximates to 5000 square miles. Along the N. the boundary is the Amir of Kabul's Afghan Turkestan province of Badakhshan, on the N.E. the Lutkho valley of Chitral. Chitral and lower Chitral enclose it to the E., and the Kunar valley on the S.E. Afghanistan proper supplies the S. limit. The ranges above the Nijrao and Pansher valleys of Afghanistan wall it in upon the W. The northern frontier is split by the narrow Minjan valley of Badakhshan, which seems to rise in the very heart of Kafiristan. Speaking generally, the country consists of an irregular series of main valleys, for the most part deep, narrow, and tortuous, into which a varying number of still deeper, narrower, and more twisted valleys, ravines, and glens pour their torrent water. The mountain ranges of Metamorphic rock, which separate the main drainage valleys, are all of considerable altitude, rugged and difficult, with the outline of a choppy sea petrified. During the winter months, when the snow lies deep, Kafiristan becomes a number of isolated communities, with few if any means of intercommunication. In the whole land there is probably nothing in the shape of a plain. Much of the silent, gigantic country warms the heart as well as captivates the eye with its grandeur and varied beauty; much of it is the bare skeleton of the world wasted by countless centuries of storms and frost, and profoundly melancholy in its sempiternal ruin. Every variety of mountain scenery can be found; silent peaks and hard, naked ridges, snowfields and glaciers; or mighty pine forests, wooded slopes and grazing grounds; or wild vine and pomegranate thickets bordering sparkling streams. At low elevations the hillsides are covered with the wild olive and evergreen oaks. Many kinds of fruit trees—walnuts, mulberries, apricots, and apples—grow near the villages, or by the wayside, as well as splendid horse-chestnuts and other shade trees. Higher in elevation, and from 4000 to 8000 feet, are the dense pine and cedar forests. Above this altitude the slopes become dreary, the juniper, cedar, and wild rhubarb gradually giving place to scanty willow patches, tamarisk, and stunted birches. Over 13,000 feet there are merely mosses and rough grass. Familiar wildflowers blossom at different heights. The rivers teem with fish. Immense numbers of red-legged partridges live in the lower valleys, as well as pigeons and doves. Gorgeously-plumaged pheasants are plentiful. Of wild animals the chief are the *markhor* (a goat) and the *uridl* (a sheep). In the winter the former are recklessly slaughtered by hunters, being either brought to bay by trained hounds, or trapped in pits, or caught floundering in the snow-drifts; but in the summer immense herds move on the higher slopes. The *ibex* is very rare. Bears and leopards are fairly common, as well as the smaller hill creatures.

Passes and Roads.—All the northern passes leading into Badakhshan or into the Minjan valley of Badakhshan seem to be over 15,000 feet in altitude. Of these the chief are the Mandal, the Kamah (these two alone have been explored by a European traveller), the Kti, the Kulam, and the Ramgal passes. Those to the east, the Chitral passes, are somewhat lower, ranging from 12,000 to 14,000 feet, *e.g.*, the Zidig, the Shui, the Shawal, and the Parpit, while the Patkun, which crosses one of the dwindled spurs near the Kunar river, is only 8400 feet high. Between neighbouring valleys the very numerous communicating footways must rarely be lower than 10,000, while they sometimes exceed 14,000 feet. The western passes are unknown. All these toilsome paths are so faintly indicated, even when free from snow, that to adventure them without a local guide is usually unsafe. Yet the light-framed cattle of these jagged mountains can be forced over many of the worst passes. Ordinarily the herding tracks, near the crest of the ridges and high above the white torrents, are scarcely discoverable to untutored eyes. They wind and waver, rise, drop, and twist about the irregular semi-precipitous slopes, with baffling eccentricity and abruptness. Nevertheless the cattle nose their way along blunderingly, but without hurt. Of no less importance in the open months, and the sole trade routes during winter, are the lower paths by the river. An unguided traveller is continually at fault upon these main lines of intercourse and traffic.

Rivers.—All the rivers find their tumultuous way into the Kabul, either directly, as the Alingar at Laghman, or after commingling with the Kunar at Arundu and at Chigar-Serai. The Bashgal, draining the eastern portion of the country, empties itself into the Kunar at Arundu. It draws its highest waters from three main sources at the head of the Bashgal valley. It glides gently through a lake close to this origin, and then through a smaller tarn. The first affluent of importance is the Skorigal, which joins it above the village of Pshui. Next comes the noisier Manangal water, from the Shawal pass, which enters the main stream at Lutdeh or Bragamatal, the chief settlement of the Bashgal branch of the Katir tribe. By and by the main stream becomes, at the hamlet of Sunra, a raging, shrieking torrent in a dark narrow valley, its run obstructed by giant boulders and great tree-trunks. Racing past Bagalgrom, the chief village of the Madugal Kafirs, the river clamours round the great spur, which, 1800 feet higher up, gives space for the terraces and houses of Kamdesh, the headquarters of the Kam people. The next important affluent is the river which drains the Pittigal valley, its passes and branches. Also on the left bank, and still lower down, is the joining-place of the Gourdesh valley waters. Finally it ends in the Kunar just above Arundu and Birkot. The middle part of Kafiristan, including the valleys occupied by the Presun, Kti, Ashkun, and Wai tribes, is drained by a river variously called the Pech, the Kamah, and the Presun or Viron river. It has been only partially explored. Fed by the fountains and snows of the quinquefid upper Presun valley, it is joined at the village of Shtevgrom by the torrent from the Kamah pass. Thence it moves quietly past meadowland, formerly set apart as holy ground, watering on its way all the Presun villages. Below the last of them, with an abrupt bend, it hurries into the unexplored and rockbound Tsaru country, where it absorbs on the right hand the Kti and the Ashkun and on the left the Wai rivers, finally losing itself in the Kunar, close to Chigar-Serai. Concerning the Alingar or Kao, which carries the drainage of Western Kafiristan into the Kabul at Laghman, there are no trustworthy details. It is formed from the waters of all the valleys inhabited by the Ramgal Kafirs, and by that small branch of the Katirs known as the Kulam tribe.

Climate.—The climate varies with the altitude, but in the summer time it is hot at all elevations. In the higher valleys the winter is rigorous. Snow falls heavily everywhere over 4000 feet above the sea-level. During the winter of 1890–91 at Kamdesh (elevation 6100 feet) the thermometer never fell below 17° F. In many of the valleys the absence of wind is remarkable. Consequently a great deal of cold can be borne without discomfort. The Kunar valley, which is wet and windy in winter, but where snow, if it falls, melts quickly, gives a much greater sensation of cold than the still Kafiristan valleys of much lower actual temperature. A deficiency of rain necessitates the employment of a somewhat elaborate system of irrigation, which in its turn is dependent upon the snowfall.

The Kafirs.—The present inhabitants are probably mainly descended from the broken tribes of Eastern Afghanistan, who, refusing to accept Islam (in the 10th century), were driven away by the fervid swordsmen of Mahommed. Descending upon the feeble inhabitants of the trackless slopes and perilous valleys of modern Kafiristan, themselves, most likely, refugees of an earlier date, they subjugated and enslaved them and partially amalgamated with them. These ancient peoples seem to be represented by the Presun tribe, by the slaves and by fragments of lost peoples, now known as the Jazhis and the Aroms. The old division of the tribes into the Siah-Posh, or the black-robed Kafirs, and the Safed-Posh, or the white-robed, was neither scientific nor convenient, for while the Siah-Posh have much in common in dress, language, customs, and appearance, the Safed-Posh divisions were not more dissimilar from the Siah-Posh than they were from one another. Perhaps the best division at present possible is into (1) Siah-Posh, (2) Waigulis, and (3) Presungalis or Viron folk.

The Siah-Posh.—The black-robed Kafirs consist of one very large widely-spread tribe, the Katirs, and four much smaller communities, the Kam, the Madugalis, the Kashtań, or Kashtoz, and the

Gourdesh. Numerically, it is probable that the Katirs are more important than all the remaining tribes put together. They inhabit several valleys, each community being independent of the others, but all acknowledging the same origin and a general relationship. The Katirs fall readily into the following groups: (*a*) Those of the Bashgal valley, also called Kamoz and Lutdehchis, who occupy eleven villages between Badawan and Sunra, the border hamlet of the Madugal country, namely, Ptsigrom, Pshui, or Pshowar, Apsai, Shidgal, Bragamatal (Lutdeh), Bajindra, Badamuk, Oulagal, Chabu, Baprok, and Purstam; (*b*) the Kti or Katwar Kafirs, who live in two settlements in the Kti valley; (*c*) the Kulam people, who have four villages in the valley of the same name; (*d*) the Ramgalis, or Gabariks, who are the most numerous, and possess the western part on the Afghan border. Of the remaining tribes of the Siah-Posh, the chief is the Kam, or Kamtoz, who inhabit the Bashgal valley, from the Madugal boundary to the Kunar valley, and its lateral branches in seven chief settlements, namely, Urmir, Kambrom, or Kamdesh, Mergrom, Kamu, Sarat, Pittigal, and Bazgal. The next Siah-Posh tribe in importance is the Muman, or Madugal Kafirs, who have three villages in the short tract between the Katirs and the Kam in the Bashgal valley. The last Siah-Posh tribe is the Kashtan, or Kashtoz, who in 1891 were all located in one greatly overcrowded village, their outlying settlement having been plundered by the Afghan tribes of the Kunar valley. One colony of Siah-Posh Kafirs lives in the Gourdesh valley; but they differ from all the other tribes, and are believed to be descended, in great part, from the ancient people called the Aroms.

The Waigulis.—Our exact knowledge of the Waigulis is scanty. They seem to be related in language and origin with a people fierce, shy, and isolated, called the Ashkun, who are quite unknown. The Wai speak a tongue altogether different from that spoken by the Siah-Posh and by the Presungalis. The names of their ten chief villages are Runchi, Nishi, Jamma, Amzhi, Chimion, Kegili, Akun or Akum, Mildesh, Bargal, and Prainta. Of these Amzhi and Nishi are the best known.

The Presungalis.—The Presungalis, also called Viron, live in a high valley. In all respects they differ from other Kafirs, in none more than in their unwarlike disposition. Simple, timid, stolid-featured, and rather clumsy, they are remarkable for their industry and powers of endurance. They probably represent some of the earliest immigrants. Six large, well-built villages are occupied by them—Shtevgrom, Pontzgrom, Diogrom, Kstigigrom, Satsumgrom, and Paskigrom.

The Slaves.—The slaves are fairly numerous. Their origin is probably partly from the very ancient inhabitants and partly from war prisoners. Coarse in feature and dark in tint, they cannot be distinguished from the lowest class of freemen, while their dress is indistinctive. They are of two classes—household slaves, who are treated not unkindly; and artisan slaves, who are the skilled handicraftsmen—carvers, blacksmiths, bootmakers, and so forth; many of the musicians are also slaves. They live in a particular portion of a village, and were considered to a certain extent unclean, and might not approach closely to certain sacred spots. All slaves seem to wear the Siah-Posh dress, even when they own as masters the feeble Presungal folk.

Women.—Little respect is shown to women, except in particular cases to a few of advanced years. Usually they are mistresses and slaves, saleable chattels and field-workers. Degraded, immoral, overworked, and carelessly fed, they are also as a rule unpleasant to the sight. Little girls are sometimes quite beautiful, but rough usage and exposure to all weathers soon make their complexions coarse and dark. They are invariably dirty and uncombed. In comparison with the men they are somewhat short. Physically they are capable of enormous labour, and are very enduring. All the field work falls to them, as well as all kinds of inferior occupations, such as load-carrying. They have no rights as against their husbands or, failing them, their male relations. They cannot inherit or possess property.

Language.—There are certainly three tongues spoken, besides many dialects, that used by the Siah-Posh being of course the most common; and although it has many dialects, the employers of one seem to understand all the others. It is a Prakritic language. Of the remaining two, the Wai and the Presun have no similarity; they are also unlike the Siah-Posh. Kafirs themselves maintain that very young children from any valley can acquire the Wai speech, but that only those born in the Presungal can ever converse in that language, even roughly. To European ears it is disconcertingly difficult, and it is perhaps impossible to learn.

Religion.—All the Kafirs were idolaters of a rather low type. There were lingering traces of ancestor-worship, and perhaps of fire-worship also. The gods were numerous; tribal, family, household deities had to be propitiated, and mischievous spirits and fairies haunted forests, rivers, vales, and great stones. Imra was the Creator, and all the other supernatural powers were subordinate to him. Of the inferior gods, Moni seemed to be the most ancient; but Gísh, the war-god, was by far the most popular. It was his worship, doubtless, which kept the Kafirs so long independent. In life as a hero, and after death as a god, he symbolized hatred to the religion of Mahommed. Every village revered his shrine; some possessed two. Imra, Gísh, and Moni were honoured with separate little temples, as was usually Dizáni goddess; but three or four of the others would share one between them, each looking out of a small separate square window. The worshipped object was either a large fragment of stone or an image of wood conventionally carved, with round white stones for eyes. Different animals were sacrificed at different shrines: cows to Imra, male goats and bulls to Gísh, sheep to the god of wealth; but goats were generally acceptable, and were also slain ceremonially to discover a complaisant god, to solemnize a vow, to end a quarrel, to ratify brotherhood. The ministers of religion were a hereditary priest, a well-born chanter of praise, and a buffoon of low station, who was supposed to become inspired at each sacrifice, and to have the power of seeing fairies and other spirits whenever they were near, also of understanding their wishes. The blood of the offering, together with flour, wine, and butter, was cast on the shrine after the animal and the other gifts had been sanctified with water sprinkled by the officiating priests, while he cried "Súch, súch!" ("Be pure!"). Dense clouds of smoke from burning juniper-cedar, which crackled and gave forth pungent incense, added to the spectacle, which was dignified by the bearing of the officials and solemnized by the devout responses of the congregation. There was no human sacrifice except when a prisoner of war, after a solemn service at a shrine, was taken away and stabbed before the wooden tomb of some unavenged headman. Kafirs believed in a kind of Hell where wicked people burned; but the Hereafter was an underground region entered by a guarded aperture, and inhabited by the shapes which men see in dreams. Suicide was as unknown as fear of dying. Melancholy afflicted only the sick and the bereaved. Religious traditions, miracles, and anecdotes were puerile, and pointed no social lesson or any religious law. Music, dancing, and songs of praise were acceptable to the gods, and every village (*grom*) had its dancing platform and dancing house (*grom ma*), furnished with a simple altar. No prayers were offered, only invocations, exhortative or remonstrant.

Tribal Organization.—The great majority of the tribes were made up of clans. A person's importance was derived chiefly from the wealth of his family and the number of male adults which it contained. The power of a family, as shown by the number and quality of its fighting men as well as by the strength of its followers, was the index of that family's influence. Weak clans and detached families, of poor but free households, carried their independence modestly. The lowest clan above the slaves sought service with their wealthier tribesmen as henchmen and armed shepherds. By intricate ceremonial, associated with complicated duties, social and religious, which extended over two years, punctuated at intervals by prodigious compulsory banquets, rich men could become elders or *jast*. Still further outlay and ostentation enabled the few who could sustain the cost to rank still higher as chief or *Mir*. Theoretically, all the important and outside affairs of the tribe were managed by the *jast* in council; actually they were controlled by two or three of the most respected of that class. Very serious questions which inflamed the minds of the people would be debated in informal parliaments of the whole tribe. Kafirs have a remarkable fondness for discussing in conclave. Orators, consequently, are influential. The internal business of a tribe was managed by an elected magistrate with twelve assistants. It was their duty to see that the customs of the people were respected; that the proper seasons for gathering fruit were rigidly observed. They regulated the irrigation of the fields, moderating the incessant quarrels which originated in the competition for the water; and they kept the channels in good repair. Their chief, helped by contributions in kind from all householders, entertained tribal guests. He also saw that the weekly Kafir Sabbath, from the sowing to the carrying of the crops, was carefully observed, the fires kept burning, and the dancers collected and encouraged. Opposition to these annual magistrates or infraction of tribal laws was punished by fines, which were the perquisites and the payment of those officials. Serious offences against the whole people were judged by the community itself; the sentences ranged as high as expulsion from the settlement, accompanied with the burning of the culprit's house and the spoliation of his goods. In such cases, the family and the clan refusing to intervene, the offender at once became cowed into submission.

Houses and Villages.—Habitations are generally strong, and built largely of wood. They are frequently two or more storeys high, often with an open gallery at the top. Wealthy owners were fond of elaborate carving in simple designs and devices. A room is square, with a smoke-hole when possible; small windows, with shutters and bolts, and heavy doors fastened by a sliding wooden pin, are common. The nature of the ground, its defensible character, the necessity of not encroaching upon the scanty arable land, and such considerations, determine the design of the villages. Specimens of many varieties may be discovered. There is the shockingly overcrowded oblong kind, fort-shaped, three storeys high, and on a river's bank, which is pierced by an underground way leading to the water. Here all rooms look on to the large central courtyard; outwards are few or no windows. There is also the tiny hamlet of a few piled-up hovels perched on the flattish top of some huge rock, inaccessible when the ladder connecting it with the neighbouring hillside or leading to the ground is withdrawn. Some villages on mounds are defended at the base by a circular wall strengthened with an entanglement of branches. Others cling to the knife-edged back of some difficult spur. Many are hidden away up side ravines. A few boldly rely upon the numbers of their fighting men, and are unprotected save by watch-towers. While frequently very picturesque at a distance, all are dirty and grimed with smoke; bones and horns of slaughtered animals litter the ground. The ground floor of a house is usually a winter stable for cows and the latrine, as well as the manure store for the household; the middle part contains the family treasures; on the top is the living-place. In cold valleys, such as the Presungal, the houses are often clustered upon a hillock, and penetrate into the soil to the depth of two or more apartments. Notched poles are the universal ladders and stairways.

Characteristics.—In height Kafirs average about 5 feet 6 inches. They are lean; always in hard condition; active jumpers, untiring walkers, expert mountaineers; exceptionally they are tall and heavy. With chests fairly deep, and muscular, springy legs, there is some lightness and want of power about the shoulder muscles, the arms, and the hand-grasp. In complexion they are purely Eastern. Some tribes, notably the Wai, are fairer than others, but the average colour is that of the natives of the Punjab. Albinos, or red-haired people, number less than ½ per cent. of the population. As a rule, the features are well-shaped, especially the nose. The glance is wild and bold, with the wide-lidded, restless gaze of the hawk; or the exact converse—a shifty, furtive peer under lowered brows. This look is rather common amongst the wealthier families and the most famous tribesmen. The shape of a man's head not uncommonly indicates his social rank. Several have the brows of thinkers and men of affairs. The degraded forms are the bird-of-prey type—low, hairy foreheads, hooked noses with receding chin, or the thickened, coarse features of the darker slave class. Intellectually they are of good average power. Their moral characteristics are passionate covetousness, and jealousy so intense that it smothers prudence. Before finally destroying, it constantly endangered their wildly cherished independence. Revenge, especially on neighbouring Kafirs, is obtained at any price. Kafirs are subtle, crafty, quick in danger and resolute, as might be expected of people who have been plunderers and assassins for centuries, whose lives were the forfeit of a fault in unflinchingness or of a moment's vacillation. Stealthy daring, born of wary and healthy nerves and the training of generations, almost transformed into an instinct, is the national characteristic. Ghastly shadows, they flitted in the precincts of hostile villages far distant from their own valleys, living upon the poorest food carried in a fetid goatskin bag; ever ready to stab in the darkness or to wriggle through apertures, to slay as they slept men, women, and babies. Then, with clothing for prize, and human ears as a trophy, they sped, watchful as hares, for their far-away hills, avenger Pathans racing furiously in their track. Kafirs, most faithful to one another, never abandoned a comrade. If he were killed, they sought to carry away his head, for funeral observances. As traders, though cunning enough, they are no match for the Afghan. They were more successful as brigands and blackmailers than as skilled thieves. In night robbery and in pilfering they showed little ingenuity. Truth was considered innately dangerous; but a Kafir is far more trustworthy than his Mahommedan neighbours. Although hospitality is generally viewed as a hopeful investment, it can be calculated on, and is unstinted. Kafirs are capable of strong friendship. They are not cruel, being kind to children and to animals, and protective to the weak and the old. Family ties and the claim of blood even triumph over jealousy and covetousness.

Dress, Weapons, Utensils, &c.—The national attire of the men is a badly-cured goatskin, confined at the waist by a leather belt studded with nails, supporting the I-hilted dagger, strong but clumsy, of slave manufacture, sheathed in wood covered with iron or brass, and often prettily ornamented. Women are dressed in a long, very dark tunic of wool, ample below the shoulders, and edged with red. This is fastened at the bosom by an iron pin, a thorn, or a fibula; it is gathered round the body by a woven band, an inch wide, knotted in front to dangle down in tassels. On this girdle is carried a fantastically-handled knife in a leather covering. The woman's tunic is sometimes worn by men. As worn by women its shape is something between a long frock-coat and an Inverness cape. Its hue and the blackness of the hairy goatskin give the name of Siah-Posh, "black-robed," to the majority of the clans. The other tribes wear such articles of cotton attire as they can obtain by barter, by theft, or by killing beyond the border, for only woollen cloth is made in the country. Of late years long robes from Chitral and Badakhshan have been imported by the wealthy, as well as the material for loose cotton trousers and wide shirts. Clothing, always hard to obtain, is precious property. Formerly little girls, the children of slaves, or else poor relations, used to be sold in exchange for clothes and ammunition. Mahommedans eagerly bought the children, which enabled them in one transaction to acquire a female slave and to convert an infidel. Men go bareheaded, which wrinkles them prematurely, or they wear Chitral caps. Certain priests, and others of like degree, wind a strip of cotton cloth round their brows. Siah-Posh women wear curious horned caps or a small square white head-dress upon informal occasions. Females of other tribes bind their heads with turbans ornamented with shells and other finery. Excellent snow gaiters are made of goat's hair for both sexes, and of woollen material for women. Boots, strongly sewn, of soft red leather cannot be used in the snow or when it is wet, because they are imperfectly tanned. For the ceremonial dances all manner of gay-coloured articles of attire, made of cheap silk, cotton velvet, and sham cloth-of-gold, are displayed, and false jewellery and tawdry ornaments; but they are not manufactured in the country, but brought from Peshawar by pedlars. Woollen blankets and goat's-hair mats cover the bedsteads—four-legged wooden frames laced across with string or leather thongs. Low square stools, 18 inches broad, made upon the same principle as the bedsteads, are peculiar to the Kafirs and their half-breed neighbours of the border. Iron tripod tables, singularly Greek in design, are fashioned in Waigul. A warrior's weapons are a matchlock (rarely a flintlock), a bow and arrows, a spear, and the dagger which he never puts aside day or night. The axes, often carried, are light and weak, and chiefly indicate rank. Clubs, carefully ornamented by carving, are of little use in a quarrel; their purpose is that of a walking-stick. As they are somewhat long, these walking-clubs have been often supposed to be leaping-poles. Swords are rarely seen, and shields, carried purely for ostentation, seldom. Soft stone is quarried to make large utensils, and great grim chests of wood become grain boxes or coffins indifferently. Prettily carved bowls with handles, or with dummy spouts, hold milk, butter, water, or small quantities of flour. Wine, grain, everything else, is stored or carried in goatskin bags. Musical instruments are represented by reed flageolets, small drums, primitive fiddles, and a kind of harp.

Peculiar Customs.—Isolated and at the outskirts of every village is a house used by women when menstruating and for lying-in. Children are named as soon as born. The infant is given to the mother to suckle, while a wise woman rapidly recites the family ancestral names; the name pronounced at the instant the baby begins to feed is that by which it is thereafter known. Everybody has a double name, the father's being prefixed to that given at birth. Very often the two are the same. There is a special day for the first head-shaving. No hair is allowed on a male's scalp, except from a 4-inch circle at the back of the head, whence long locks hang down straight. Puberty is attained ceremoniously by boys. Girls simply change a fillet for a cotton cap when nature proclaims womanhood. Marriage is merely the purchase of a wife through intermediaries accompanied by feasting. Divorce is often merely a sale or the sending away of a wife to slave for her parents in shame. Sexual morality is low. Public opinion applauds gallantry, and looks upon adultery as hospitality, provided it is not discovered by the husband. If found out, *in flagrante delicto*, there is a fiscal fine in cows. There is much collusion to get this penalty paid in poor households. Funeral rites are most elaborate, according to the rank and warrior fame of the deceased, if a male, and to the wealth and standing of the family, if a woman. Children are simply carried to the cemetery in a blanket, followed by a string of women lamenting. A really great man is mourned over for days with orations, dancing, wine-drinking, and food distribution. Gun-firing gives notice of the procession. After two or three days the corpse is placed in the coffin at a secluded spot, and the observances are continued with a straw figure lashed upon a bed, to be danced about, lamented over, and harangued as before. During regular intervals for business and refreshment old women wail genealogies. A year later, with somewhat similar ritual, a wooden statue is inaugurated preliminary to erection on the roadside or in the village Valhalla. The dead are not buried, but deposited in great boxes collected in an assigned place. Finery is placed with the body, as well as vessels holding water and food. Several corpses may be heaped in one receptacle, which is, rarely, ornamented with flags; its lid is kept from warping by heavy stones. The wooden statues or effigies are at times sacrificed to when there is sickness, and at one of the many annual festivals food is set before them. Among the Presungal there are none of these images. Blood-feuds within a tribe do not exist. The slayer of his fellow, even by accident, has to pay a heavy compensation or else become an outcast. Several hamlets and at least one village are peopled by families who had thus been driven forth from the community. The stigma attaches itself to children and their marriage connexions. Its outward symbol is an inability to look in the face any of the dead person's family. This avoidance is ceremonial. In private and after dark all may be good friends after a decorous interval. The compensation is seldom paid, although payment carries with it much enhancement of family dignity. All the laws to punish theft, assault, adultery, and other injury are based on a system of compensation whenever possible, and of enlisting the whole of the community in all acts of punishment. Kafirs have true conceptions of justice. There is no death penalty; a fighting male is too valuable a property of the whole tribe to be so wasted. War begins honourably with proper notice, as a rule, but the murder of an unsuspecting traveller may be the first intimation. Bullets or arrow-heads sent to a tribe or village is the correct announcement of hostilities. The slaying of a tribesman need not in all cases cause a war. Sometimes it may be avoided by the sinning tribe handing over a male to be killed by the injured relations. Ambush, early morning attacks by large numbers, and stealthy killing parties of two or three are the favourite tactics. Peace is made by the sacrifice of cows handed over by the weaker tribe to be offered up to a special god of the stronger. When both sides have shown equal force and address, the same number of animals are exchanged. Field work falls exclusively to the women. It is poor. The ploughs are light and very shallow. A woman, who only looks as if she were yoked with the ox, keeps the beast in the furrows, while a second holds the handle. All the operations of agriculture are done primitively. Grazing and dairy-farming are the real trade of the Kafirs, the surplus produce being exchanged on the frontier or sold for Kabul rupees. Herders watch their charges fully armed against marauders.

See ROBERTSON. *Kafirs of the Hindu-Kush.* London, 1896.

(G. S. R.)

Kagalnik, a town of south-east Russia, province of Don Cossacks, 27 miles south-west of Rostov. It has important fairs, and trade in horses, cattle, and fish. *Kagalnitskiy kut* is the name given to the north-east littoral of the Sea of Azov, renowned for its fisheries. Population, 14,000.

Kahlur, or BILASPUR, a native state of India, within the Punjab, one of the hill states that came under British protection after the first Sikh war in 1846. It occupies part of the basin of the Sutlej, amid the lower slopes of the Himalaya. Area, 451 square miles. The population in 1881 was 86,546; in 1891, 91,760; average density, 203 persons per square mile; estimated gross revenue, Rs.1,57,000; tribute, Rs.8000; military force, 1021. The chief, whose title is raja, is a Chandeli Rajput. The present raja (1902) is distinguished for his successful administration. The town of BILASPUR is situated in 31° 19′ N. lat., and 76° 50′ E. long., on the left bank of the Sutlej, which is here crossed by a bridge, 1465 feet above the sea.

Kaira, or KHEDA, a town and district of British India, in the Gujarat division of Bombay. The town is 20 miles north-west of Ahmedabad, and 5 miles from a railway station. Population (1881), 12,640; (1891), 10,101. There are two printing-presses, each issuing a vernacular newspaper; a brass foundry; and a creamery with 36 separators. The district has an area of 1609 square miles. The population in 1881 was 804,800; in 1891, 871,589, showing an increase of 8 per cent.; average density, 542 persons per square mile, being considerably the highest in the province. In 1901 the population was 715,725, showing a decrease of 18 per cent., due to the results of famine. The land revenue was Rs.21,39,700, the incidence of assessment being Rs.3 : 13 : 5 per acre; cultivated area (1897–98), 639,572 acres, of which 38,011 were irrigated from wells, &c., including 1126 acres from Government canals; number of police, 707; children at school (1897–98), 29,497, being 3·5 per cent. of the total population; registered death-rate (1897), 28·48 per thousand. The principal crops are cotton, millets, rice, and pulse; the manufactures are of cotton cloth, calico-printing, dyeing, soap, and glass. The chief centre of trade is Nariad, on the railway, with a cotton mill. The Bombay and Baroda railway runs through the district for 72 miles. A special article of export is *ghi*, or clarified butter. The famine of 1899–1900 was felt more severely here than in any other part of the province, the loss of cattle being specially heavy.

Kaiserslautern, a town of Bavaria, Germany, in the Palatinate, 41 miles by rail west of Mannheim. It has a couple of technical schools, school of architecture, and agricultural school. It has developed considerable industrial activity in cotton spinning and weaving, factories for sewing-machines, brewing, brickworks, railway works, sawmills, iron works and foundries, and the manufacture of calico and wooden wares. Population (1885), 31,449; (1900), 48,306.

Kalach, a Cossack village of south-east Russia, province of the Don, chief river port on the Don, 31 miles north-east of Nijne-Chirskaya, at the place where the Don approaches nearest the Volga. Its permanent population, which numbers but a few thousands, much increases in summer. It is the terminus of the 50-miles railway which connects the Don with Tsaritsyn on the Volga, and all the goods which are brought from the Caspian Sea up the Volga and are destined for middle Russia, or for export through the Sea of Azov, are unloaded at Tsaritsyn and sent over to Kalach on the Don, to be shipped either up or down the Don or to be sent to middle Russia by rail. Large quantities of fish, from the lower Volga, Ural, and Caspian fisheries, are sent on this route. Naphtha, which comes from Baku, is pumped at Tsaritsyn from the ships to cistern-waggons and brought partly to Kalach. Finally, corn and timber, which are shipped down the Volga, are also sent from Tsaritsyn to Kalach to be shipped thence south-westwards. Nearly 460,000 tons reach Kalach to be distributed every year, giving employment to from 150 to 300 vessels; corn alone represents an item of 370,000 tons.

Kalahandi, or KAROND, a feudatory state of India, in the Chhattisgarh division of the Central Provinces. Area, 3745 square miles; population (1881), 224,548; (1891), 326,295; average density, 87 persons per square mile. In 1901 the population was 336,961, showing an increase of 3 per cent., compared with an apparent increase of 45 per cent. in the previous decade. The estimated revenue is Rs.1,55,000; tribute, Rs.12,000. The chief, who is a Rajput, is the only one in the Central Provinces entitled to a salute of 9 guns, which he received at the Delhi durbar in 1877. The present (1901) chief is a minor, and the state is under British administration. The inhabitants mostly belong to the aboriginal race of Kandhs. A murderous outbreak against Hindu settlers called for armed intervention in 1882.

Kalamata, a town in the Morea, Greece, 17 miles west by south of Sparta, in the province of Messenia, about a mile from the sea. The harbour, though recently improved, offers little shelter to shipping. Vessels load and discharge by means of lighters, the outer harbour having a depth at entrance of 24 feet and inside of 14 feet. The inner harbour has a depth of 15 feet, and is sheltered by a breakwater 1640 feet in length. The silk industry, formerly important, still employs about 300 women and girls in four spinning establishments. Olive oil and silk are the chief exports. Population (1889), 10,696; (1896), 14,298.

Kalamazoo, capital of Kalamazoo county, Michigan, U.S.A., on the Kalamazoo river, at an altitude of 760 feet. It has a fairly level site and a regular plan, is divided into five wards, and has a good water-supply by the Holly pumping system. The river furnishes water power for manufactures, which in 1890 had a capital of $4,000,000, employed over 5000 hands, and had a product valued at $6,000,000. It is at the intersection of four railways, the

Chicago, Kalamazoo, and Saginaw, the Grand Rapids and Indiana, the Lake Shore and Michigan Southern, and the Michigan Central. Kalamazoo is the seat of Kalamazoo College, a Baptist institution, founded in 1855, which had in 1899 fourteen instructors and 241 students, 94 of whom were women. One of the state insane asylums is located here. Population (1890), 17,853; (1900), 24,404, of whom 4710 were foreign-born and 471 negroes.

Kalát (*Khalat*), capital of Baluchistan, situated in 29° 2′ N. and 66° 37′ E., about 6780 feet above sea-level. The word Kalát is derived from *kala*—a fortress—and Kalát is the most picturesque and most impressive fortress to be found in the Baluch highlands. It crowns a low hill, round the base of which clusters the closely-built mass of flat-roofed mud houses which form the insignificant town. Kalát as a capital and the residence of the chief of Baluchistan has long been eclipsed in importance by Quetta, about 90 miles to the north, the residence of the agent to the Governor-General of India. There is a population of 7000 to 8000 people within the town walls of Kalát. The valleys immediately surrounding the prettily situated fortress are well cultivated and thickly inhabited, in spite of their elevation and the extremes of temperature to which they are exposed. Recent surveys of Baluchistan have determined the position of Khozdar (27° 48′ N., 66° 38′ E.) about 50 miles south of Kalát. Khozdar was the former capital of Baluchistan, and is as directly connected with the southern branches of the Mulla pass as Kalát is with the northern, the Mulla being the ancient trade route to Gandava (Kandabel) and Sind. In spite of the rugged and barren nature of the mountain districts of the Kalát highlands, the main routes through them (concentrating on Khozdar rather than on Kalát) are comparatively easy. The old "Pathan vat," the trade highway between Kalát and Karachi by the Hab valley, passes through Khozdar. From Khozdar another route strikes a little west of south to Wad, and then passes easily into Las Bela. This is the "Kohan vat." A third route runs to Nal, and leads to the head of the Kolwah valley (meeting with no great physical obstruction), and then strikes into the open highroad to Persia. Some of the valleys about Kalát (Mastang, for instance) are wide and fertile, full of thriving villages and strikingly picturesque; and in spite of the great preponderance of mountain wilderness (a wilderness which is, however, in many parts well adapted for the pasturage of sheep) existing in the Sarawan lowlands almost equally with the Jalawan highlands, it is not difficult to understand the importance which the province of Kalát, anciently called Turán (or Tubarán), maintained in the eyes of mediæval Arab geographers (see BALUCHISTAN). New light has been thrown on the history of Kalát by the translation of an unpublished manuscript obtained at Tatta by Mr G. P. Tate, of the Indian Survey Department, who has added thereto notes from the Tufhat-ul-Kirám, for the use of which he was indebted to Khan Sahib Rasul Baksh, mukhtiardar of Tatta. According to these authorities, the family of the khans of Kalát is of Arabic origin, and not, as is usually stated, of Brahuic extraction. They belong to the Ahmadzai branch of the Mirwari clan, which originally emigrated from Oman to the Kolwah valley of Makrán.

See Mr Tate's pamphlet, published in Calcutta in 1896.

(T. H. H*.)

Kalgoorlie, a thriving town of West Australia, 24 miles east-north-east of Coolgardie by rail. Good water was struck in 1896. The gold-field here is a rich one, supporting about 15,000 miners. Population, 6583.

Kalisz, a government of Russian Poland, having Prussia on the W. and N.W., and the governments of Warsaw and Piotrków on the E. and S. Its area occupies 4392 square miles. Its surface is a lowland, sloping towards the west, and is watered by the Prosna and the Warta and their numerous small tributaries, as also the Bzura. It was formerly covered with countless small lakes and thick forests, now mostly destroyed. Many small lakes and large marshes exist still. Its population was 846,719 in 1897 (427,978 women), of whom 113,609 lived in towns. They are chiefly Poles. The vast majority of the people are Roman Catholics, but the Jews and Protestants each number some 80,000. The land is divided among 80,000 owners (including 142 village communities), the subdivision of land rapidly progressing, and its market value growing steadily. In 1900, 109,100 acres were under crops, and 230,000 under forests. Agriculture is carried on to perfection on a number of estates, as also cattle-breeding. There were in 1897, 92,098 horses, 261,046 horned cattle, and over 1,104,000 sheep, out of which about 600,000 were of finer breeds. A variety of domestic trades, including the weaving of linen and wools, is carried on in the villages. There are various factories, the joint output of which is valued at two millions sterling. The government is divided into eight districts, the chief towns of which are: Kalisz (21,680 inhabitants), Koło (9400), Konin (8530), Lęczića (8863), Słupec (3758), Sieradz (7019), Turek (8141), and Velun (7442).

Kalisz, chief town of the above province, situated in the low valley of the Prosna, 148 miles west-south-west of Warsaw, near the Prussian frontier. Population (1897), 21,680, of whom 48 per cent. were Catholics, 37 per cent. Jews, and 11 per cent. Protestants. Several factories (sugar, woollen cloth, woollens, ribbons, &c.), with an aggregate return of £300,000 are situated in the town and its suburbs.

Kalitvenskaya, a Cossack village of Russia, province of the Don, 7 miles east-south-east of Kamenskaya, on a tributary of the Donets. Good sandstone is extracted in considerable quantities. Population, 20,025.

Kalk, a town of Prussia, in the Rhine province, 2 miles east of Cologne. It has various iron and chemical industries, brickworks, and breweries. Population (1885), 11,418; (1900), 20,581.

Kalmyk, or KALMUCK STEPPE, a territory or reservation belonging to the Kalmyks, having a quadrilateral shape and limited by the Volga on the N.E., and the Manych (West Caucasia) on the S.W., the Caspian Sea on the S.E., and the province of the Don Cossacks on the N.W. Its area covers 36,900 square miles, to which a second reservation (1,955,000 acres), on the left bank of the lower Volga, must be added. According to Mushketoff, the Kalmyk Steppe must be divided into two parts, western and eastern. The former, occupied by the Ergheni Hills, is a deeply ravined plain, 300 and occasionally 630 feet above the sea. It is built up of Tertiary deposits, of the Sarmatian division of the Miocene period, covered with loess and black earth, and its escarpments represent the old shoreline of the Caspian. No Caspian deposits are found on or within the Ergheni Hills. The flora of these hills is the usual black earth flora, and they have a settled population. The eastern part is a low plain lying for the most part from 30 to 40 feet below the level of the sea, gently sloping from Sarepta to the Volga. Post-Pliocene "Aral-Caspian deposits," containing the usual fossils (*Hydrobia*, *Neritina*, eight species of *Cardium*, two of *Dreissena*, three of *Adacna* and *Lithoglyphus caspius*), attain varying thicknesses from 105 feet to 7 or 10 feet, and disappear in places. Lacustrine and fluviatile deposits are found mixed with the above. Large tracts of moving sands are spread about Enotaevsk, where high dunes or *barkhans* have been formed. A narrow tract of land along the north-west coast of the Caspian, described as *mochaghi* by the Russians, and known in geography as the "hillocks of Baer," is covered with hillocks elongated from west to east, perpendicularly to the coast-line, the spaces between these mounds being filled with water or covered with thickets of rushes, as well as with thickets of *Salix*, *Ulmus campestris*, almond trees, &c. Quite an archipelago of little islands is formed close to the littoral by these mounds, which have on the north and north-west a succession of salt lakes partly desiccated. Small streams originate in the Erghenis, but are lost as soon as they reach the low land, where water can only be obtained from wells, while the scanty vegetation becomes a mixture of the flora of south-east Russia and of the deserts of Central Asia. The steppe is divided into eight *uluses*, and has a total population of 27,713 *kibitkas*, or felt tents, and 109,620 souls. There are no less than 62 Buddhist monasteries and 965 lamas for that population. Part of the Kalmyks are settled (chiefly in the hilly parts), the remainder being nomads. They have over 50,000 horses, 180,000 cattle, and half a million sheep, but suffer heavy losses from murrain. Some attempts at agriculture and tree-planting on a small scale are being made. Cattle-breeding, fishing, and some domestic trades, chiefly carried on by women, are the main sources of living. The steppe is intersected in all directions by paths, and communication is everywhere easy.

Prof. MUSHKETOFF. *Geol. Researches in the Kalmyk Steppe in 1884–85.* St Pet., 1894 (Russian).—KOSTENKOFF'S works (1868–70); and a great number of earlier works enumerated in P. SEMENOFF'S *Geogr. Dictionary* and *Russ. Encycl. Dict.* (P. A. K.)

Kalnoky, Gustav, COUNT (1832–1898), Austrian statesman, was born at Lettowitz, in Moravia, of an old Transylvanian family. After spending some years in the army, in 1854 he entered the diplomatic service; was for the ten years 1860 to 1870 secretary of Legation at London, and then, after serving at Rome and Copenhagen, was in 1880 appointed ambassador at St Petersburg. The ability he showed in this important post, especially, it is said, in the despatches he sent home, attracted the attention of the Emperor, and on the death of Baron v. Haymerle in 1881 he was appointed Minister of Foreign Affairs for Austria-Hungary, and held this post for fourteen years. Essentially a diplomatist, he took little or no part in the vexed internal affairs of the empire, and he was little heard of in public except at the annual statement on foreign affairs before the Delegations. His management of the affairs of his department was, however, very successful: he confirmed and maintained the alliance with Germany which had been formed by his predecessors, and co-operated with Bismarck in the arrangements by which Italy joined the alliance. Kalnoky's special influence was seen in the improvement of Austrian relations with Russia, which followed the meeting at Skiernevice at which he was present, a policy which caused some adverse criticism in Hungary. His friendliness for Russia did not, however, prevent him from strengthening the position of Austria in the Balkan peninsula and establishing a closer political and commercial understanding with Servia and Rumania. In 1885 he interfered after the battle of Slivnitza to arrest the advance of the Bulgarians. Though he kept aloof from the Clerical party, Kalnoky was a strong Catholic; and his sympathy for the difficulties of the Church caused some adverse comment in Italy, when, in 1891, he stated in a speech that the question of the position of the Pope was still quite unsettled. He explained that by this he did not refer to the Roman question, which was of course permanently settled, but to the possibility of the Pope leaving Rome. It was the jealousy felt in Hungary against the Ultramontanes which led to his fall. In 1895 a case of clerical aggression by Agliardi, the Nuncio in Hungary, aroused a strong protest in the Hungarian parliament, and Banffy, the Hungarian minister, expressed himself in such a way as to trespass on the functions of the foreign minister. Kalnoky therefore offered his resignation, which, after some delay, the Emperor was obliged to accept. He died on the 13th of February 1898.

Kalpi, or CALPEE, a town of British India, in the Jalaun district of the North-West Provinces, on the right bank of the Jumna, 45 miles south-west of Cawnpore. Population (1891), 12,713; municipal income (1897–98), Rs.14,368. It is still a centre of local trade, with a station on the Indian Midland railway from Jhansi to Cawnpore, which here crosses the Jumna. There are manufactures of sugar and paper, and a municipal school.

Kaluga, a province of middle Russia, with an area of 11,942 square miles. Its surface is an undulating plain, 800 to 900 feet in its highest parts in the south-west, and deeply ravined, especially in the north-east. It is built up mainly of Carboniferous deposits—upper, middle, and lower (coal-bearing), with patches of the soft Jurassic clays and limestones which formerly covered them. Cretaceous deposits (phosphorites) occur in the south-west, and Devonian limestones and shales creep out in the south-east. It is covered with a thick layer of boulder clay in the north, with vast ridges and fields of boulders brought by the ice-sheet from Finland and Olonets; large areas are strewn with flint boulders in its middle parts, and patches of loess are seen farther south. Iron ores are the chief mineral wealth, 30,000 tons of cast-iron being obtained, and nearly 40,000 persons being engaged in mining. Beds of coal are known in several places, and some of them are worked. Fireclay, china-clay, chalk, grindstone, pure quartz sand (for glass), phosphorite, and copper are also extracted. Forests cover 19 per cent. of the surface, but are distributed very unequally, chiefly in the south. The soil, which is rather unfertile, is not very suitable for agriculture, and owing to a rather dense population, considerable numbers of the inhabitants find occupation in industry, or as carriers and carpenters who work for one half of the year at the Black Sea ports.

The population (1,025,705 in 1860) was 1,185,726 in 1897, nearly all Great Russians. There are 116 women to 100 men, 94,853 living in towns. Of the 7,663,000 acres of available land, 4,072,700 acres were owned by the peasant communities, 2,993,300 acres by private owners, and 249,500 by the Crown. The chief crops are rye, oats, barley, sarrazin, and potatoes. Hemp is grown for local use and export. There were in 1892, 417 factories, employing 14,520 persons, and showing an annual output valued at about 16,500,000 roubles. The chief items of industry are distilleries, iron works, woollen cloth, cottons, paper, matches, leather, china, steam flour-mills, and oil works. Large quantities of all sorts of wooden goods are fabricated in the villages of the south. A considerable trade is carried on in hemp, hempseed, and hempseed oil, corn and hides; and iron, machinery, leather, glass, chemicals, and linen are exported. The schools are very insufficient (853), and there were in them 38,325 boys and only 9590 girls. Owing to the great number of Nonconformists, many children are taught in private peasant schools. The province is divided into 11 districts: Kaluga, Borovsk (8407 inhabitants), Kozelsk (5908), Likhvin (1776), Maloyaroslavets (2500), Medyñ (4392), Meshchovsk (3667), Mosalsk (2652), Peremyshl (3956), Tarusa (1989), and Zhizdra (5996). Several villages, such as Ludinovo, Polotnyanyi Zavod, and several others, are more populous than the above towns. KALUGA, the capital, is situated on the Oka, 149 miles south-west of Moscow, and is connected by rail with Vyazma (103 miles) and Tula (81 miles). Population (1862), 37,918; (1897), 49,728.

Kałusz, a district town and trading centre in south-eastern Galicia, Austria, on the Lomnicza, a tributary of the Dniester. It has large salt works, and a considerable timber, corn, and cattle trade. Population (1890), 7526; (1900), 7821.

Kamchatka, a large peninsula of north-east Asia, in the northern Pacific, stretching from the Land of the

Chukchis in a southern direction for 850 miles, with a width of from 70 to 250 miles (51° to 60° N., and 156° to 164° 20′ E.), between the Sea of Okhotsk and Bering Sea, forming part of the Russian Maritime Province (*Primorskaya Oblast*), with an area of 104,260 square miles.

The orography is not yet fully known, but the ridge which is drawn on many maps, from the Land of the Chukchis to the southern extremity of the peninsula, does not exist. From 59° 40′ N. to 62° N. the isthmus which connects the peninsula with the mainland is a flat *tundra*, gently sloping both ways (Ditmar, Bogdanovich, Kennan). As to the ridge, which Ditmar called central, it seems to be interrupted under 57° N. by a deep indentation corresponding to the valley of the Tighil, where the hydrographical net, as well as the south-west to north-east stretching of the clay-slates and Metamorphic schists on Ditmar's map, seems rather to indicate the existence of two chains running south-west to north-east, parallel to the volcanic chain of south-east Kamchatka. Glaciers were not known till the year 1899, when they were discovered by an expedition on the Byelaya and Ushkinskaya mountains. They are small, but formerly had a much greater extension. Thick Tertiary deposits, probably Miocene, cover the middle portions of the west coast. The southern parts of the central ridge are composed of granites, syenites, porphyries, and crystalline slates, while in the north of Ichinskaya volcano, which is the highest summit of the peninsula (16,920 feet), the mountains consist chiefly of Tertiary sandstones and old volcanic rocks. Coal-bearing clays, containing fresh-water molluscs and dicotyledonous plants, as also conglomerates, alternate with the sandstones in these Tertiary deposits. Amber is also found in them. Very extensive layers of melaphyre and andesite, as also of conglomerates and volcanic tuffs, cover the middle portions of the peninsula. The south-eastern portion is occupied by a range of volcanoes, both active and extinct, running south-west to north-east along the indented coast, from Cape Lopatka to Cape Kronotskiy (54° 25′ N.), and separated from the rest of the peninsula by the valleys of the Bystraya (west coast) and the Kamchatka river. Another chain of volcanoes runs from Ichinskaya (which burst into activity several times in the 18th and 19th centuries) to Shiveluch, seemingly parallel to the above, but to the north of it. The two chains contain twelve active and twenty-six extinct volcanoes, from 7000 to more than 15,000 feet high. The highest volcanoes are grouped under the 56th degree of latitude, and the highest of them, Kluchevskaya (16,032 or 16,500 feet), is in a state of almost continuous activity, a flow of its lava having reached to Kamchatka river in 1853. The active Shiveluch (9898 feet) is the last volcano of this row. Several lakes and probably Avacha Bay are old craters. Copper, mercury, and iron ores, as also pure copper, ochre, and sulphur, are found in the peninsula. The main river is the Kamchatka (about 325 miles long), which flows first north-eastwards in a fertile longitudinal valley, and then, bending suddenly to the east, pierces the above-mentioned volcanic ridge. The other rivers are the Tighil (135 miles) and the Bolstraya (120 miles), both flowing into the Sea of Okhotsk; the Avacha, flowing into the Pacific; and the Zhupanova. The floating ice which accumulates in the northern parts of the Sea of Okhotsk and the cold current which flows along the east coast of the peninsula render its summers cold, but the winter is relatively warm, and temperatures below –40° Fahr. are only found in the highlands of the interior and on the Okhotsk littoral. The average temperatures at Petropavlovsk (53° N.) are: year 36° Fahr., January 17°, July 58°; while in the valley of the Kamchatka the average temperature of the winter is 16°, and of the summer as high as 58° and 64°. The rains and snow are copious, and dense fogs clothe the coast in summer; consequently the mountains are well covered with wood and the meadows with grasses, except in the *tundras* of the north. The coasts are rich in *Delphinopterus leucus*, *Otaria Stelleri*, and walrus. The sea-otter (*Enhydris marina*) has been destroyed. The population, which numbered 7331 in 1853 and 5846 in 1870, was 7199 in 1888. The southern part of the peninsula is occupied by Kamchadales, who have many features of the Mongolian race, but are more similar to the aborigines of north-east Asia and north-west America. Dr Dybowski found them rather good-looking, and with less flat faces and less prominent cheek-bones than Siberian aborigines. Steller and Krasheninnikoff, who visited Kamchatka in the 18th century, found the Kamchadales still in the mode of life of the Stone Age. They have since taken to the Russian mode of living. Fishing (quantities of salmon enter the rivers) and hunting are their chief occupation. The efforts of the Government to introduce cattle-breeding have failed, there being in 1889 only 655 horses, 1832 cattle, and 43,300 reindeer. Beyond the 57th degree the peninsula is peopled with Koryaks, settled and nomads, and Lamuts or Tunguses, who came from the west coast of the Sea of Okhotsk. The chief Russian settlements are: Petropavlovsk, on the east coast, on Avacha Bay (53° N. and 158° 44′ E.), excellent roadstead; Verkhne-Kamchatsk and Nijne-Kamchatsk, in the valley of the Kamchatka river; Bolsheryetsk, on the Bolstraya; and Tighil. All goods, except rye, flour, and tobacco, are imported from San Francisco. The trade is nearly all by barter.

LITERATURE.—See, besides the works mentioned in the earlier volumes, C. von DITMAR'S "Reisen und Aufenthalt in Kamchatka in den Jahren 1851–1855," in *Beiträge zur Kenntniss des Russischen Reichs*, 3te Folge, Bd. vii.—K. DIENER, in *Petermann's Mitteilungen*, 1891, Bd. xxxvii.—OBRUCHEFF, in *Izvestia* of the East Siberian Geographical Society, vol. xxiii. pp. 4, 5, 1892.—GUILLEMAN. *Cruise of the "Marchesa."* (P. A. K.)

Kamenets Podolsk, a town of south-west Russia, chief town of the government of Podolia, 876 miles south-west of Moscow, near the Austrian frontier, 3 miles from the railway terminus of the south-western railways. An interesting archæological museum for church antiquities was founded in 1890. Population (1863), 20,699; (1897), 34,383.

Kamenskaya, a district town of Russia, province of the Don, on the northern Donets, 66 miles by rail north of Novocherkassk. It is one of the richest places in the province, owing to the neighbouring coal mines, and has also tanneries and oil works, as well as trade in cattle and grain. Population (1897), 23,576.

Kamerun. See CAMEROON.

Kampti, or KAMTHI, a town of British India, in the Nagpur district of the Central Provinces, just below the confluence of the Kanhan with the rivers Pench and Kolar; 1019 feet above the sea; 8 miles north-east of Nagpur by rail. Population (1881), 50,987; (1891), 43,159. Kampti is well laid out with wide roads, gardens, and tanks. It is the headquarters of a military district, though the garrison is now much reduced, consisting of a battery of artillery, a European and a Madras native infantry regiment. It is an important centre of trade, especially since the opening of the Bengal–Nagpur railway, which here crosses the Kanhan river by a fine iron-girder bridge. There are two steam factories for ginning and pressing cotton. The Roman Catholic convent school had 11 boys and 125 girls in 1896–97.

Kamrup, a district of British India, in the Brahmaputra valley division of Assam. The headquarters are at Gauhati, the former capital. Area, 3660 square miles; in 1881 the population was 644,960; in 1891, 634,249, showing a small decrease; average density, 173 persons per square mile, being the highest in the Brahmaputra valley. Classified according to religion, Hindus numbered 445,377; Mahommedans, 55,350; hill tribes, 131,759; Christians, 948, of whom 42 were Europeans; "others," 815. In 1901 the population was 589,303, showing a further decrease of 7 per cent., which may be ascribed to the prevalence of a malignant type of fever. The land revenue was Rs.13,88,194, the incidence of assessment being Rs.2:8:2 per acre; number of police, 304; number of boys at school (1896–97), 12,185, being 25·3 per cent. of the male population of school-going age; registered death-rate (1897), 46·19 per thousand. In 1897 the number of tea gardens was 31, with 5873 acres under tea, employing 3959 persons, of whom 1211 were children, and producing an out-turn of 753,228 ℔, or at the rate of 132 ℔ per acre. A section of the Assam–Bengal railway, which will ultimately be continued across the hills, starts from Gauhati. In 1896 about 75 miles of this section were open, but had to be closed owing to the damage caused by the earthquake of 12th June 1897, which was estimated at Rs.6,55,000. In 1899 it was reopened to a farther length of 93 miles in all. A metalled road runs due south from Gauhati to Shillong (63 miles), which was also seriously damaged by the earthquake. A ferry across the Brahmaputra at Gauhati is worked by a Government steamer.

Kamyshin, a district town of Russia, government and 120 miles south-south-west of Saratoff, on the right bank of the Volga. Being the terminus of the railway to Tamboff, Moscow, and the Baltic ports, it is an important port for the export of corn and salt from the Volga, and imports timber and wooden goods. Population (1861), 8644; (1897), 15,934.

Kanara, or Canara, the name of two districts of British India—North Kanara attached to Bombay, South Kanara to Madras. North Kanara district forms part of the Konkan division of Bombay. The administrative headquarters are at Karwar, which is also the chief seaport. Area, 3910 square miles; population (1881), 421,840; (1891), 446,351, showing an increase of nearly 6 per cent.; average density, 114 persons per square mile, being the lowest in the Presidency. In 1901 the population was 454,238, showing a further increase of 2 per cent. The land revenue and rates were Rs.11,08,400, the incidence of assessment being nearly Rs.3 per acre; number of police, 702; children at school, 11,358, being 2·6 per cent. of the population; death-rate (1897), 36 per thousand. The Bombay survey tenure has not been fully extended to North Kanara, so that agricultural statistics are not available. Forests cover no less than 3794 square miles. The trade of the interior, which used to pass down to the seaports, has now been largely diverted by the opening of the Southern Mahratta railway. South Kanara district has its headquarters at Mangalore. Area, 3902 square miles; population (1881), 959,514; (1891), 1,056,081, showing an increase of 10 per cent.; average density, 271 persons per square mile. In 1901 the population was 1,134,624, showing a further increase of 7 per cent. The land revenue and rates (1897–98) were Rs.15,27,035, the rate of assessment being nearly Rs.3 per acre; number of police, 609; children at school (1896–97), 27,010, being 1 in 39 of the total population; death-rate (1897), 28 per thousand. The one staple crop is rice. The Madras *rayatwari* system has not been extended to South Kanara, where land is treated as private property, subject to a traditional assessment. Tiles are manufactured in several places out of a fine potter's clay. In 1897–98 the total seaborne trade was valued at Rs.1,77,04,146, of which nearly one-third was with foreign countries.

Kandahar.—Since the withdrawal of the British army of occupation from southern Afghanistan, at the close of the Afghan war of 1878–80, no important information (other than that which is supplied by a native agent to the Indian political department) has been gathered about Kandahar. The close of the Russo-Afghan Boundary Commission in 1887 afforded an opportunity for surveying the country bordering the Helmund which lies beyond Kandahar, on the road to Farah and Herat. This district, known as Zamindawar, is very highly cultivated and thickly populated, and it is here that the most turbulent and most fanatical of Afghan tribesfolk (Achakzais and Nurzais of the Durani clans) are mostly gathered. To the south those routes which connect the city with the coast of southern Baluchistan and Karachi have been carefully surveyed, but of the city itself nothing more is known than has already been included in the description given of it in the earlier volumes of this work. Trade statistics of late years show a gradual increase of exports to India from Kandahar and the countries adjacent thereto, but a curious falling-off in imports. The exports in 1899–1900 amounted to about Rs.43,24,772 in value, but the imports, Rs.28,18,412, contrasted unfavourably with those of 1894–95. The short-sighted policy of the Amir Abdur Rahman in discouraging imports doubtless affected the balance, nor did his affectation of ignoring the railway between New Chaman and Kila Abdulla (on the Peishin side of the Kojak) conduce to the improvement of trade. (T. H. H*.)

Kandy, a town near the centre of Ceylon, 75 miles from Colombo by rail. It has been greatly improved. Governor Sir William Gregory did much to restore the ancient Kandy decorations, while the Victoria Jubilee Commemoration Building, including "Ferguson Memorial Hall," and two fine hotels, add to the improvements. The Royal Botanic Gardens are situated at Peradeniya, 3 miles distant. It is a uniquely beautiful, highland, tropical town, full of interesting historical and Buddhistical associations. A water-supply and electric lighting are amongst recent introductions. Roman Catholic missions are extensive, and very active in the work of education, for which a large block of buildings has been erected. The Church of England, Wesleyan, and Baptist missions are also at work. The population of the town in 1900 was 26,117; of the district, 375,665. Average annual rainfall is 81½ inches; average temperature is 75·3°. There is a branch railway from Kandy, north to Matale, 17 miles.

Kane, a borough of McKean county, Pennsylvania, U.S.A., at the intersection of several railways. It lies in a region of natural gas, oil, and lumber, and contains railway repair shops. Population (1890), 2944; (1900), 5296, of whom 971 were foreign-born.

Kangávar, a small district of Persia, situated between Hamadán and Kermánshah, and, being held in fief by the family of a deceased court official, forming a separate government. The district is very fertile and contains 30 villages. Its revenues amount to about £500 per annum, and its chief place is the large village of Kangávar, which has a population of about 2500, and is 47 miles from Hamadán on the high-road to Kermánshah.

Kangra, a town and district of British India, in the Jullundur division of the Punjab. The town, sometimes called Nagarkot, is situated in 32° 5′ N. and 76° 18′ E., 2409 feet above the sea. Population (1881), 5387; (1891), 5234; municipal income (1897–98), Rs.5670. In 1855 the headquarters of the district were removed to the sanitarium of Dharmsala, where a zenana hospital was opened in 1897. The district of Kangra extends from the Jullundur Doab far into the southern ranges of the Himalaya. Besides some Rajput states, annexed after the Sikh wars, it includes Lahul, Spiti, and Kulu, which are essentially Tibetan. Area, 9574 square miles, of which Kangra proper has only 2725. Population (1881), 730,845; (1891), 763,030; average density, 80 persons per square mile, ranging from 224 in Kangra proper to only one person per square mile in Spiti. In 1901 the population was 768,382, showing an increase of less than 1 per cent. The land revenue and rates were Rs.9,17,049, the incidence of assessment being R.1:1:11 per acre; cultivated area (1896–97), 602,867 acres, of which 173,037 were irrigated from private canals; number of police, 427; number of schools (1896–97), 88, with 3619 pupils, the proportion of boys at school to the male population of school-going age being 5·9 per cent.; registered death-rate (1897), 28·6 per thousand. Tea cultivation was introduced into Kangra about 1850, and has been adopted by the natives. There are also several English planters. The total area under tea is about 10,000 acres, with a yearly out-turn of about 2,300,000 ℔. There are a printing-press and a brewery at Dharmsala. There is no railway in the district, nor are there any metalled roads.

Kankakee, capital of Kankakee county, Illinois, U.S.A., on the Kankakee river, at an altitude of 627 feet. It is at the intersection of the Cleveland, Cincinnati, Chicago and St Louis, the Illinois Central, and the Indiana, Illinois, and Iowa railways. It has a level site on the prairie and a regular plan. It contains a state insane asylum. Population (1890), 9025; (1900), 13,595, of whom 3346 were foreign-born and 175 negroes.

Kano. See Hausa.

Kansas, the central commonwealth of the American Union, bounded on the N. by Nebraska, on the E. by Missouri, on the S. by Oklahoma and Indian Territory, on the W. by Colorado. It is commonly known as the Sunflower State. The eastern third of the state is heavily timbered along the streams, and the forest area increased rather than diminished during the last quarter of the 19th century, in consequence of the settling of the country, which put a stop to prairie fires. The rainfall is ample, and general crop failures are unknown. The western third of the state is in the semi-arid region, with insufficient rain and without forests. The prevalent natural vegetation is buffalo grass, cactus, and yucca. Alfalfa, Kaffre corn, and other drought-resisting plants are grown, and cattle raising and fattening have become the most profitable industries. The central third of the state is intermediate in character between the eastern and western sections. The annual rainfall of the eastern section is 35 inches; of the central section, 25 inches; of the western section, 15 inches.

Population.—According to the census of 1880, the population was 995,966; in 1890 it was 1,427,096, and in 1900 it was 1,470,495. There was a steady increase from 1880 until 1888, when it reached 1,518,552. The opening of Oklahoma for settlement in 1889 withdrew at least 50,000 people, and this, combined with unsettled political conditions, produced a reduction to 1,334,734 in 1895. During each year since 1895 there was a gradual gain, until in 1899 the population reached 1,425,119, and in 1900 was 1,470,495. The net increase from 1880 to 1890 was 43·3 per cent., and from 1890 to 1900, 3 per cent. The population of the eleven largest towns in 1900 was as follows: Kansas City, 51,418; Topeka, 33,608; Wichita, 24,671; Leavenworth, 20,735; Atchison, 15,722; Lawrence, 10,862; Fort Scott, 10,322; Galena, 10,155; Pittsburg, 10,112; Hutchinson, 9379; Emporia, 8223. Of the population of Kansas in 1900, 768,716 (52·3 per cent.) were males and 701,779 were females; 1,343,810 were native-born and 126,685 (8·6 per cent.) were foreign-born. The total white population was 1,416,319; the total coloured population was 54,176, of whom 52,003 were negroes, 4 Japanese, 39 Chinese, and 2130 Indians.

Education.—The total amount expended for common school purposes in Kansas in 1899 exceeded $4,000,000; the number of children of school age was 496,000; the number of pupils enrolled was 370,240; the average daily attendance was 257,000; the number of teachers required was 12,513; the average length of the school year was twenty-five weeks; the average salary of male teachers was $39 per month, of female teachers, $32; the total value of common school property was $10,000,000. In 1900 Kansas stood near the head of the list of American states in the small percentage of illiteracy. Out of 413,786 adult males, 14,214, or 3·4 per cent., were illiterate (unable to write); the percentage of illiteracy among the native white adult males of native parents was only 1·7. Not a single soldier in the famous 20th Kansas regiment in the Spanish war was unable to write his own name. The state maintains, as a part of her free school system, a well-equipped state university at Lawrence, an Agricultural College at Manhattan, and a Normal School at Emporia. The university in 1900 had a faculty of 78 members, an attendance of 1150 students, 10 buildings, and an annual maintenance fund of $130,000. The state Agricultural College and the state Normal School had also progressed satisfactorily. In addition to the state schools, flourishing colleges are supported by the various religious denominations.

Charities.—The following table shows the state charitable and correctional institutions, with the number of inmates, May 1900, and the appropriations for support for 1899 and 1900. In addition to this, 77 counties, with farms for poor, cared for 1595 indigent persons in 1899 at a net cost of $105,440; out-door relief given in 100 counties amounted to $344,555. The state voted support for 14 charitable institutions, chiefly hospitals, amounting to $19,600 for 1899 and 1900, and reimbursed counties for the support of insane in previous years to the amount of $221,950, besides providing for the expenses of the state Board of Charities to the amount of $17,000, and for other local boards to the amount of $11,600 for the years named.

Name.	Locality.	Inmates.	Appropriation.	
			Current Expenses.	Improvements.
Penitentiary	Lansing	988[1]	$308,702	$154,000
Industrial Reformatory	Hutchinson	220	115,630	77,500
Industrial School (girls)	Beloit	116	48,820	25,000
Reform School (boys)	Topeka	180	126,304	25,000
Insane Asylum	Topeka	850	287,620	33,500
Insane Asylum	Osawatomie	1030	303,198	50,000
Blind Asylum	Kansas City	85	49,578	None
Imbecile School	Winfield	204	88,940	40,000
Deaf and Dumb School	Olathe	250	92,180	4,000
Soldiers' Orphans' Home	Atchison	184	75,960	None

Agriculture.—The following table exhibits the quantities and values of farm crops and live-stock products for 1899:—

	1899 Quantities.	1899 Values.
Winter wheat	42,815,471 bushels	$22,016,970
Spring wheat	871,542 ,,	389,441
Corn	225,183,432 ,,	53,530,576
Oats	26,046,773 ,,	4,951,636
Rye	1,754,406 ,,	690,408
Barley	3,352,845 ,,	781,202
Buckwheat	8,268 ,,	5,374
Irish potatoes	7,664,405 ,,	2,612,340
Sweet potatoes	334,080 ,,	150,269
Castor beans	37,862 ,,	34,076
Cotton	27,650 ℔	1,383
Flax	1,412,941 bushels	1,271,647
Hemp	34,000 ℔	1,700
Tobacco	12,250 ,,	1,225
Broom corn	14,000,705 ,,	455,023
Millet [2]	796,320 tons	2,354,348
Sorghum	1,539,193 gallons	492,541
Sorghum forage	...	2,457,304
Milo maize	25,159 tons	66,093
Kaffre corn	2,095,429 ,,	5,073,598
Jerusalem corn	10,497 ,,	25,179
Forage [3]	2,656,482 ,,	9,278,817
Animals [4]	...	50,533,797
Poultry and eggs [5]	...	4,241,869
Wool clip	712,181 ℔	106,827
Cheese	1,163,680 ,,	104,731
Butter	43,757,767 ,,	5,890,273
Milk sold	...	648,054
Garden products [6]	...	700,745
Horticultural [6]	...	523,445
Wood [6]	...	125,105
Wine	155,778 gallons	116,834
Honey and Beeswax	760,450 ℔	114,307
Grand total		$169,747,037

Mineral Products.—Since 1880 extensive mineral deposits have been discovered. A bed of rock-salt underlies nearly the whole of central and western Kansas at depths of from 300 to 1200 feet, varying in thickness from 250 feet in Ellsworth county to upwards of 400 feet in Harper, Kingman, and Reno counties. The salt mined in 1899 was valued, without cooperage, at $760,200, and the total production since 1880 was valued at $5,538,855. Natural gas, oil, zinc, and lead have been discovered in south-eastern Kansas. In 1899, 63,369 tons of zinc ore, worth $2,321,775, yielded 31,684 tons of metallic zinc, valued at $3,643,729; and 13,190 tons of lead ore, worth $337,038, yielded metallic lead of the value of $429,344. The coal produced was valued at $5,124,248, and the total output 1880 to 1899 was valued at $60,209,900. The total value of mineral products in 1899 was $11,894,576, and the grand total value 1880 to 1899 was estimated at $120,053,088.

Railways.—There are 29 railways in the state, with a total Kansas mileage of 8777 in 1899, as compared with 3104 in 1880. The most important of these railways and their respective mileage in Kansas are as follows: Atchison, Topeka, and Santa Fé, 2440 miles; Chicago, Rock Island, and Pacific, 1124 miles; Union Pacific, 480 miles; Chicago, Burlington, and Quincy, 259 miles; St Louis and San Francisco, 269 miles; Missouri Pacific, 1826 miles; Kansas City, Fort Scott, and Memphis, 258 miles; Missouri, Kansas, and Texas, 444 miles.

Finance.—The total assessed valuation of property for the fiscal year 1898-99 was $325,889,744. The total state tax levy for the same year was $4\frac{1}{10}$ mills, but the amount of income from this levy was so much in excess of the amount required for the state expenses that the sum of $80,000 was returned to the various counties. The constitution of Kansas forbids the contraction of a state debt in excess of $1,000,000. The actual state debt, 30th June 1900, was $692,000.

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[1] 207 from Oklahoma, 3 Federal civil.

[2] Including Hungarian.

[3] Grass, alfalfa, and clover.

[4] For slaughter.

[5] Sold.

[6] Marketed.

Banks.—According to the report of the state bank commissioner of 1898, there were in Kansas 101 national banks, with capital stock paid in of $8,442,100, with individual deposits of $21,243,147, and with average reserve held of 33·69 per cent. There were also 370 state and private banks, with an average invested capital of $7,436,097, with individual deposits of $22,500,000, and a reserve of nearly 50 per cent.

Religious Sects.—The statistics of religious denominations in Kansas in 1890 were as follows: Number of congregations, 4927; number of churches, 2859; seating capacity, 708,134; value of church property, $7,452,269; communicants, 236,729; percentage of communicants to population, 23·58. The following is a tabular exhibit of the different denominations and their statistics:—

	Congregations.	Churches.	Seating Capacity.	Value of Church Property.	Communicants.
Adventists . .	107	25	5,090	$19,550	8,205
Baptists	617	864	95,715	921,958	84,665
Catholics . . .	367	271	55,780	625,561	67,562
"Christians"	49	8	1,665	8,250	1,676
Congregationalists . .	183	152	34,975	485,975	11,945
Disciples of Christ . .	352	197	55,045	468,975	25,200
Dunkards	91	40	15,185	61,625	4,067
Evangelical Association . .	96	50	10,060	85,600	4,459
Friends (3 bodies) . . .	70	56	16,384	84,815	8,257
German Evangelical Synod . .	28	19	3,794	87,750	2,053
Lutherans	205	147	33,688	418,410	16,262
Latter-Day Saints . . .	25	4	800	3,800	1,072
Mennonites	62	31	9,208	45,130	4,620
Methodists	1529	894	219,839	2,230,265	95,781
Presbyterians	521	359	91,934	1,299,260	31,393
Protestant Episcopal (2 bodies) .	96	48	9,090	316,225	3,593
Reformed	29	18	8,882	55,400	1,139
United Brethren	355	139	36,650	193,970	14,356
Others	129	49	10,466	89,950	4,966

Manufactures.—The following table shows the condition of manufacturing in Kansas in 1890 and 1900:—

	1890.	1900.	Per cent. of Increase.
Number of establishments	4,471	7,830	75·1
Capital	$43,926,002	$66,827,362	52·1
Average number of wage-earners. . . .	28,237	35,193	24·6
Total wages . . .	$13,288,175	$16,317,689	22·8
Salaried officials, clerks, &c.—			
Number . . .	4,606[1]	3,860	16·2[2]
Salaries . . .	$3,040,310[1]	$3,256,086	7·1
Miscellaneous expenses .	$5,853,466	$5,241,450	10·5[2]
Cost of materials used .	$78,845,167	$129,485,320	64·2
Value of products, including custom work and repairing. . . .	$110,219,805	$172,129,398	56·2

The most important manufacturing industry in 1900 was slaughtering and meat-packing, with 14 factories, a capital of $16,486,177, an average number of 8117 wage-earners, and products valued at $77,411,883. The flouring and grist-mill industry ranked next, with 533 factories, an average number of 1451 wage-earners, and products valued at $21,926,768.

Politics.—Until 1890 Kansas had always been strongly Republican, giving in 1888 a majority of 80,000 for Benjamin Harrison in the Presidential election. But widespread depression on account of short crops and excessive mortgage indebtedness gave rise to the People's Party, commonly known as the Populist Party, and in 1890 the Republican state ticket was elected by only a small plurality. In general, the People's Party alone has not been able to carry the state; but in 1896, by means of a fusion, it elected the state officials and both branches of the legislature, and Bryan Presidential electors. In 1898, with the return of prosperity, the payment of $100,000,000 of mortgage indebtedness, and the decline of the silver issue, the Republicans elected the state ticket.

Liquor Traffic.—The people of Kansas, in November 1880, adopted an amendment to the state constitution forever prohibiting the manufacture and sale of intoxicating liquors except for medical, scientific, and mechanical purposes. At every subsequent session of the legislature the enemies of the prohibitory law attempted to overthrow it, but without avail. The degree of its enforcement has varied from zero to perfection, according to the locality. Being an agricultural state, with no city of more than 50,000 inhabitants, and only eight cities exceeding 10,000, Kansas is favourably conditioned for the enforcement of such a law. According to the *Brewers' Journal*, the official organ of the United States Brewers' Association (January 1900), Kansas consumes annually an average of 5257 barrels of beer, or only 1-30th as much as Nebraska, 1-40th as much as Colorado, and 1-450th as much as Missouri. (F. H. S.)

Kansas City, capital of Wyandotte county, Kansas, U.S.A., in 39·07° N. and 94·37° W., on the west bank of the Missouri, at the mouth of the Kansas, at an altitude of 760 feet. It is separated from Kansas City, Missouri, only by the state line. It is the largest city in the state, and is built mainly upon the low, level bottom-land, at the junction of the two rivers, in part spread up on the surrounding heights. Its plan is regular; it is divided into six wards, and its business streets are paved mainly with wood. It contains numerous stockyards, and its chief business is slaughtering and meat-packing. With the exception of Chicago, it is the largest live-stock market in the world. The census of 1900 showed 492 manufacturing establishments, with $18,633,475 capital, 10,544 hands, and a product valued at $82,768,943. Of this $73,205,027 consisted of the product of its slaughtering and meat-packing houses. The city is upon the Union Pacific, the Missouri Pacific, and the Kansas City and North-Western railways. Kansas City University was founded in 1896. In 1899 this had 78 instructors and 213 students, of whom 49 were women. The assessed valuation of real and personal property in 1900, on a basis respectively of about one-third and one-fifth of the full value, was $10,956,263; net debt, $2,392,216; rate of taxation, $50 per $1000. Kansas City was founded in 1886, by the consolidation of Kansas City, Armourdale, Armstrong, and Wyandotte. Population (1890), 38,316; (1900), 51,418, 6377 being foreign-born and 6509 negroes.

Kansas City, in Jackson county, Missouri, U.S.A., the second city in size and importance in the state, is situated on the right bank of the Missouri, immediately below the mouth of the Kansas river, in 39° 5′ N. and 94° 38′ W. It lies on the boundary line between Missouri and Kansas, and adjoins Kansas City, Kansas. The two form a single commercial community with undivided interests. Kansas City, Missouri, in 1890 had 132,416 inhabitants, and in 1900, 163,752, 18,410 being foreign-born and 17,567 negroes. Out of 53,708 adult males, 2096 were illiterate (unable to write), of whom 1176 were negroes. The two cities cover an area of 40 square miles. Though the cities have separate municipal organizations, the boundary is so little heeded that in many cases houses and factories have been built upon it. Kansas City, Missouri, is built upon an irregular surface with a variation of almost 300 feet in altitude from the heights to the stretches which lie along the rivers, and which are occupied by railroad tracks, wholesale houses, and live-stock yards. As a result of the trend of trade, which makes the commercial territory of most American cities lie to the west of them, it is allied more with Kansas than with Missouri. Its live-stock market is the second largest in the world, receipts in 1901 having amounted to 6,640,000 head of cattle, hogs, and sheep, of which 5,350,000 were slaughtered in the great packing-houses of the city, and the product distributed throughout the world. It is the largest primary winter wheat market in the United States. Its grain receipts in 1901 were 40 million bushels. It has flour-mills with capacity for 2 million barrels a year. Its sales of agricultural machinery exceed those of any other city in the world, and it has a large wholesale trade in groceries, hardware, drugs, dry goods, shoes, shirts, and garments, extending to the Gulf of Mexico and to the Pacific coast. Twenty-two railways, of sixteen separate systems, have termini in Kansas City. The Convention Hall can accommodate 20,000 persons. The city has ten miles of boulevards, and the park system includes 450 acres in the city and 1350 acres lying four miles beyond the city limits. The cost of buildings erected in 1901 was 7 million dollars. The street car systems embrace 140 miles of track, and are worked by electricity and by cable. The deposits in the banks amount to 75 million dollars. The bank clearances in 1901 were 920 million dollars. The annual cost of city government is above 1 million dollars, and the municipal debt (1901) was $3,600,000, including $3,100,000 invested in the waterworks, which the city owns, and which yield a net revenue more than sufficient to pay the interest. (W. R. N.)

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[1] Includes proprietors and firm members, with their salaries.
[2] Decrease.

Kansk, a district town of Russia, eastern Siberia, government of Yeniseisk, 142 miles by rail east of Krasnoyarsk, on the Kan river and the Siberian highway. Although it is the chief town of a district in which gold is found (in the tributaries of the Kan), the town is slow to develop, as it lies on low ground inundated by the river. Population (1897), 7504.

Kaposvár, a corporate town in the south-western part of Hungary, capital of the county of Somogy. It is a pleasant little town, with a large hospital, county hall, state gymnasium, two secondary schools (burgher schools) for girls, an institute for children of railway employees, a foundling hospital, three military barracks, and school for deaf and dumb children. Among the factories are a sugar refinery, a cement-plate works, and two steam mills. Its industry and commerce, as well as its stock-rearing, are considerable. Population (1890), 12,544; (1900), 18,218.

Kapunda, a town of South Australia, in the county of Light, 48 miles by rail north-north-east of Adelaide. The celebrated copper mines were closed in 1879. The district is a wheat-growing one, and has quarries of fine marble.

Kapurthala, a native state of India, within the Punjab. Area, 598 square miles; population (1881), 252,617; (1891), 299,690, showing an increase of 19 per cent.; average density, 501 persons per square mile. In 1901 the population was 314,269, showing a further increase of 5 per cent. The estimated gross revenue was Rs.20,00,000; tribute, Rs.1,31,000; military force (including police) 1773 men. The raja, Sir Jagatjit Sing, K.C.S.I., has more than once visited Europe, and was present at the celebration of Queen Victoria's Diamond Jubilee in London. During the Tirah expedition of 1897–98 the raja's Imperial Service infantry took a prominent part. The territory is crossed by the railway from Jullundur to Amritsar. In 1896–97 the total number of schools was 160, with 3985 pupils, including 214 girls; the proportion of boys at school was as high as 1 out of every 41 of the total male population. There is one arts college, with 6 students; and four Anglo-vernacular schools, with 944 pupils, of whom 9 passed the matriculation. The town of KAPURTHALA is situated in 31° 23′ N. and 75° 25′ E., 11 miles from Jullundur. Population, about 15,000.

Karachev, a district town of Russia, government and 55 miles by rail west-north-west of Orel. It is one of the oldest towns of Russia, having been mentioned in the annals since 1146, and has hemp factories and oil works, besides trade in grain, hemp, hempseed, hides, and horses. Population, 15,605.

Karachi, or KURRACHEE, a seaport city and district of British India, in the Sind province of Bombay. The city is at the extreme western end of the Indus delta, 500 miles by sea from Bombay and 820 miles by rail from Lahore, being the maritime terminus of the North-Western railway. Population (1881), 73,560; (1891), 105,199, showing an increase of 44 per cent.; (1901), 115,407, showing a further increase of 10 per cent. Karachi practically dates from its occupation by the British in 1839, when it was at once chosen for the seat of government for Sind instead of Haidarabad. The natural harbour formed by Manora Point has been greatly improved by the construction of the Napier mole from Kiamari island to the mainland, and of a breakwater seawards. It can now admit vessels of the largest tonnage, and has excellent railway accommodation. It has been growing yearly in importance as the maritime outlet for the produce of the entire valley of the Indus. It ranks as the fifth port in India, with nearly 7 per cent. of the total commerce. In 1897–98 the aggregate value of its seaborne trade amounted to Rs.14,91,31,890, of which Rs.9,63,21,602 represented foreign trade and Rs.5,28,10,288 coasting trade. The foreign imports were valued at Rs.5,01,10,718, of which Rs.2,95,97,101 represented imports from the United Kingdom, the other countries next in order being Germany, Austria, Belgium, Mauritius, Persia, Turkey, the Mekrán coast and France. The number of steamers that entered with cargoes was 111, of 168,154 tons; the number that cleared was 130, of 225,553 tons. The gross amount of import duty collected was Rs.27,05,844. During the ten years from 1888–89 to 1897–98, the total value of private merchandise imported rose from Rs.3,56,29,570 to Rs.4,63,28,110; and the total value of private merchandise exported rose from Rs.3,81,42,550 to Rs.4,59,56,210. During the same period the total number of steam and sailing vessels that entered and cleared with cargoes fell from 764 to 727; but the tonnage rose from 413,576 to 431,236. The large industries include seven cotton presses, employing about 300 hands; three ironworks, employing 400 hands; and six flour-mills. There are also manufactures of cotton-cloth, silk scarves, and carpets. Manora Head contains the lighthouse and the port establishment. The military cantonments, stretching north-east of the city, contain accommodation for a battery and a European regiment. An excellent water-supply is provided by an underground aqueduct 18 miles in length. The chief educational institutions are the Dayaram Jethmal College, with a law class; five high schools, of which two are for Europeans; a convent school for girls, with a training class for mistresses; and an engineering class. In 1896–97 almost all of these were closed because of the plague, which ravaged the city intermittently for four years. In 1897 the registered death-rate was 70 per 1000; and down to July 1898 the total number of deaths from plague was 5800. The expenditure incurred has reduced the municipality almost to a state of bankruptcy. There are thirteen printing-presses, issuing several newspapers in English and the vernaculars. The district of KARACHI has an area of 14,182 square miles; population (1881), 489,496; (1891), 560,880, showing an increase of 15 per cent.; average density, 40 persons per square mile. In 1901 the population was 607,439, showing an increase of 6 per cent. The land revenue and rates were Rs.15,34,763, the incidence of assessment being R.1 per acre; cultivated area (1897–98), 591,135 acres, of which 439,253 were irrigated, including 191,342 from Government canals; number of police, 1285; children at school (1897–98), 14,677, being 2·9 per cent. of the total population; registered death-rate (1897), 22 per 1000, showing that the plague was then almost confined to the city, though in 1898 it broke out rather severely in the district from April to June. The principal crops are rice, millet, oil-seeds, and wheat. In addition to Karachi, there are seaports at Sirgonda and Keti Bandar, which conduct a considerable coasting trade. Tatta was the old capital of Sind. Kotri is an important railway station on the Indus. The main line of the North-Western railway runs through the district for 230 miles, with 15 stations. From Kotri downwards the line has been doubled to Karachi, and at Kotri a bridge has been constructed across the Indus opposite Haidarabad, to connect with the Rajputana railway system. (J. S. CO.)

Kara-Hissar.—1. Afiún Kara-Hissar (*q.v.*). 2. Ichje, or Ischa Kara Hissar, the ancient *Docimium*, a small village about fourteen miles north-east of No. 1. Docimium was a Macedonian colony established on an older site. It was a self-governing municipality, striking its own coins, and stood on the Apamea–Synnada–Pessinus road, by which the celebrated marble called Synnadic, Docimian, and Phrygian was conveyed to the coast. The quarries are two and a half miles from the village, and the marble was carried thence direct to Synnada (Chifút Kassaba). Some of the marble has the rich purple veins in which poets saw the blood of Atys. (Ramsay, *Hist. Geog. of Asia Minor;* Murray, *Hbk. to Asia Minor.*) 3. Kara-Hissar Sharki, *i.e.*, western Kara-Hissar, also called Shabin Kara-Hissar from the "alum" mines in its vicinity, the chief town of a sanjak of the same name in the Sivas viláyet of Asia Minor. The town (the ancient *Colonia*, Armenian *Nikopoli*), altitude 4860 feet, is built round the foot of a lofty rock, upon which stand the ruins of the Byzantine castle, Maurocastron. It is connected with its port, Kerasund, and with Sivas, Erzingan, and Erzerúm, by carriage roads. Its population is 12,000 (Moslems 7500, Christians 4500). In October 1895 there was a massacre of Armenians. Colonia was a fortress of importance during the frontier wars of the later Byzantine Empire.

Karakoram. See Pamirs.

Karakorum (Turkish, *black stone débris*), the name of two cities in Mongolia. One of these, according to Potanin, was the capital of the Uigur kingdom in the 8th century, and the other was in the 13th century a capital of the steppe monarchy of Mongolia. The same name seems also to have been applied to the Khangai range at the headwaters of the Orkhon. (1) The Uigur Karakorum, also named Mubalik (*bad town*), was situated on the left bank of the Orkhon, in the Talal-khain-dala steppe, to the south-east of Ughei-nor. It was deserted after the fall of the Uigur kingdom, and in the 10th century Abaki, the founder of the Kidan kingdom, planted on its ruins a stone bearing a description of his victories. (2) The Mongolian Karakorum was founded at the birth of the Mongolian monarchy established by Chinghiz Khan. A palace for the khan was built in it by Chinese architects in 1234, and its walls were erected in 1235. Plano Carpini visited it in 1246, Ruysbruk in 1253, and Marco Polo in 1275. Later, the fourth Mongolian king, Khubilai, left Karakorum, in order to reside at Kai-pin-fu, near Peking. When the khan Arik-bog declared himself and Karakorum independent of Khubilai-khan, the latter besieged Karakorum, took it by famine, and probably laid it waste so thoroughly that the town was afterwards forgotten. The exact sites of the two Mongolian capitals were only established in 1889–91. Yule (*The Book of Marco Polo*, 1871) was the first to distinguish two cities of this name. The Russian traveller Paderin in 1871 visited the Uigur capital, named now by the Mongols Khara-kherem (*black wall*), of which only the wall and a tower are in existence, while the streets and ruins outside the wall are seen at a distance of 1¾ miles. As to the site of the Mongolian Karakorum, the natives describe it as the ruins of Keta-khoto. The proper position of the two Karakorums was determined by the expedition of Yadrintseff in 1889, and the two expeditions of the Helsingfors Ugro-Finnish Society (1890) and the Russian Academy of Science, under Dr Radloff (1891), which were sent out to study Yadrintseff's discovery. See *Works* (*Trudy*) *of the Orkhon Expedition.* St Petersburg, 1892. (P. A. K.)

Kara-kul, Great and **Small,** two lakes of Russian Turkestan, Osh district of Fergana, on the Pamir plateau. Great Kara-kul, 14 miles long and about 13 miles wide (formerly much larger), is under 39° N., to the south of the trans-Alai range, at an altitude of 13,200 feet; it is surrounded by high mountains, and is reached from the north through the Kizil-art pass (14,560 feet). Small Kara-kul lies in the north-east Pamir, or Sarykol, to the north-west of the Mustagh-ata peak (25,800 feet), at an altitude of 12,700 feet. A stream of the same name flows through it, and is named Ghöz in its farther course. Kara-kul is also the name of an oasis on the Transcaspian railway, formerly flourishing but now nearly buried in sand.

Kara-kum (*Black Sands*), two plains, partly prairie-like and partly sandy, in Russian Central Asia. One of them occupies a surface of nearly 110,000 square miles, bounded on the N.W. by the Ust-urt plateau, on the E. by the Amu-daria, on the S. by the Turcoman oases, and on the W. nearly reaching the Caspian Sea. Only part of this surface is covered with real sand. There are also wide spaces (*takyrs*), nearly horizontal, covered with clay, upon which water accumulates in the spring; in the summer they are muddy first, but later quite dry, and merely a few Solaneæ and bushes grow on their surface. There are also *shors*, similar to the above, but covered with salt and gypsum, and adorned only with Solaneæ along their borders. The remainder is occupied with sand, which, according to V. Mainoff, takes five different forms: (1) The *barkhans*, chiefly in the east, which are mounds of loose sand, from 15 to 35 feet high, hoof-shaped, having their gently-sloping convex side turned towards the prevailing winds, and a concave side, 30° to 40° steep, on the opposite slope. They are disposed in groups or chains, and the winds make them slowly progress towards the south and south-east. Some grass (*Stipa pennata*) and bushes of *saksaul* (*Haloxylon ammodendron*), and other steppe bushes (*Calligonum, Halimodendron, Atraphaxis*, &c.), cover them. (2) Mounds of sand, of about the same size, but irregular and of a slightly stronger consistence, mostly covered with the same bushes, and also with *Artemisia* and *Tamarix;* they are chiefly met with in the east and south portion of the Kara-kums. (3) A sandy desert, slightly undulating, and covered in the spring with grass and flowers (tulips, *Rheum*, various umbellifers, &c.), which are soon burned by the sun; they cover very large spaces in the south-east. (4) Sands disposed in large waves from 50 to 70, and occasionally up to 100, feet high, at a distance of from 200 to 400 feet from each other; they cover the central portion, and their vegetation is about the same as in the preceding division. (5) The dunes on the shores of the Caspian, composed of moving sands, from 35 to 80 feet high and devoid of vegetation.

A typical feature of the Kara-kums is the number of "old beds," which may have been either beds of branches of the Amu and other rivers, or depressions which contained elongated salt lakes. (See Transcaspian Province.) Water is only found in wells, from 13 to 20 miles apart—sometimes as much as 100 and 110 miles—which are pierced in the *takyrs* and give salted water, occasionally unfit to drink, and in *kaks* or pools of rain-water retained in the lower parts of the *takyrs.* The population of the Kara-kums, consisting of nomadic Kirghiz and Turcomans, is very small. The region in the north of the Syr-daria, towards Lake Chalkar denghiz, is also called Kara-kum. (P. A. K.)

Karasu-bazar, a town of Russia, Crimea, government of Taurida, district and 28 miles east-north-east of Simpheropol. Population (1897), 12,961, consisting of Tatars, Armenians, Greeks, Karaims, Jews, and about 200 so-called Krymchaki, *i.e.*, Jews who have adopted the Tatar language and dress, who live chiefly by embroidering morocco leather goods and by other small handwork. It is a considerable centre for the export of fruit from various parts of Crimea.

Karatau, a chain of mountains in Russian Turkestan, running from the south-west extremity of the Talas Alatau (Tian Shan) in a north-west direction, for 250 miles, between the Syr-daria and the Chu, ending in 44° 15′ N. Its average altitude is about 5000 feet, and some of its summits, especially in its middle and south-east portion, reach 7000 feet. It is built up of Metamorphic slates and Devonian, Carboniferous, and Jurassic deposits, with occasional intrusions of granites and melaphyres. Its south-west slope is gentler than the opposite slope. The ridge is but poorly clothed with forests in its south-east parts, and the rivers which rise in it are short and soon lost in the sands. At its base it has a girdle of loess. Coal, lead, and iron are found.

Karateghin, a bekdom occupying a hilly part of Bokhara, on the middle course of the Vaksh or Surkhab. It has on the N. the Russian Turkestan provinces Samarkand and Fergána, from which it is separated by the Hissar and Alai ridges; Fergana on the E.; Darvaz on the S. (ridge of Peter the Great); and Hissar on the W. Its area covers about 4200 square miles, and its population numbers some 60,000. Surrounded by high mountain ridges of difficult access, it is also nearly all covered with mountains, its best part being the high valley of Surkhab (4500 to 6500 feet of altitude). The population consists chiefly of Tajiks and some 10,000 Kara-kirghiz in the east. The former carry on agriculture and gardening, and the latter cattle-breeding. Some rough stuffs, carpet-bags, and woollen goods are made in the villages. Sheepskins, furs, carpet-bags, and so on are exported. The chief town is Garm, on the Vaksh.

Karauli, or KEROWLEE, a native state of India, in the Rajputana Agency. Area 1229 square miles; population (1881), 148,670; (1891) 156,587, showing an increase of 5 per cent.; average density, 127 persons per square mile. In 1901 the population was 156,786. The revenue (1896–97) was Rs.4,67,000; no tribute. The maharaja, Bhanwar Pal Deo, was born in 1862 and succeeded in 1866. He was appointed G.C.I.E. in 1897, on the occasion of Queen Victoria's Diamond Jubilee. In 1897–98 coins to the value of Rs.25,060 were struck at the mint. On the reverse they bear the title "Kaisar-i-Hind" in Persian characters. The town of KARAULI has a population (1881) of 25,607; (1891), 23,124. Its schools had 198 pupils in 1897–98, of whom 39 were learning English.

Karen-ni, the country of the Red Karens, a collection of small states, formerly independent, but now feudatories of Burma. It is situated approximately between 18° 50′ and 19° 55′ N. and between 97° 10′ and 97° 50′ E. The tract is bounded on the N. by the Shan States of Möng Pai, Hsatung, and Mawkmai; on the E. by Siam; on the S. by the Papun district of Lower Burma; and on the W. a stretch of mountainous country, inhabited by the Brè and various other small tribes, formerly in a state of independence, divides it from the districts of Tungu and Yamèthin. It is divided in a general way into eastern and western Karen-ni; the former consisting of one state, Gantarawadi, with an approximate area of 2500 square miles; the latter of the four small states of Kyèbogyi, with an area of about 350 square miles; Bawlâkè, with an area of 200 square miles; Nammèkôn, with 50 square miles; and Naungpalè, with about 30 square miles. The small states of western Karen-ni were formerly all subject to Bawlâkè, but the subordination had for long been becoming less and less defined, and has now ceased. There was also a small state in the hills west of the Pawn stream, called Saohpayun, containing six villages, with a chief in charge of them. The state of Ngwedaung, called Loi Ngün by the Shans, is now also subordinate to Gantarawadi. Karen-ni consists of two widely differing tracts of country, which roughly mark now, and formerly actually did mark, the division into east and west. Gantarawadi has, however, encroached westwards beyond the boundaries which nature would assign to it. The first of these two divisions is the southern portion of the valley of the Hpilu, or Balu stream, an open, fairly level plain, well watered and in some parts swampy. The eastern half consists of the Loikaw and Ngwedaung circles of Gantarawadi, and the western of the Nammèkôn and Naungpalè states. South of this valley and between the Nam Pawn and its principal tributary, the Tu, lies a stretch of downs, having no overground drainage, undulating and exceedingly dry, though in parts fertile. On its eastern side are two or three small lakes, tinged by the soil to a permanent brick red. On the western side, in Kyèbogyi state, are a few small streams, which in April and May almost entirely dry up and only just suffice for the wants of the villages. The second division is a series of chains of hills, intersected by deep valleys, through which run the two main rivers, the Salween and the Pawn, and their feeder streams. Many of the latter are dried up in the hot season and only flow freely during the rains. Here there are small, level, watered valleys, as at Mèsè, Man Maü (Ywathit), Hsataw, and Sawlôn, but for the most part the country is precipitous and the soil arid. The whole country being hilly, the most conspicuous ridge is that lying between the Pawn and the Salween, which has an average altitude of 5000 feet. It is crossed by several tracks, passable for pack-animals, the most in use being the road between Sawlôn, the capital of Gantarawadi and Man Maü. The principal peak east of the Salween is on the Loi Lan ridge, 7109 feet above mean sea-level. Parts of this ridge form the boundary between eastern Karen-ni and Mawkmai on the west and Siam on the east. It falls away rapidly to the south, and at Pang Salang is crossed at a height of 2200 feet by the road from Hsataw to Mèhawnghsawn. West of the Balu valley the continuation of the eastern rim of the Myelat plateau rises in Loi Nangpa to about 5000 feet. The Nam Pawn is a large river, with an average breadth of 100 yards, but is unnavigable owing to its rocky bed. Even timber cannot be floated down it without the assistance of elephants. The Salween throughout Karen-ni is navigated by large native craft. Its tributary, the Mè Pai, on the eastern bank, is navigable as far as Mèhawnghsawn in Siamese territory. The Balu stream flows out of the Inle lake, and is navigable from that point to close on Lawpita, where it sinks into the ground in a marsh or succession of funnel holes. Its breadth averages 50 yards and its depth is 15 feet in some places.

Little of the history of the Red Karens is known, but it appears to be generally admitted that Bawlâkè was originally the chief state of the whole country, east and west, but eastern Karen-ni under Papaw-gyi early became the most powerful. Slaving raids far into the Shan States brought on invasions from Burma, which, however, were not too successful. Eastern Karen-ni was never reduced until Sawlapaw, having defied the British Government, was overcome and deposed by General Collett in the beginning of 1889. Sawlawi was then appointed Myoza, and received a *sanad* or patent of appointment on the same terms as the chiefs of the Shan States. The independence of the western Karen-ni states had been guaranteed by the British Government in a treaty with King Mindôn in 1875. They were, however, formally recognized as feudatories in 1892 and were presented with *sanads* on the 23rd January of that year. Gantarawadi pays a regular tribute of Rs.5000 yearly, whereas these chieflets pay an annual *kadaw* or *nuzzur* of Rs.100. They are forbidden to carry out a sentence of death passed on a criminal, without the sanction of the superintendent of the southern Shan States, but otherwise retain nearly all their customary law.

Tin, or what is called tin, is worked in Bawlâkè. It appears, however, to be very impure. It is worked intermittently by white Karens on the upper waters of the Hkèmapyu stream. Rubies, spinels, and other stones are found in the upper Tu valley and in the west of Nammèkôn state, but they are of inferior quality. The trade in teak is the chief or only source of wealth in Karen-ni. The largest and most important forests are those on the left bank of the Salween. Others lie on both banks of the Nam Pawn, and in western Karen-ni on the Nam Tu. The yearly out-turn is estimated at over 20,000 logs, and forest officers have estimated that an annual out-turn of 9000 logs might be kept up without injury to the forests. Some quantity of cutch is exported, as also stick-lac, which the Red Karens graft so as to foster the production. Other valuable forest produce exists, but is not exported. Rice, areca-palms and betel-vine leaf are the chief agricultural products. The Red Karen women weave their own and their husbands' clothing. A characteristic manufacture is the *Pa-si* or Karen metal drum, which is made at Ngwedaung. These drums are from two and a half to three feet across the boss, with sides of about the same depth. The sound is out of proportion to the metal used, and is inferior to that of the Shan and Burmese gongs. It is thought that the population of Karen-ni is steadily decreasing. The estimated totals in 1897 were Gantarawadi, 23,000; Kyèbogyi, 4400; Bawlâkè, 4500; Nammèkôn, 3500; Naungpalè, 1750. The birth-rate of the people is considered to exceed the death-rate by very little, and the Red Karen habit of life is most unwholesome. They are short and small-made, but have great powers of endurance. Numbers have enlisted in the Burma police, but there are various opinions as to their value. (J. G. SC.)

Karlsburg. See GYULA FEHÉRVÁR.

Karnál, a town and district of British India, in the Delhi division of the Punjab. The town is 7 miles from the right bank of the Jumna; railway station, 76 miles north of Delhi. Population (1881), 23,133; (1891), 21,963; municipal income (1897–98), Rs.31,234; death-rate (1897), 37 per 1000. There are manufactures of cotton cloth, blankets, and boots, besides considerable local trade and an annual horse fair. There is a municipal high school, with boarding-house, a printing-press, and four literary institutions. The district of KARNÁL stretches along the right or west bank of the Jumna, north of Delhi. It includes the historic sites of Panipat and Thanesar. Area, 2440 square miles; population (1881), 645,219; (1891), 683,718, showing an increase of 6 per cent.; average density, 280 persons per square mile. In 1901 the population was 883,457, showing an increase of 29 per cent., probably due to the extension of canal irrigation. The land revenue and rates (1897–98) were Rs.9,57,734, the incidence of assessment being 8 annas per acre; cultivated area, 449,621 acres, of which 289,356 were irrigated, including 169,083 from Government canals; number of police, 555; number of schools (1896–97), 155, attended by 4185 boys, being 6·7 per cent. of boys of school-going age; death-rate (1897), 40·8 per 1000. The principal crops are millet, wheat, pulse, rice, cotton, and sugar-cane. There are two factories for ginning and pressing cotton. The district is traversed for 74 miles by the Delhi–Umballa–Kalka railway, and also by the Western Jumna canal. It suffered from the famine of 1896–97, when the maximum number of persons on relief was 12,361 in March 1897; and again to some extent in 1899–1900.

Karnul, or KURNOOL, a town and district of British India, in the Madras Presidency. The town is at the confluence of the Hindri river with the Tungabhadra. Population (1881), 20,329; (1891), 24,376; municipal income (1897–98), Rs.68,110. The water-supply was provided at a cost of Rs.1,50,000. The municipal high school had 137 pupils in 1897. The district of KARNUL has an area of 7514 square miles; population (1881), 678,551; (1891), 817,811, showing an increase of 21 per cent. after the famine of 1876–77; average density, 109 persons per square mile, being the lowest in the province. In 1901 the population was 872,423, showing a further increase of 6 per cent. The land revenue and rates (1897–98) were Rs.19,54,404, the incidence of assessment being R.1 per acre; cultivated area, 1,835,560 acres, of which 89,313 were irrigated, including 23,307 from Government canals; number of police 1071; boys at school (1896–97), 11,775, being 19 per cent. of the male population of school-going age; registered death-rate (1897), 28·8 per 1000. The principal crops are millet, cotton, oil-seeds, and rice, with a little indigo and tobacco. Karnul suffered very severely from the famine of 1876–77, and to a slight extent in 1896–97. It is traversed by the branch of the Southern Mahratta railway from Guntakal to Cumbum. It is also the chief scene of the operations of the Madras Irrigation Company, taken over by Government in 1882. The canal, which starts from the Tungabhadra river near Karnul town, was constructed at a total cost of Rs.2,16,38,942. In 1897–98 the irrigated area was 46,402 acres; and the receipts were Rs.1,56,220, compared with an expenditure (including interest) of Rs.9,92,570. A more successful work is the Cumbum tank, formed under native rule by damming a gorge of the Gundlakamma river. In 1897–98 the irrigated area was 8192 acres; and the return on capital outlay was 9 per cent. Apart from the weaving of coarse cotton cloth, the chief industries are 3 cotton presses, 167 indigo vats, and 21 saltpetre refineries.

Karolinenthal (Czech, *Karlín*), the chief town of a government district in Bohemia, Austria, and a manufacturing suburb of Prague, in which it is now practically merged. Population (1890), 19,540; (1900), 21,094, chiefly Czech.

Karolyi Aloys, COUNT (1825–1899), Austrian diplomatist, was born 8th August 1825. He sprang from a noble Magyar family which can trace its genealogy to the time of the foundation of the monarchy. After holding various inferior diplomatic appointments, he was in 1860 appointed envoy at Berlin. This post he held till the outbreak of war in 1866, and it was his duty to conduct the lengthy and complicated negotiations regarding Schleswig-Holstein, first during the co-operation of the two Great Powers, and afterwards when the final rupture was approaching. The story is well known how at the beginning of 1865 he was instructed categorically to ask Bismarck whether Prussia proposed to violate the treaty of Gastein. "No," answered Bismarck, but continued, "If we did intend to do so, I should give the same answer." It was a tribute to the ability he had shown in a very difficult position that he was chosen to negotiate with Bismarck the treaty of Nikolsburg, and when after 1870 thoroughly friendly relations were re-established between the two German powers, he returned with the rank of ambassador to his old post. He was one of the Austrian representatives at the Congress of Berlin in 1878. In the next year he was transferred to London, where he remained till the year 1888, when he retired, owing to ill-health. It was to him that in 1880 Mr Gladstone addressed an apology for the unfriendly expressions regarding Austria-Hungary which he had used in his Midlothian campaign of that year. Karolyi died suddenly, while out shooting in Hungary, on 20th December 1889.

Karpathians. See CARPATHIAN.

Karr, Jean Baptiste Alphonse (1808–1890), French novelist, was born in Paris, 24th November 1808, and after being educated at the Collège Bourbon, became a teacher there. In 1832 he published a novel, *Sous les tilleuls,* characterized by an attractive originality and a delightful freshness of personal sentiment. A second novel, *Une heure trop tard,* followed next year, and was succeeded regularly by many others, which speedily made Karr a public favourite. His *Vendredi Soir* (1835) and *Le chemin le plus court* (1836) continued the vein of autobiographical romance with which he had made his first success. *Geneviève* (1838) is one of his best stories, and his *Voyage autour de mon jardin* (1845), was deservedly popular. Others were *Feu Bressier* (1848), and *Forte en thème* (1853), which had some influence in stimulating educational reform. In 1839 Alphonse Karr, who was essentially a brilliant journalist, became editor of *Le Figaro,* to which he had been a constant contributor; and he also started a monthly journal, *Les Guêpes,* of a keenly satirical tone, a publication which brought him the reputation of a somewhat bitter wit. In 1848 he founded *Le Journal.* In 1855 he went to live at Nice, where he indulged his predilections for floriculture, and gave his name to more than one new variety. He was also devoted to fishing, and in *Les Soirées de Sainte-Adresse* (1853) and *Au bord de la mer* (1860) he made use of his experiences. His reminiscences, *Livre de bord,* were published in 1879–80. He died at Nice, 30th September 1890.

Karsandas Mulji (1832–1875), native journalist and social reformer of western India, was born on 25th of July 1832, of parents belonging to the Bania caste. Having lost his mother in infancy, he was left to the care of his stepmother, whose relations with Karsandas were not very affectionate. He received an ordinary Gujrathi education and then joined the Elphinstone Institution to study English. He competed for a prize offered for an essay on the re-marriage of Hindu widows, but his parents were so shocked at the lad's earnest advocacy of this reform that they turned him out of the house. He had to stop his collegiate education, and starvation stared him in the face. At last he succeeded in getting a teachership at the Gokuldas Tejpal seminary, thus attaining a position in which he could freely express his views on social reform. To promote this end he also co-operated with some benevolent men of Bombay, prominent among whom was Raghunathdas Madhowdas, J.P., who set a practical example by marrying a widow himself. They started two weekly papers, *The Rast Goftar* and *The Satyaprakash,* to influence public opinion. The part Karsandas took in the controversy that ensued was the chief work of his life. When the American Civil War gave an impetus to the cotton trade of Bombay in 1864, Karsandas was sent to England by a firm in Bombay as their agent, but this new movement did not thrive long. On his return in 1874 he was met by persecution from his caste people. The Governor, Sir Bartle Frere, who had a high opinion of him, appointed him to administer the native state of Limree during the minority of the chief. He held that office till his death in 1875.

Karsandas Mulji's title to the memory of his co-religionists rests on his work as editor of *The Satyaprakash*, out of which the notorious "Maharaja" libel case arose. The hereditary chief priests of the Vaishnava community of Bombay are called Maharajas. They are descendants of the religious teacher Vallabhacharya (born in Champaran in Samvat 1535, A.D. 1479), and are like him believed to be incarnations of the god Krishna. Karsandas began about 1857 to denounce their avarice and immorality. The Maharajas tried in vain to silence the newspaper by threats of excommunication, and in order to avoid publicity, urged the passing of an Act to exempt them from personal attendance in courts of justice. After some years of religious polemics regarding female education and widow re-marriage, one Maharaja Jadunathji Brijratanji, in May 1861, filed an action for a libel contained in an article dated the 21st October 1860, in which Karsandas replied to the charge of heresy made by the Maharajas in their monthly magazine. Karsandas pleaded not guilty, and also justification, urging that the plaintiff and the other Maharajas carried into practice the carnal knowledge of female worshippers which is inculcated in the religious works explaining the Pushtimarga rule of life, and exalted by the Vallabhacharya sect into a new creed. At a meeting of the Bhattia caste, on the 6th September 1861, in order to suppress evidence of notorious immoralities, it was resolved that no one should bear witness against the plaintiff under the penalty of excommunication. The undaunted Karsandas thereupon charged the instigators of this resolution with conspiracy to defeat justice, and on conviction some of them were heavily fined. The trial of the libel case began in the Supreme Court on the 26th January 1862, and, after a lengthy hearing before Chief Justice Sir Mathew Sausse and Mr Justice Sir Joseph Arnould, the plaintiff was awarded nominal damages on the plea of not guilty, but both judges found that the charges of immoral dealings made by Karsandas were proved to be true. The Chief Justice held, nevertheless, that Karsandas had no right to publish them ; but Sir Joseph Arnould was of the contrary opinion (on the authority of *Harrison* v. *Bush*, 5 Ellis and Blackburn), holding that as a Vallabhacharyan addressing his co-sectaries, and as a Banian addressing his caste fellows, he had a right, and as a journalist addressing readers composed principally of followers of the Maharajas, he had a duty to attack their misdeeds ; for if such evils were to exist for ever without public animadversion, one of the great uses of a free press would be at an end. The result of the trial was a great victory for the reformers in the Vaishnava community. (For the dogma and history of the Vallabhacharyan religion, and details of the trial in the Supreme Court, see *History of the Sect of Maharajas or Vallabhacharyas of Western India.* London, Trübner and Co., 1865.)

(N. B. W.)

Karwar, or CARWAR, a town of British India, administrative headquarters of North Kanara district in Bombay; on the sea-coast 295 miles south of Bombay city. Population (1881), 13,761; (1891), 14,579. Its commercial importance has declined since the opening of the Southern Mahratta railway system. There is a high school, with 279 pupils in 1896–97; and two printing-presses, issuing one vernacular newspaper.

Kashan, a small province of Persia, situated between Isfahán and Kum. It is divided into the two districts Germsir, the "warm," and Sardsir, the "cold," the former with the city of Kashan in the plains, the latter in the hills. It has a population of 75,000 to 80,000, and pays a yearly revenue of about £18,000. KASHAN (Cashan) is the provincial capital, in 34° 0′ N. and 51° 27′ E., at an elevation of 3190 feet, 150 miles from Tehran; population, 25,000 to 30,000, comprising a few hundred Jews occupied as silk-winders, and a few Zoroastrians engaged in trade. Great quantities of silk stuffs, from raw material imported from Gilán, and copper utensils are manufactured at Kashan and sent to all parts of Persia. Kashan also exports rose-water made in some villages in the hilly district about 20 miles from the city, and is the only place in Persia where cobalt can be obtained, from the mine at Kamsar, 19 miles to the south.

Kashinath Trimbak Telang (1850–1893), a puisne judge of the High Court, Bombay, was born at Bombay on 30th August 1850. By profession an advocate of the High Court, he was also a brilliant Sanskrit scholar. He took besides a vigorous share in literary, social, municipal and political work, as well as in the affairs of the University of Bombay, over which he presided as vice-chancellor from 1892 till his death. He was held in high esteem by Europeans in India, and his career is cherished by the native community as an example of varied eminence, attained by personal merits on the soil of India itself, circumstances having prevented him from ever visiting Europe. Telang grew up in a patriarchal family of Gaud Saraswat Brahmins, who derived their origin from Goa. He was the second son of Bapu, but was adopted by his uncle. At the age of five he was sent to the Amarchaud Wadi vernacular school, and in 1859 entered the high school in Bombay which bears the name of Mountstuart Elphinstone. Here he came under the influence of Narayan Mahadev Purmanand, a teacher of fine intellect and force of character, afterwards one of Telang's most intimate friends. From this school he passed to the Elphinstone College, of which he became a fellow, and after taking the degree of M.A. and LL.B., decided to follow the example of Bal Mangesh Wagle, the first Indian admitted by the judges to practise on the original side of the High Court, a position more like the status of a barrister than a vakil or pleader. He passed the examination and was enrolled in 1872. His learning and other gifts soon brought him an extensive practice. He had complete command of the English language, and his intimacy with Sanskrit enabled him to study and quote the Hindu law-books with an ease not readily attained by European counsel. Mr Telang, finding his career assured, declined an offer of official employment. But in 1889 he accepted a seat on the High Court Bench, where his judgments are recognized as authoritative, especially on the Hindu law. He was syndic of the university from 1881, and vice-chancellor from 1892 till his death. In that year also he was elected president of the local branch of the Royal Asiatic Society. These two offices had never been held by a native of India before. His intimacy with Dr Wordsworth when at the Elphinstone College, his experience as professor of law, joined with his keen intellect and never-ceasing study, fitted Telang for the influential part he was called to take in many educational matters where both European methods and Oriental sentiments had to be considered. The decoration of C.I.E. conferred on him in 1882 was a recognition of his services as a member of a mixed commission appointed by the Government to deal with the educational system of the whole of India. He was nominated to the local legislative council in 1884, but declined a similar position on the Viceroy's council. Along with Mr P. M. Metha, he was the originator of the Bombay Presidency Association. When a student he had won the Bhugwandas scholarship in Sanskrit, and in this language his later studies were profound. His translation of the *Bhagwadgita* into English prose and verse is a standard work; and he criticized Professor Weber's hypothesis that the story of the *Ramayana* was influenced by the Homeric epics. While devoted to the sacred classics of the Hindus, Telang did not neglect his own vernacular, Mahratti literature being enriched by his translation of Lessing's *Nathan the Wise,* and an essay on *Social Compromise.* Mr Telang married a lady of the Kanvindé family, and left two sons and three daughters. Learned, judicial, and amiable, Telang was in his social life, like many other Brahmins, a man of plain living and high thinking. He spoke, wrote, and worked consistently for social reform, the elevation of women, the permission to widows to remarry, female education, and so forth. He died at Bombay, 1st September 1893.

(N. B. W.)

Kashmir.—Since 1880 the Kashmir Durbar has resumed its authority over those outlying provinces stretching to the north-west, the administrative responsibility for which had been inherited by the Dogras from the Sikhs. The centre of these trans-Indus provinces is Gilgit, on the river of that name which joins the Indus where it takes its great bend to the south-west ere breaking through the Himalaya to the Peshawar plain. Kashmir had never loosed its hold on Gilgit, but Gilgit had never paid Kashmir tribute; so that the hold in 1885 was weak, and Kashmir authority, in some parts of the Gilgit basin, was set at naught. Kashmir suzerainty was even disputed by China. The late history of Kashmir consequently largely centres in the story of the establishment of the Gilgit Agency (in March 1889) and those subsequent events which hinged upon it, including expeditions to Chitral and the conquest of the valley of Hunza. Much of this, together with a general account of the geographical conformation and ethnology of the Gilgit province, will be found elsewhere (see GILGIT). Much has happened in the chequered history of the valley of Kashmir (that land of enchantment—the only land which never disappoints expectations) which requires a brief record. In September 1885 the Maharaja Sir Pratáp Singh, G.C.S.I., succeeded his father Zanbir Singh, and at once inaugurated a series of most useful reforms. There is no longer a British officer on "special duty" in Kashmir, but a Resident who resides at Srinagar and Jammu, and who permanently represents the British Government in the Durbar. The political influence thus established reaches by proxy to Kashgar, to Leh (the capital of Ladakh), to Gilgit, and Chitral. The Resident at Srinagar is the warden of British India on the north. With the establishment of the Residency there has been an increase in the number of English visitors yearly, and a certain amount of British settlement in the country. The hill station of Gulmurg, in one of the glades on the northern slopes of the Pir Panjal, has sprung into existence. Here the construction of temporary residences is permitted by the Maharaja, and the European visitors to Srinagar follow the Resident in his summer migration to the hills. Round about Lake Dal there is already a scattering of pretty English villas, and the cultivation of fruit, hops, and vines has advanced beyond the experimental stages of 1890. A syndicate has been formed for the exploitation and working of the mineral wealth of the country, and a railway will place Srinagar in direct connexion with the Punjab. Meanwhile an immense improvement in the matter of roads has been effected. A good cart road now connects Murree with Baramulla, and Baramulla with Srinagar; and the transit by tonga over this road, with regular stages at intervals, is a delightful experience compared with the old wearisome monotony of daily marches. The distances from point to point of the route are as follows:—From the rail-head at Rawal Pindi to Murree is a drive of 40 miles—all uphill. From Murree to Kohála (where the Jhelum is bridged) is a downhill journey of 20 miles. Then, following the left bank of the Jhelum closely, there are 90 miles of road to Baramulla. From Baramulla to Srinagar a driving road of about 35 miles in length now supersedes the old boat journey through the Wulur lake by the Jhelum, although it can hardly afford the attraction of the placid, if somewhat indolent, method of drifting to the capital amidst the ever-varying scenery of the most beautiful country in the East. From Bandipur, on the northern edge of the Wulur, an excellent road now leads to Gilgit across the Tragbal pass, rising from 5200 feet in the valley to 11,400 feet on the pass, and falling again into the sweet valley of Gurais before surmounting the Burzil (13,500 feet) and striking the Astor valley, which it follows to its junction with the Indus near Bunji. At Bunji the river is bridged. Here the height above sea-level is little over 4000 feet, and there is a comparatively gentle rise to Gilgit (4400 feet), although the road climbs over many a spur and skirts many a precipice in its course. Gilgit is by this route about 400 miles from the railway at Rawal Pindi. A route to Leh, which has been developed for trade purposes, now follows the Sind valley to its head under the Soji La (11,300), and then crosses the elevated Dras plateau to the Indus. This is the great trade artery of Kashmir and Tibet. The improvement in these main lines of communication, together with the introduction of telegraphs, has doubtless developed a certain amount of internal traffic; but it is a curious feature of this general commercial advance that the trade with Tibet has rather diminished than increased in value. The general increase in Kashmir trade may be gathered from the following statistics:—In 1892–93 the value of the exports (exclusive of treasure) was Rx.533,309, and the imports Rx.486,825. In the year 1896–97 the exports amounted to Rx.759,740, and the imports to Rx.702,842.

But undoubtedly the most beneficial measure introduced by the administration within late years was the land settlement in the Kashmir valley and the inauguration of an equitable assessment of property and crops. In the year 1887 the people were still in a condition of serfdom, with no rights and no power to represent their grievances. They were forced to labour and to sow, and others gathered the increase. Cultivation was bad, and the revenue was not paid. The character of the people, timid yet persistent, degraded yet intellectual, was the direct result of evil administration. Forced labour was imposed by local officialdom, and no heart was left in the labourers. Yet with the persistency of their forefathers, who had survived the despotism of Pathan, Moghul, Sikh, and Dogra, the Kashmiris clung to their land and their traditions; and they probably represent to this day a people historically older than any to be found in northern India still associated with the land of their ancestors. Remembering the beauty and the fertility of the vale of Kashmir, this is perhaps not so surprising as it would otherwise seem. There is but little crime amongst these people. They are a law-abiding race, as they were under their Hindu kings. Successive dynasties have left no impress on their national character. They are to-day what they were thousands of years ago. And at last the land settlement has brought a good measure of prosperity and contentment amongst them.

The revenues collected from the valley of Kashmir in 1880–89 amounted to—Land revenue, Rx.123,126, other sources, Rx.55,312; in 1893–94, land revenue, Rx.147,984, other sources, Rx.91,527. The valley comprises three districts (Khas, Anantnag, and Sopur) with eleven *tehsils*, independently of the districts of Mozafarabad, Gilgit, and Astor, and is under the executive charge of the Governor of Kashmir (the Hakim-i-Ala). Ladakh and Skardu are under the Governor of Jammu. In 1835 the population of the valley did not exceed 200,000, to which it had been reduced from 800,000 in twenty years by oppression, earthquake, pestilence, and famine. In 1866 a census (the accuracy of which, however, is doubtful) gave a population of 112,715. In 1873 another census returned the total population of the valley at rather under 500,000. Later, but before the famine, they were computed at 400,000. In 1877–79 there occurred the terrible scourge of famine, and the mortality which ensued has never been fully estimated. It seems probable that 67,000 people died in the city (rather more than half of its inhabitants) and 175,000 in the villages (or about three-fifths of the population). A number of the chief valleys of the north were entirely deserted—whole villages lay in ruins, some suburbs of the city were tenantless, the city itself half destroyed, the graveyards were filled to overflowing, the river had been full of corpses thrown into it. In 1891 the population of the valley was 814,000, of whom 119,000 lived in Srinagar. Ninety-three per cent. of the people were Mahommedans, and the rest chiefly Hindus. In 1901 the population of the state of Kashmir numbered 1,157,759, of whom 122,536 were in Srinagar. The 1901 census gives for Jammu, Kashmir, Malakand, Chitral, and the neighbouring frontier states a total population of 2,906,173, as compared with 2,543,952 in 1891.

But the terrible famine of 1877–79 is not the only calamity to be recorded in the last quarter of the 19th century. In 1885 an earthquake occurred of long duration, which occasioned great loss of life. Three thousand five hundred people are believed to have perished. The most violent shocks were felt in an elliptical area whose focuses were Srinagar and Baramulla. The earthquake commenced on 30th May, and shocks were felt up to 16th August. Villages were destroyed and panic was universal. Old water springs disappeared and landslips occurred frequently. Large earth fissures appeared about Baramulla and Patan.

In 1892 between 11,000 and 12,000 persons died of cholera in the Kashmir valley, and the horror and demoralization of that terrible visitation are still vivid in the minds of the people. Villages were deserted, cultivation was abandoned, and business entirely stopped. Men would not lend money, and in the villages the people would sit all day long about the graveyards, absolutely silent. The long lines of coffins borne to the burial-grounds resembled an endless regiment on the march, while on the river a sad procession of boats floated down to the burning ghats, and living passengers in other boats passed by with averted faces.

Truly, if Kashmir is the land of Oriental ideal around which have been woven endless tales in prose and song—a theme for romance, offering wide fields for revels of imagination or for the exercise of vivid description—it is a land of calamity also; a land of grim, gray catastrophe and horror, such as is hardly known in countries less fair. But a brighter dawn has already broken, and the chequered light and shadow of her late history are rapidly yielding to the broad day of contentment and prosperity.

See Drew. *Jammu and Kashmir.*—Laurence, W. R. *The Valley of Kashmir*, London, 1895.—Durand, Col. A. *The Making of a Frontier*, London, 1899.—Lydekker, R. "The Geology of the Kashmir and Chamba Territories," *Records of the Geological Survey of India.*

(T. H. H*.)

Kasimoff, a district town of Russia, government and 90 miles east-north-east of Ryazañ, on Oka river. The population in 1897 was 13,500, of whom about 1000 are Tatars (about 5000 in the district). It is a wealthy town, well provided with educational institutions, and famed for its tanneries and leather goods, sheepskins and bells, these trades giving occupation to nearly 4000 persons. It was founded in 1152. In the 15th century it became the capital of a Tatar khanate, vassal to and patronized by Moscow, as a rival to Kazan, and contains interesting antiquities.

See Veliaminoff-Zernoff's *The Kasimoff's Tsars.* St Petersburg, 1863–77.

Kassa (*Kaschau*), a municipal town of Hungary, capital of the county of Abauj-Torna. Formerly the chief town of Upper Hungary, it is still in respect of industry, commerce, and traffic the centre of the north-eastern part of the country. Its most important manufactures are tobacco, machinery, iron, furniture, and textiles; there are many steam mills. Population (1890), 28,884; (1900), 40,101.

Kastamúni, or Kastambúl.—1. A viláyet of Asia Minor which includes Paphlagonia and parts of Pontus and Galatia. It is divided into four sanjaks—Kastamúni, Boli, Changra, and Sinope—is rich in mineral wealth, and has many mineral springs and extensive forests. Its population comprises 1,000,000 Moslems and 30,000 Christians. 2. The capital of the above, the ancient *Castamon*, altitude 2500 feet, situated in the narrow valley of the Geuk Irmak (*Amnias*), and connected by a carriage road, 54 miles, with its port Ineboli on the Black Sea. The town is noted for its copper utensils, and it has a large trade in mohair. The climate, though subject to extremes of heat and cold, is healthy; in winter the roads are often closed by snow. The population of 17,000 includes 2900 Christians. Castamon, an important city in later Byzantine times, was taken by the Danishmand Emirs of Sivas early in the twelfth century.

Katha, a district in the northern division of Upper Burma, with an approximate area of 7000 square miles, 3000 of which consist of the former separate state of Wuntho. It is bounded on the N. by the Upper Chindwin, Bhamo, and Myitkyina districts, on the E. by the Kaukkwe river as far as the Irrawaddy, thence east of the Irrawaddy by the Shan State of Möna Mit (Momeik), and by the Shweli river, on the S. by the ruby mines district and Shwebo, and on the W. by the Upper Chindwin district. There are three ranges of hills running through the district, known as the Minwun, Gangaw, and Mangin ranges. They separate the three main rivers—the Irrawaddy, the Mēza, and the Mu. The Minwun range runs from north to south, and forms for a considerable part of its length the dividing line between the Katha district proper and what formerly was the Wuntho state. Its average altitude is between 1500 and 2000 feet. The Gangaw range runs from the north of the district for a considerable portion of its length close to and down the right bank of the Irrawaddy as far as Tigyaing, where the Myatheindan pagoda gives its name to the last point. Its highest point is 4400 feet, but the average is between 1500 and 2000 feet. The Katha branch of the railway crosses it at Petsut, a small village 12 miles west of Katha town. The Mangin range runs through Wuntho. Its highest peak, Maingthôn, attains an altitude of 5450 feet.

Gold, copper, iron, and lead are found in considerable quantities in the district. The Kyaukpazat gold mines, worked by an English company, give good returns. The iron, copper, and lead are not now worked. Jade and soapstone also exist, and salt is produced from brine wells. There are three forest reserves in Katha—the Upper Mèza range with 234 square miles, the Lower Mèza range with 188 square miles, and the Irrawaddy range, which is under process of constitution. The population according to the census of 1891 was as follows:—Europeans and Eurasians, 78; other mixed classes, 1400; Hindus, 500; Mahommedans, Burmese, Shans, and Kadus, 105,796; aboriginal races, mainly Kachins, 3814—a total of 111,588; and in 1901, 176,514, of whom 86,790 were males and 89,724 females. The number of Shans is about half that of Burmese, and of Kadus half that of Shans. The Shans are mostly in the Wuntho subdivision. Rice is the chief crop in the plains, tea, cotton, sesamum, and hill rice in the hills. The valley of the Mèza, which is very malarious, was used as a convict settlement in Burmese times. The district was first occupied by British troops, but it was not finally quieted till 1890, when the Wuntho Sawbwa was deposed and his state incorporated in the Katha district.

Katha, the headquarters of the district, contained 486 houses in 1897. The principal public buildings are the courthouse, jail, hospital, bazaar, telegraph and post offices, military and civil police lines, railway station and wood depôt, dâk bungalow and public works department offices. The principal means of communication are the Irrawaddy Flotilla steamers, which run between Mandalay and Bhamo, and the railway which communicates with Sagany to the south and Myitkyina to the north. A ferry-boat plies between Katha and Bhamo. (J. G. Sc.)

Kathiawar, or Kattywar, a peninsula of India, within the Gujarat division of Bombay, giving its name to a political agency. Total area, about 23,300 square miles; population, 3,000,000. These figures include a portion of the British district of Ahmedabad, a portion of the state of Baroda, and the small Portuguese settlement of Diu. The political agency of Kathiawar has an area of 20,559 square miles; population (1881), 2,343,899; (1891), 2,752,404, showing an increase of 17 per cent.; average density, 134 persons per square mile. In 1901 the population was 2,327,456, showing a decrease of 15 per cent., due to the results of famine. The estimated gross revenue was Rs.1,98,19,520; total tribute, Rs.11,35,000.

There are altogether 188 states of varying size and importance, of which 14 exercise independent jurisdiction, while the rest are more or less under British administration. Most of them pay tribute to the British Government, the Gaekwar of Baroda, or the Nawab of Junagarh; but the tribute is always collected by British officials. The seven states of the first class are Junagarh, Nawanagar, Bhaunagar, Porbandar, Dhrangadra, Morvi, and Gondal. The headquarters of the political agent are at Rajkot, in the centre of the peninsula, where also is the Rajkumar College, for the education of the sons of the chiefs. There is a similar school for *girasias*, or chiefs of lower rank, at Gondal. In 1897–98 the total number of schools was 1334, with 85,569 pupils, being 3·1 per cent. of the population, compared with 2.4 per cent. for the whole of Bombay. An excellent system of metre-gauge railways has been provided at the cost of the leading states. Maritime trade is also very active, the chief ports being Porbandar, Mangrol, and Verawal. In 1897–98 the sea-borne exports were valued at Rs.2,01,06,931, and the imports at Rs.2,39,31,523. The progressive prosperity of Kathiawar received a shock from the famine of 1899–1900, which was felt everywhere with extreme severity. The monsoon again failed in 1901.

Katkoff, Michael Nikiforovitch (1818–1887), Russian journalist, was born in Moscow in 1818. On finishing his course at the university he devoted himself to literature and philosophy, and showed so little individuality that during the reign of Nicholas I. he never once came into disagreeable contact with the authorities. With the Liberal reaction and strong reform movement which characterized the earlier years of Alexander II.'s reign (1855–81) he thoroughly sympathized, and for some time he warmly advocated the introduction of liberal institutions of the British type, but when he perceived that the agitation was assuming a Socialistic and Nihilist tinge, and that in some quarters of the Liberal camp indulgence was being shown to Polish national aspirations, he gradually modified his attitude until he came to be regarded by the Liberals as a renegade. At the beginning of 1863 he assumed the management and editorship of the *Moscow Gazette*, and he retained that position till his death in 1887. During these twenty-four years he exercised considerable influence on public opinion and even on the Government, by representing with great ability the moderately Conservative spirit of Moscow in opposition to the occasionally ultra-Liberal and always cosmopolitan spirit of St Petersburg. With the Slavophils he agreed in advocating the extension of Russian influence in south-eastern Europe, but he carefully kept aloof from them and condemned their archæological and ecclesiastical sentimentality. Though generally temperate in his views, he was extremely incisive and often violent in his modes of expressing them, so that he made many enemies and sometimes incurred the displeasure of the press-censure and the ministers, against which he was more than once protected by the emperor Alexander III. in consideration of his able advocacy of national interests. His frequent changes of opinion are now forgotten, and he is remembered chiefly as an energetic opponent of

Polish national aspirations, of extreme Liberalism, of the system of public instruction based on natural science, and of German political influence. In this last capacity he helped to prepare the way for the Franco-Russian alliance. (D. M. W.)

Katrine, Loch, a Scottish lake, lying between Stirling and Perth shires, 364 feet above the sea. It has an area of about 4000 acres, and a maximum depth of 78 fathoms. Glengyle water and nearly fifty rivulets feed it, and it is drained by Achray water and by the tunnels of the Glasgow waterworks. Since 1859 it has been the principal source of the water-supply of Glasgow, and the surface has been raised 5 feet in order to increase the capacity, which, along with that of Loch Arklet, with which it is connected, is 12,000 million gallons. One consequence of the raising of the level was the submergence of the Silver Strand and an appreciable lessening of the size of Ellen's Isle.

Kattowitz, a town of Prussia, province of Silesia, 5 miles south-south-east of Beuthen. It lies in the midst of ironworks and coal mines, and has flour mills and manufactures of glass, machinery, and household utensils. Population (1885), 14,200; (1900), 31,745.

Kaufbeuren, a town of Bavaria, Germany, district of Swabia, on the Wertach, 55 miles by rail south-west of Munich. It is still surrounded by walls, and has a new town hall. It is a seat of the cotton industries. Population (1885), 6495; (1900), 8361.

Kaufmann, Constantine Petrovitch (1818–1882), Russian general, was born at Maidani on 3rd March 1818. He entered the Imperial Engineers in 1838, served in the army of the Caucasus, rose to be colonel, and commanded the sappers and miners at the siege of Kars in 1855. On the capitulation of Kars he was deputed to settle the terms with General Sir W. Fenwick Williams. He was promoted to be major-general in 1857, and in 1861 became director-general of engineers at the War Office at St Petersburg, assisting General Milutin in the reorganization of the army. Promoted lieutenant-general in 1864, he was nominated aide-de-camp-general and governor of the military conscription of Vilna. In 1867 he became governor of Turkestan, and held the post until his death, making himself a name in the expansion of the empire in central Asia. He accomplished a successful campaign in 1868 against Bokhara, capturing Samarkand and gradually subjugating the whole country. In 1873 he attacked Khiva, took the capital, and forced the khan to become a vassal of Russia. Then followed in 1875 the campaign against Khokand, in which Kaufmann defeated the khan, Nasr-ed-din. Khokand north of the Syr-daria was annexed to Russia, and the independence of the rest of the country became merely nominal. This rapid absorption of the khanates brought Russia into close proximity to Afghanistan, and the reception of Kaufmann's emissaries by the Amir was a main cause of the British war with Afghanistan in 1878. Although Kaufmann was unable to induce his Government to support all his ambitious schemes of further conquest, he sent Skobeleff in 1880 and 1881 against the Akhal Tekkés, and was arranging to add Merv to his successful annexations when he died suddenly at Tashkend on 15th May 1882. (R. H. V.)

Kaukauna, a city of Outagamie county, Wisconsin, U.S.A., on the Fox river and the Chicago and North-Western railroad. It has paper and pulp mills. Population (1880), 834; (1890), 4667; (1900), 5115, of whom 1044 were foreign-born.

Kavala, or CAVALLA, a town of Turkey, on the shore of the Bay of Kavala, behind the Ægean island of Thasos. Its resident population of about 17,000 is increased in summer by an influx of peasantry, of whom during the season 5000 to 6000 are employed in curing, drying, and preparing for export the tobacco which is the speciality of the town, and which engrosses all its agricultural, industrial, and commercial energies. The production more than doubled in the last twenty years of the 19th century. It is now largely bought by the State monopolies of Austria-Hungary, Italy, Rumania, and Servia, and is making way in Germany, Great Britain, Russia, and the United States. The crop of 1898 produced 16,000 tons of marketable tobacco, and that of 1899 was even larger. In 1900, out of a total export value of £1,220,670, over £1,193,220 was for tobacco. The total imports average about a quarter of a million sterling. The house in which Mehemet Ali was born—a mean little structure in one of the tortuous streets of the old town—is still standing. It is distinguishable by a plate which the authorities have affixed to it.

Kavanagh, Arthur Macmorrough (1831–1889), Irish politician, son of Thomas Kavanagh, M.P., who traced his descent to the ancient kings of Leinster, was born in Co. Carlow, Ireland, 25th March 1831. He had only the rudiments of arms and legs, but in spite of these physical defects had a remarkable career. He learnt to ride in the most fearless way, strapped to a special saddle, and managing the horse with the stumps of his arms; and also fished, shot, drew, and wrote, various mechanical dodges being devised to supplement his limited physical capacities. He travelled extensively in Egypt, Asia Minor, Persia, and India between 1846 and 1853, and after succeeding to the family estates in the latter year, he married in 1855 his cousin, Miss Frances Mary Leathley. Assisted by his wife, he was a most philanthropic landlord, and was an active county magistrate and chairman of the board of guardians. A Conservative and a Protestant, he sat in Parliament for Co. Wexford from 1866 to 1868, and for Co. Carlow from 1868 to 1880. He was opposed to the disestablishment of the Irish Church, but supported the Land Act of 1870, and sat on the Bessborough Commission. In 1886 he was made a member of the Privy Council in Ireland. He died of pneumonia 25th December 1889, in London. It is supposed that his extraordinary career suggested the idea of "Lucas Malet's" novel, *The History of Sir Richard Calmady.*

Kazañ, a government of middle Russia, at the confluence of the Volga with the Kama. Area, 24,601 square miles. Population (1879), 1.872,437; (1897), 2,191,058, of whom 1,113,555 were women, and 176,396 lived in towns. It consisted of Russians (885,683 out of a total of 2,221,100 in 1893), Tatars (688,650), and a variety of Finno-Turkish stems: Chuvashes (482.260), Cheremisses (118,511), Mordves (26,648), Votyaks (8792), Mescheryaks (3628): some Jews (2829), some Poles (2702), &c. The Russians belong to the Greek Church or are Nonconformists; the Tatars are Mussulmans, and the other Finno-Turkish stems are either pagans or belong officially to the Greek Church, the respective figures being (in 1893): Greek Orthodox, 1,529,235; Nonconformists, 24,112 (more in reality); other Christian religions, 4025; Mussulmans, 648,877; Jews, 2367; pagans, 12,462. The average natural yearly increase of population (slightly in excess among the Russians) was about 25,000; marriages about 18,000.

Agriculture is the chief occupation, and 82 per cent. of the population are peasants. Out of 7,672,600 acres of arable land, 4,516,500 were under crops—chiefly rye, oats, some wheat, barley, sarrazin, lentils, flax, hemp, and potatoes. The crops leave on an average year an available surplus of about 1,450,000 quarters, resulting in a great scarcity and even famine in bad years. There are 450,000 horses, 300,000 horned cattle, 1,200,000 sheep, 100,000 swine, and 32,000 goats. Bee-keeping is an important branch of income. Factories occupy only about 10,000 persons, and show a yearly return of about £1,500,000. A great variety of petty trades, especially those connected with wood, are carried on in the villages, partly for export. The fairs are well attended. There is considerable shipping on the Volga, Kama, Vyatka, and their tributaries, the yearly returns of the aggregate shipping on the first two rivers being estimated at from £800,000 to £1,100,000. The schools are very unequally distributed in the different districts of the province, and are attended mainly by the Russians and the Chuvashes, but not by the Mussulman children. There were, in 1892, 1238 schools, of which 101 were at Kazañ. The village schools were visited by 40,209 boys and 11,039 girls. A seminary for teachers, 12 Russian schools, and 682 *medresses* and *mektebs* gave education to 20,930 Mussulman boys and 12,295 girls. Kazañ is divided into twelve districts, the chief towns of which are Kazañ, Cheboksary (4568 inhabitants), Chistopol (20,161), Kozmodemiyansk (5172), Laishev (3743), Mamadyzh (4213), Spassk (2779), Sviyazhsk (2363), Tetyushi (4754), Tsarevokokshaisk (1654), Tsyvilsk (2337), and Yadrin (2467).

Kazañ, capital of the above government, 50 miles above the confluence of the Volga with the Kama, and 5 miles from the left bank of the Volga, one of the chief cities of eastern Russia. It has not yet been brought into direct railway communication with Moscow, and is situated 276 miles to the east of the Nijni-Novgorod railway terminus; but it has been connected by a branch line with Saransk on the Ryazañ–Samara line (head of the Siberian railway). It is probably on this account that its population, which rapidly increased from 1850 to 1883, when it reached 140,726, has since decreased (125,889 in 1889), and only rose to 131,508 in 1897. Russians form 83 per cent. of its population and Tatars 11 per cent. The city has been embellished by several churches and public buildings. The university of Kazañ, to which students flock from north-east, east, and south-east Russia, as well as from Siberia, has an average of about 800 students, an excellent library (150,000 vols.), good laboratories, an observatory, a botanical garden, and a variety of museums (relics of Bulgarian antiquities at the Archæological Society; Persian moneys and Arabian MSS., both described in special works). Nine scientific and medical societies connected with the university, and issuing their special serials, are important centres for the study of north-east and east Russia and for scientific research. The factories (100) show a yearly return of about £900,000. Soap and candle works, tanneries and metal works are the chief. Kazañ is also a very important centre for trade, not only with eastern Russia, but also with Turkestan, Bokhara, and Persia.

See Pineghin's *Kazañ New and Old.*—*Towns and Villages on the Volga*, by the Statistical Committee; *Year-books* of the same.—V. Veliaminoff Zernoff's *Kasimoff Tsars and Tsarevitchs.* St Petersburg, 1864, 3 vols.—Zarinsky's *Sketches of Old Kazañ.* Kazañ, 1877.—Trofimoff's *The Siege of Kazañ in 1552.* Kazañ, 1890.—N. A. Firsoff's works relative to the history of the native population. Kazañ, 1864 and 1869. (P. A. K.)

Kazanskaya.—1. A Cossack village of south-east Russia, province of Don Cossacks, district Donets, on the left bank of the upper Don, 165 miles north-north-east of Kamenskaya. It has rapidly developed, owing to its trade in cattle and horses, and its vineyards. Population, 16,970. 2. Another Cossack village of same name, in North Caucasia, government and 92 miles west-north-west of Stavropol, on Kubañ river. It has become a centre of home industries for the weaving of coarse linen and knitting of woollen hosiery. Population, 6550.

Kazbek (Georgian, *Mkin-vari;* Ossetian, *Urs-khokh*), one of the chief summits of the Caucasus (the sixth in order of altitude), 42° 41′ 56″ N. and 44° 29′ 48″ E., altitude 16,546 feet, 7 miles as the crow flies from a station of the same name on the high road to Tiflis. It rises at the eastern extremity of the high range which runs to the north of the main range (main water-parting), and which is pierced by the gorges of the Ardon and the Terek. It represents an extinct volcano covered with lava, and has the shape of a double cone, whose base lies at an altitude of about 5700 feet. Owing to the steepness of its slopes, its eight glaciers cover only an aggregate surface of 8 square miles, and the longest of them, Ortz-veri, is only 5 miles long with its *nevé* and 2½ miles without it. The best-known glacier is the Devdorak, which creeps down the north-eastern slope into a gorge of the same name, reaching a level of 7580 feet with its snout. Its fall being very steep, and its snout being only 3·4 miles from the military highway, masses of ice and snow occasionally fall down upon the latter. Parrot and Engelhardt made the first attempt to climb up Kazbek in 1811, but reached only a height of 13,863 feet; neither Meyer in 1829 (14,840 feet) nor Colenati in 1844 (14,547 feet) reached the summit, which was first attained in 1868 by Freshfield, Moore, and Tucker, with a Swiss guide. Several successful ascents have been made since, the most valuable in scientific results being that of Pastukhoff (1889). Kazbek has a great literature, and has left a deep mark in Russian poetry (see D. W. Freshfield in *Proceedings Geogr. Soc.*, Nov. 1888, and *The Exploration of the Caucasus,* 2 vols., 1896; Hatisian's "Kazbek Glaciers," in *Izvestia Russ. Geogr. Soc.* xxiv. 1888; Pastukhoff in *Izvestia of the Caucasus Branch of Russ. Geogr. Soc.* vol. x. 1. 1891, with large-scale map).

Kazvín, a province of Persia, situated north-west of Tehran and south of Gílán. On the west it is bounded by Khamseh. It pays a yearly revenue of about £22,000, and contains many important and rich villages which produce much grain. Kazvín, the capital of the province, is situated at an elevation of 4165 feet, in 36° 15′ N. and 50° E., and 92 miles by road from Tehran. It has a population of about 35,000, and a thriving transit trade, particularly since the carriage road between Rasht and Tehran, with Kazvín as half-way stage, was opened. It has a telegraph station (since 1859) and a post office (since 1876). It is the birthplace of several celebrated writers (mentioned in the earlier volumes), notably of Hamd Ullah Mustofí, postmaster-general in the beginning of the 14th century, author of the *Nuzhat ul Kulúb*, the *Táríkh i guzídeh*, and the *Zafar námeh*, the last a very rare MS. obtained by the British Museum a few years ago.

Kearney, capital of Buffalo county, Nebraska, U.S.A., in the broad bottom-lands of the Platte river on the north side, at an altitude of 2152 feet. Its site is level and its plan regular. It is on the main overland line of the Union Pacific, and on a branch of the Burlington and Missouri River railroad. It is in a very fertile agricultural region, with whose development it has kept pace. Population (1880), 1782; (1890), 8074; (1900), 5634, of whom 650 were foreign-born.

Kearsley, a township in the Radcliffe-cum-Farnworth parliamentary division of Lancashire, England, 4 miles south-east of Bolton, with a station on the Lancashire and Yorkshire railway. Besides the parish church of St Stephen, there are Congregational, Wesleyan, Primitive Methodist, and Swedenborgian places of worship. The industries are coal-mining, iron-founding, paper-making, and cotton-spinning. Area of township and urban district, 997 acres; population (1881), 7253; (1901), 9217.

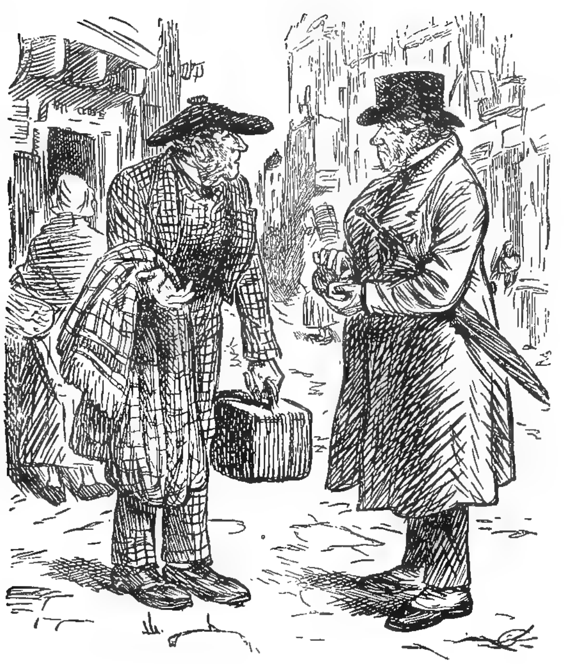
Kecskemét, a municipal town of Hungary, in the county of Pest-Pilis-Solt-Kis-Kun, with 48,493 inhabitants in 1890 and 57,812 in 1900. Besides raising cereals, fruit is extensively cultivated, and there is a considerable production of wine. More than a million baskets of fine apples and apricots are yearly exported.

Keeley, Mary Anne (1806–1899), English actress, was born at Ipswich, 22nd November 1805 or 1806. Her maiden name was Goward. She went on the stage at an early age, and, after some experience in the provinces, appeared in London in 1825. So far she had principally undertaken "singing parts," but it was not long before she gave these up in favour of the drama proper, where her powers of character-acting could have scope. In June 1829 she was married to Robert Keeley, an admirable comedian, who died in 1869. Between 1832 and 1838 she acted at Covent Garden, at the Adelphi with Buckstone, and at the Olympic with Charles Mathews. Late in 1838 she made her first great success in the part of Nydia, the blind girl, in a dramatized version of *The Last Days of Pompeii*, and followed this with an equally striking impersonation as Smike in *Nicholas Nickleby*. In 1839 came her decisive triumph with her picturesque and spirited acting as the hero of a play founded upon Harrison Ainsworth's *Jack Sheppard*. So dangerous was considered the popularity of the play, with its glorification of the prison-breaking felon, that the Lord Chamberlain ultimately forbade the performance of any piece upon the subject. It is perhaps mainly as Jack Sheppard that Mrs Keeley has lived in the memory of playgoers who saw her, despite her long subsequent career in plays more worthy of her remarkable gifts. Under Macready's management at Drury Lane she played Nerissa in *The Merchant of Venice*, and Audrey in *As You Like It*; managed the Lyceum with her husband from 1844 to 1847; acted with Webster and Kean at the Haymarket; returned for five years to the Adelphi; and eventually made her last regular public appearance at the Lyceum in 1859. From that time she appeared upon the boards only to assist at benefits and similar performances. In spite of the great age she attained, she preserved an altogether exceptional vigour and youthfulness of disposition until the short illness which terminated in her death on 12th March 1899. (R. F. S.)

Keeling Islands (often called Cocos, and Cocos-Keeling Islands), a group of coral islands in the Indian Ocean, between 12° 4′ and 12° 13′ S. and 96° 49′–57′ E., but including a smaller island in 11° 50′ N. and 96° 50′ E. They were discovered in 1609 by Captain Keeling on his voyage from Batavia to the Cape, were in 1878 (after several years of existence as an independent possession of the Crown) attached to the Government of Ceylon, and eventually in 1882 were placed under the authority of the governor of the Straits Settlements. Since Forbes's account of his sojourn in 1878, the islands have been visited, at the expense of Sir John Murray, the distinguished naturalist of the *Challenger*, by Dr Guppy, Mr Ridley, and Dr Andrews. The object of their visits was the investigation of the fauna and flora of the atoll, more especially of the formation of the coral reefs, the account of which by Darwin (who spent a short period on the group in 1836 on his voyage in the *Beagle*) made the islands classic ground, as it was from the observations he there made that his celebrated theory of the formation of coral reefs was founded. Dr Guppy was fortunate in reaching North Keeling Island, which, as it can be landed on only during the calmest weather, has very seldom been visited. The island he found to be about a mile long, with a shallow enclosed lagoon, less than 3 feet deep at ordinary low water, with a single opening leading into it on its east or weather side. A dense vegetation of iron-wood (*Cordia*) and other trees and shrubs, together with a forest of cocoanut palms, covers its surface. It is tenanted by myriads of sea-fowl, frigate-birds, boobies, and terns (*Gygis candida*), which find here an excellent nesting-place, free from disturbance, for the island is uninhabited, and is visited by the owner (Mr J. Clunies Ross) only once or twice a year for the purpose of gathering its produce. The excrement from this large colony has changed the carbonate of lime in the soil and the coral nodules on the surface into phosphates, to the extent in some cases of 60–70 per cent., thus forming a valuable deposit, beneficial to the vegetation of the island itself and probably yet to be of commercial value. The lagoon is slowly filling up and becoming cultivable land, but the rate of recovery from the sea has been specially marked since the eruption of Krakatoa, the pumice from which has been washed on to it in enormous quantity, so that the lagoon has advanced its shores from 20 to 30 yards. There is an anchorage on the west side of the island; but, unless in dead calm weather, it must be used with the utmost caution, as a northerly wind suddenly arising would place a vessel in the greatest jeopardy. Forbes's and Guppy's investigations go to show that, contrary to Darwin's belief, there is no evidence of upheaval or of subsidence in either of the Keeling groups. The atoll has an exceedingly salubrious climate, and it might well be used as a sanatorium for phthisical patients, the temperature never going to extremes. The highest annual reading of the thermometer almost never tops 89° F. or falls beneath 70°. The mean temperature for the year is 78·5° F., and as the rainfall rarely exceeds 40 inches, the atmosphere never becomes unpleasantly moist. The south-east trade blows almost ceaselessly for ten months of the year. Both groups of the Keelings continue under the proprietorship of Mr Ross. A profitable trade is done in cocoanuts, of which the islands, now nearly all fully planted, yield an enormous number. There are few other exports. The imports are almost entirely food-stuffs and other necessaries for the inhabitants, who are all practically the dependants of, and form a patriarchal colony under, Mr Ross, who is the Crown's representative as well as absolute owner, as he holds from the Government under a lease of a thousand years.

See Henry O. Forbes. *A Naturalist's Wanderings in the Eastern Archipelago*. London, 1884.—Dr H. B. Guppy. "The Cocos-Keeling Islands," *Scottish Geographical Magazine*, vol. v., 1889. (H. O. F.)

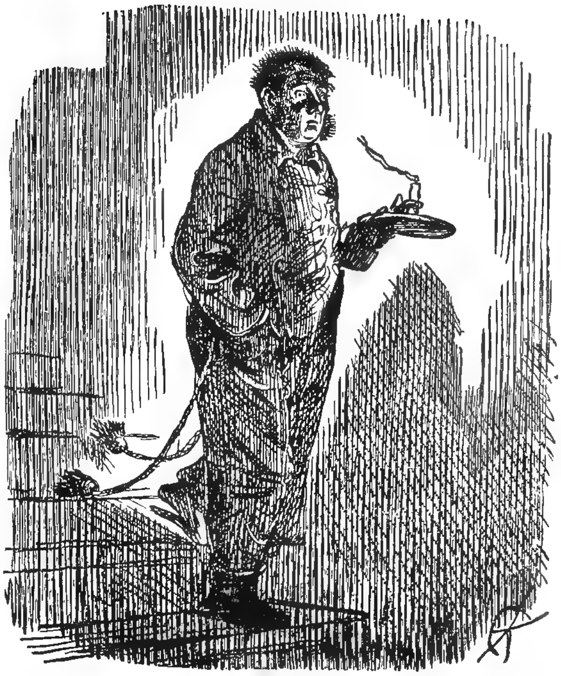
Keene, Charles Samuel (1823–1891), English black-and-white artist, the son of Samuel Browne Keene, a solicitor, was born at Hornsey on the 10th of August 1823. Educated at the Ipswich Grammar School until his sixteenth year, he early showed artistic leanings. Two years after the death of his father he was articled to a London solicitor, but, the occupation proving uncongenial, he was soon removed to the office of an architect, Mr Pilkington. His spare time was now spent in drawing historical and nautical subjects in water-colour. For these trifles his mother, to whose energy and common-sense he was greatly indebted, soon found a purchaser, through whom he was brought to the notice of the Whympers, the wood-engravers. This led to his abandoning his work as an architect and being bound to them as apprentice for five years. His earliest known design is the frontispiece, signed "Chas. Keene," to *The Adventures of Dick Boldhero in Search of his Uncle*, &c. (Darton and Co., 1842). His term of apprenticeship over, he hired as studio an attic in the block of buildings standing, up to 1900, between the Strand and Holywell Street, and was soon hard at work for the *Illustrated London News*. At this time he was a member of the "Artists' Society" in Cliptone Street, afterwards removed to the Langham studios. In December 1851 he made his first appearance in *Punch* and, after



THRIFT.

Peebles Body (*to Townsman who was supposed to be in London on a visit*) "E—eh, Mac! ye're sune Hame again!"

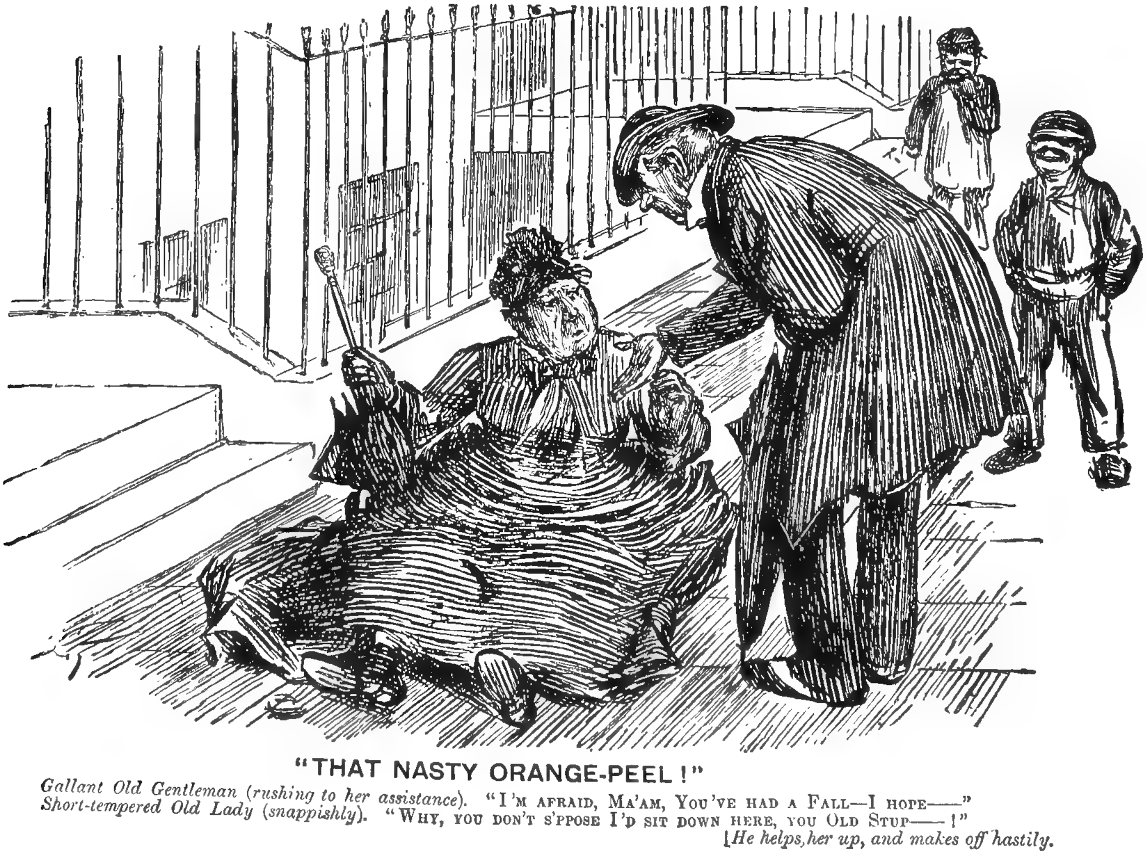
Mac. "E—eh, it's just a ruinous Place, that! Mun, a had na' been the-erre abune Twa Hoours when—*Bang*—went *Saxpence!!!*"



"THE UNSEEN WORLD."

Scientific Gent (*with his hair on end*). "Ve'y strange! But I could almost Swear—I hear Foo'steps—followinmedownstairs—— !"

[*Bolts into his bedroom, locks the door, and writes to the "Athenæum" next day!*



"THAT NASTY ORANGE-PEEL!"

Gallant Old Gentleman (*rushing to her assistance*). "I'm afraid, Ma'am, You've had a Fall—I hope——"

Short-tempered Old Lady (*snappishly*). "Why, you don't s'ppose I'd sit down here, you Old Stup—— !"

[*He helps, her up, and makes off hastily.*

Illustrations by Charles Keene. (*By permission of the Proprietors of "Punch."*)

nine years of steady work, was called to a seat at the famous table. It was during this period of probation that he first gave evidence of those transcendent qualities which make his work at once the joy and despair of his brother craftsmen. On the starting of *Once a Week* in 1859, Keene's services were at once requisitioned, his most notable series in this periodical being the illustrations to Charles Reade's *A Good Fight* (afterwards rechristened *The Cloister and the Hearth*) and to Mr George Meredith's *Evan Harrington.* There is a quality of conventionality in the earlier of these which completely disappears in the later. In 1858 Keene, who was endowed with a fine voice and was an enthusiastic admirer of old-fashioned music, joined the "Jermyn Band," afterwards better known as the "Moray Minstrels." He was also for many years a member of Leslie's Choir, the Sacred Harmonic Society, the Catch, Glee, and Canon Club, and the Bach Choir. He was also an industrious performer on the bagpipes, of which instrument he brought together a considerable collection of specimens. About 1863 the Arts Club in Hanover Square was started, with Keene as one of the original members. In 1864 John Leech died, and Keene's work in *Punch* thenceforward found wider opportunities. It was about this time that the greatest of all modern artists of his class, Menzel, discovered Keene's existence, and became a subscriber to *Punch* solely for the sake of enjoying week by week the work of his brother craftsman. In 1872 Keene, who, though fully possessed of the humorous sense, was not within measurable distance of Leech as a jester, and whose drawings were consequently not sufficiently "funny" to appeal to the laughter-loving public, was fortunate enough to make the acquaintance of Mr Joseph Crawhall, who had been in the habit for many years of jotting down any humorous incidents he might hear of or observe, illustrating them at leisure for his own amusement. These were placed unreservedly at Keene's disposal, and to their inspiration we owe at least 250 of his most successful drawings in the last twenty years of his connexion with *Punch.* A list of more than 200 of these subjects is given at the end of *The Life and Letters of Charles Keene of "Punch."* In 1879 Keene removed to 239 King's Road, Chelsea, which he occupied until his last illness, walking daily to and from his house, 112 Hammersmith Road. In 1881 a volume of his *Punch* drawings was published by Messrs Bradbury and Agnew, with the title *Our People.* In 1883 Keene, who had hitherto been a strong man, developed symptoms of dyspepsia and rheumatism. By 1889 these had increased to an alarming degree, and the last two years of his life were passed in acute suffering borne with the greatest courage. He died unmarried, after a singularly uneventful life, on the 4th of January 1891, and his body lies in Hammersmith cemetery. Keene, who never had any regular art training, was essentially an artists' artist. He holds the foremost place amongst English craftsmen in black and white, though his work has never been appreciated at its real value by the general public. No doubt the main reason for this lack of public recognition was his unconventionality. He drew his models exactly as he saw them, not as he knew the world wanted to see them. He found enough beauty and romance in all that was around him, and, in his *Punch* work, enough subtle humour in nature seized at her most humorous moments to satisfy him. He never required his models to grin through a horse collar, as Gillray did, or to put on their company manners, as was du Maurier's wont. But Keene was not only a brilliant worker in pen and ink. As an etcher he has also to be reckoned with, notwithstanding the fact that his plates numbered not more than fifty at the outside. Impressions of them are exceedingly rare, and hardly half a dozen of the plates are now known to be in existence. He himself regarded them only as experiments in a difficult but fascinating medium. But in the opinion of the expert they suffice to place him among the best etchers of the 19th century. Apart from the etched frontispieces to some of the *Punch* pocket-books, only three, and these by no means the best, have been published. Writing in *L'Artiste* for May 1891 of a few which he had seen, M. Bracquemond says: "By the freedom, the largeness of their drawing and execution, these plates must be classed amongst modern etchings of the first rank." A few impressions are to be found in the British Museum, but in the main they were given away to friends and lie hidden in the albums of the collector.

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Keene, capital of Cheshire county, New Hampshire, U.S.A., on the Ashuelot, and on branches of the Boston and Maine and the Fitchburg railways. Its site is a level plain, on which it is regularly laid out, with broad, well-shaded streets, and it has an excellent water-supply. It has varied manufactures, including the repairing-works of the Fitchburg railroad. Population (1880), 6784; (1900), 9165, of whom 1255 were foreign-born.

Keewatin, a district of Canada, bounded on the E. by Committee Bay, Fox Channel, and Hudson and James Bays, on the S. and S.W. by the Albany and English rivers, Manitoba, Lake Winnipeg, and Nelson river, on the W. by the 100th meridian, and on the N. by Simpson and Rae straits and gulf and peninsula of Boothia; thus including an area of 445,000 square miles. Its surface is in general barren and rocky, studded with innumerable lakes with intervening elevations, forest-clad below 60° N., but usually bare or covered with moss or lichens, forming the so-called "barren lands" of the north. With the exception of a strip of Silurian and Devonian rocks, 40 to 80 miles wide, and extending from the vicinity of the Severn river to the Churchill, and several isolated areas of Cambrian and Huronian, the district is occupied by Laurentian rocks. The principal river is the Nelson, which, with its great tributary, the North Saskatchewan, is 1450 miles long; other tributaries are the Berens, English, Winnipeg, Red, Assiniboine, and South Saskatchewan. The Hayes, Severn, and Winisk also fall in from the south-west into Hudson Bay, and the Ekwan, Attawapiskat and Albany, 500 miles long, into James Bay. The Churchill, 925 miles, Thlewiaza, Maguse, and Ferguson rivers discharge into Hudson Bay on the west side; the Kazan, 500 miles, and Dubawnt, 660 miles, into Chesterfield Inlet; and Back's river, rising near Aylmer Lake, flows north-eastwards 560 miles to the Arctic Ocean. The principal lakes are St Joseph and Seul on the southern boundary; northern part of Lake Winnipeg, 710 feet above the sea; Island; South Indian; Etawney; Nuelltin; Yathkyed, at an altitude of 300 feet; Maguse; Kaminuriak; Baker, 30 feet; Aberdeen, 130 feet; and Garry. The principal islands are Southampton, with an area of 17,800 square miles; Marble Island, the usual wintering place for whaling vessels; and Bell and Coats Islands, in Hudson Bay; and Akimiski, in James Bay. A few small communities at the posts of the Hudson Bay Company constitute practically the whole of the white population. In 1897 there were 852 Indians in the Churchill and Nelson rivers district, but no figures are available for the district as a whole. The principal posts in Keewatin are Norway House, near the outlet of Lake Winnipeg; Oxford House, on the lake of the same name; York Factory, at the mouth of Hayes river; and Forts Severn and Churchill, at the mouths of the Severn and Churchill rivers respectively. The lieutenant-governor of Manitoba is, *ex officio,* lieutenant-governor of Keewatin. (J. Wh*.)

Kehl, a river port of Germany, grand duchy of Baden, standing on the Rhine, opposite to Strasburg, and 30 miles by rail south-west of the town of Baden. Here was opened in 1900 a harbour, 11,480 feet long, and 330 feet wide, with an easy entrance. It is protected from the Rhine by a dyke 26 feet high (above Rhine low water), and cost some £425,000. A second basin is to be added. Population (1900), 3003.

Kei Islands, a group in the Malay Archipelago, belonging to the residency of Amboyna, lying between 5° and 6° 5′ S. and 131° 50′ and 133° 15′ E., and consisting of four parts: Nuhu-Iut or Great Kei, Roa or Little Kei, the Tayanda, and the Kur group. Great Kei differs geologically in every respect from the other groups. It is of Tertiary formation (Miocene), and its mountain-chain of stone, running in the direction of its longitudinal axis, has peaks such as Boo, Daap, &c., reaching a height of 2600 feet. All the other groups are of post-Tertiary formation and of level surface, hardly relieved by any heights. According to Professor Martin, the frontier of the islands, detached as they are from the Asiatic continent on the one hand and the Australian continent on the other, runs between (*a*) Great Kei and the north-west of Timor and (*b*) the western isles of the Kei group. Among the products of the islands are copra, maize, yams, and tobacco. Planten estimates the population at about 23,000, of whom 14,900 are pagans, 8300 Mahommedans, and about 22 Christians. Area, 572 square miles.

See Kan, "Onze geographische kennis der Keij-Eilanden," in *Tijdschr. Aardr. Gen.*, 1887.—Martin, "Die Kei-inseln u. ihr Verhältniss zur Australisch-Asiatischen Grenzlinie," in *ibid.*, part vii., 1890.—Van Hoëvell, "De Kei-Eilanden," in *Tijdschr. Bat. Gen.*, 1889; "Verslagen van de wetenschappelijke opnemingen en onderzoekingen op de Keij-Eilanden," 1889–90, by Planten and Wertheim, 1893, with map and ethnographical atlas of the south-western and south-eastern islands by Pleyte.

Keighley, a municipal borough (incorporated 1882, extended 1895) in the Keighley parliamentary division of Yorkshire, England, on the Aire, 9 miles north-west of Bradford by rail. By the Leeds and Liverpool canal the town is connected with Hull and Liverpool. A grammar-school was founded in 1713, the operations of which have been extended so as to embrace a trade school (1871) for boys and a grammar-school for girls. The Public Libraries Acts have been adopted. There are a hospital and considerable charities, and also three public pleasure-grounds. The principal industries are manufactures of woollen goods, spinning, sewing, and washing machines, and tools. Population (1891), 35,012; (1901), 41,565.

Keith, a police burgh and important railway junction of Banffshire, Scotland, on the river Isla, 53¼ miles north-west of Aberdeen. There are a public hall, a hospital, and an institute and museum. Keith is the centre of the agricultural trade of Banffshire; there are manure and lime works, and tweed and blanket factories; an extensive dead meat trade is conducted. The public school has a secondary department. Population (1881), 4339; (1901), 4753.

Kekulé, Friedrich August (1829–1896), German chemist, was born at Darmstadt on 7th September 1829. He was intended to adopt the profession of an architect, and it was while he was studying at Giessen, in furtherance of that design, that he came under the influence of Liebig and was induced to take up chemistry. From Giessen he went to Paris, where he attended lectures by Regnault, Fremy, and Wurtz, and contracted a friendship with Gerhardt; then, after a short sojourn in Switzerland, he visited England, and became acquainted with the doctrines of Williamson and Odling. He thus enjoyed the advantage of personal intercourse with several of the leading chemical thinkers of the period. On his return to Germany he started a small chemical laboratory at Heidelberg, where, with a very slender equipment, he carried out several important researches. In 1858 he was appointed professor of chemistry at Ghent, and in 1865 was called to Bonn to fill a similar position, which he held till his death on 13th June 1896. Kekulé's main importance lies in the far-reaching contributions which he made to chemical theory, especially in regard to the constitution of the carbon compounds. The doctrine of atomicity had already been enunciated by Frankland, when in 1858 Kekulé published a paper in which, after giving reasons for regarding carbon as a tetravalent element, he set forth the essential features of his famous doctrine of the linking of atoms. He explained that in substances containing several carbon atoms it must be assumed that some of the affinities of each carbon atom are bound by the affinities of the atoms of other elements contained in the substance, and some by an equal number of the affinities of the other carbon atoms. The simplest case is when two carbon atoms are combined so that one affinity of the one is tied to one affinity of the other; two, therefore, of the affinities of the two atoms are occupied in keeping the two atoms together, and only the remaining six are available for atoms of other elements. The next simplest case consists in the mutual interchange of two affinity units, and so on. This conception led Kekulé to his "closed chain" or "ring" theory of the constitution of benzene (see Chemistry in vol. xxvi.), which has been called the "most brilliant piece of prediction to be found in the whole range of organic chemistry," and this in turn led in particular to the elucidation of the constitution of the "aromatic compounds," and in general to new methods of chemical synthesis and decomposition, and to a deeper insight into the composition of numberless organic bodies and their mutual relations. Professor F. R. Japp, indeed, went so far as to say, in the Kekulé memorial lecture he delivered before the London Chemical Society on 15th December 1897, that three-fourths of modern organic chemistry is directly or indirectly the product of Kekulé's benzene theory, and that without its guidance and inspiration the industries of the coal-tar colours and the artificial therapeutic agents in their present form and extension would have been inconceivable.

(H. M. R.)

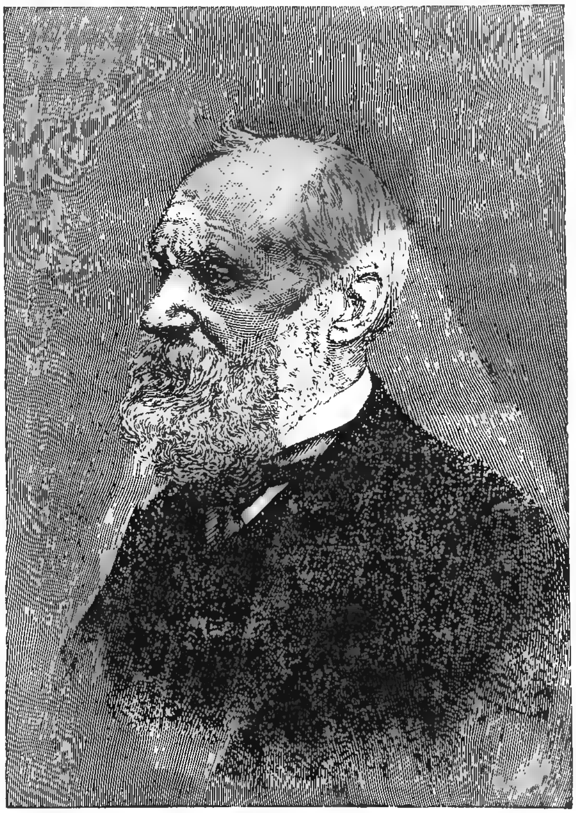
Keller, Gottfried (1819–1890), German novelist, was born at Zürich, 19th July 1819. His father, a master joiner, dying while Gottfried was young, his education was imperfect, and he wasted much time in trying to learn to paint. At length interest in politics threw him into literature—his talents, first disclosed by some short poems, obtaining recognition from the government of his native canton, and he was enabled to go through a regular course of study at the University of Heidelberg. From 1850 to 1855 he lived at Berlin, where he wrote his most important novel, *Der Grüne Heinrich* (23rd ed. 1901), remarkable for its delicate autobiographic portraiture and the beautiful episodes interwoven with the action, and *Die Leute von Seldwyla* (27th ed. 1901), studies of Zürich life, including in *Romeo und Julia aus dem Dorfe* the most powerful story of real life ever written in German, and in *Die drei gerechten Kammmacher,* almost as great a masterpiece in the department of humour. Returning to his native city with a considerable reputation, he received the appointment of public secretary. For a time his creative faculty seemed paralysed by his public duties, but in 1872 appeared *Sieben Legenden*, and in 1874 a second series of *Die Leute von Seldwyla*, in both which books, if no longer visited by such happy inspirations as in his youth, he displayed no abatement of power and originality. He retired from the public service in 1876, and employed his leisure in the production of *Züricher Novellen* (1878), *Das Sinngedicht*, a charming novel (1881) and *Martin Salander* (21st ed. 1901), a criticism on Swiss institutions in the form of a fiction (1886). He died on 15th July 1890. Keller's place among German novelists is very high, and his genius is entirely original. Few have united such fancy and imagination to such uncompromising realism, or such tragic earnestness to such abounding humour. The serious didactic purpose of his novels is so far from being obtruded that, except in the last, it is hardly perceived. His *Gesammelte Werke* were published in eleven volumes in 1889–1901.

See BÄCHTOLD, *Kellers Leben, seine Briefe und Tagebücher* (Berlin, 1893–95), and *Gottfried Keller, a Selection of his Tales*, translated by Kate Freiligrath Kroeker (London, 1891). (R. G.)

Kelso, a burgh of barony and police burgh of Roxburghshire, Scotland, on the river Tweed at its junction with the Teviot, 23 miles west-south-west of Berwick-on-Tweed by road. The distinctive local industry now is the making of fishing tackle of all kinds, for which Kelso firms are widely famed. There is a high school. Population (1881), 4701; (1901), 4006.

Kelvin, William Thomson, 1st Baron (1824– ——), British physicist, the second son of James Thomson, LL.D., professor of mathematics in the University of Glasgow, was born at Belfast, Ireland, 26th June 1824, his father being then teacher of mathematics in the Royal Academical Institution. In 1832 James Thomson accepted the chair of mathematics at Glasgow, and migrated thither with his two sons, James and William, who in 1834 matriculated in that university, William being then little more than ten years of age, and having acquired all his early education through his father's instruction. In 1841 William Thomson entered Peterhouse, Cambridge, and in 1845 took his degree as second wrangler, to which honour he added that of the first Smith's Prize. The senior wrangler in his year was Stephen Parkinson, a man of a very different type of mind, yet one who was a prominent figure in Cambridge for many years. In the same year Thomson was elected Fellow of Peterhouse. At that time there were few facilities for the study of experimental science in Great Britain. At the Royal Institution Faraday held a unique position, and was feeling his way almost alone. In Cambridge science had progressed little since the days of Newton. Thomson therefore had recourse to Paris, and for a year worked in the laboratory of Regnault, who was then engaged in his classical researches on the thermal properties of steam; but his stay in Paris was comparatively short, for in 1846, when only twenty-two years of age, he accepted the Chair of Natural Philosophy in the University of Glasgow, which he filled for fifty-three years, attaining universal recognition as one of the greatest physicists of his time. The Glasgow chair was a source of inspiration to scientific men for more than half a century, and many of the most advanced researches of other physicists grew out of the suggestions which Thomson scattered as sparks from his anvil. One of his earliest papers dealt with the age of the earth, and brought him into collision with the geologists of the Uniformitarian school, who were claiming thousands of millions of years for the formation of the stratified portions of the earth's crust. Thomson's calculations on the conduction of heat showed that at some time between twenty millions and four hundred millions, probably about one hundred millions, of years ago, the physical conditions of the earth must have been entirely different from those which now obtain. This led to a long controversy, in which the physical principles held their ground. In 1847 Thomson first met James Prescott Joule at the Oxford meeting of the British Association. A fortnight later they again met in Switzerland, and together measured the rise of temperature of the water in a mountain torrent due to its fall. Joule's views of the nature of heat strongly influenced Thomson's mind, with the result that in 1848 Thomson proposed his absolute scale of temperature, which is independent of the properties of any particular thermometric substance (see THERMODYNAMICS, *Ency. Brit.* vol. xxiii. p. 285), and in 1851 he presented to the Royal Society of Edinburgh a paper on the Dynamical Theory of Heat, which reconciled the work of Carnot with the conclusions of Rumford, Davy, Mayer, and Joule, and placed the Dynamical Theory of Heat and the fundamental principle of the Conservation of Energy in a position to command universal acceptance. It was in this paper that the principle of the Dissipation of Energy, briefly summarized in the second law of thermodynamics, was first stated (*ibid.* xxii. 479; xxiii. 285). In 1850 Thomson experimentally verified the theoretical conclusion of his brother James that, since water expands on freezing, increase of pressure must lower the freezing point (*ibid.* xii. 612). Applying his principles of energy to thermo-electric currents, Thomson showed that in an unequally heated conductor of the same metal a current of electricity must generally affect the distribution of temperature ("Thomson effect," *ibid.* viii. 97).

Although his contributions to Thermodynamics may properly be regarded as his most important scientific work, it is in the field of electricity, especially in its application to submarine telegraphy, that Lord Kelvin is best known to the world at large. From 1854 he is most prominent among telegraphists. The stranded form of conductor was due to his suggestion (*ibid.* xxiii. 114); but it was in the letters which he addressed in November and December of that year to Professor Stokes, and which were published in the *Proceedings of the Royal Society* for 1855, that he discussed the mathematical theory of signalling through submarine cables, and enunciated the conclusion that in long cables the retardation due to capacity must render the speed of signalling inversely proportional to the square of the cable's length (*ibid.* xxiii. 115, 125). Some held that if this were true ocean telegraphy would be impossible, and sought in consequence to disprove Thomson's conclusion. Thomson, on the other hand, set to work to overcome the difficulty by improvement in the manufacture of cables, and first of all in the production of copper of high conductivity and the construction of apparatus which would readily respond to the slightest variation of the current in the cable. The mirror galvanometer (*ibid.* x. 49, *sq.*) and the siphon recorder, which was patented in 1867 (*ibid.* xxiii. 124, 125), were the outcome of these researches; but the scientific value of the mirror galvanometer is independent of its use in telegraphy, and the siphon recorder is the direct precursor of one form of galvanometer (d'Arsonval's) now commonly used in electrical laboratories. A mind like that of Thomson could not be content to deal with any physical quantity, however successfully from a practical point of view, without subjecting it to measurement. Thomson's work in connexion with telegraphy led to the production in rapid succession of instruments adapted to the requirements of the time for the measurement of every electrical quantity, and when electric lighting came to the front a new set of instruments was produced to meet the needs of the electrical engineer. Some account of Thomson's electrometer is given in the earlier volumes of this work (viii. 119–121), while every modern work of importance on electric lighting describes the instruments which he has specially designed for central station work; and it may be said that there is no quantity which the electrical engineer is ordinarily called upon to measure for which Lord Kelvin has not constructed the suitable instrument. Currents from the ten-thousandth of an ampere to ten thousand amperes, electrical pressures from a minute fraction of a volt to 100,000 volts, come within the range of his instruments, while the private consumer of electric energy is provided with a meter recording Board of Trade units.



Lord Kelvin.
(From a photograph by Elliott and Fry, London.)

When Weber in 1851 proposed the extension of Gauss's system of absolute units to electromagnetism, Thomson took up the question, and, applying the principles of energy, calculated the absolute electromotive force of a Daniell cell, and determined the absolute measure of the resistance of a wire from the heat produced in it by a known current. In 1861 it was Thomson who induced the British Association to appoint its first famous committee for the determination of electrical standards, and it was he who suggested much of the work carried out by Clerk Maxwell, Balfour Stewart, and Fleeming Jenkin as members of that committee (*ibid.* viii. 44, 45, and 104). The oscillatory character of the discharge of the Leyden jar, the foundation of the work of Hertz and of wireless telegraphy, were investigated by him in 1853.

It was in 1873 that he undertook to write a series of articles for *Good Words* on the mariner's compass. He wrote the first, but so many questions arose in his mind that it was five years before the second appeared. In the meanwhile the compass went through a process of complete reconstruction in his hands, a process which enabled both the permanent and the temporary magnetism of the ship to be readily compensated, while the weight of the 10-inch card was reduced to one-seventeenth of that of the standard card previously in use, although the time of swing was increased (*ibid.* vi. 228). Second only to the compass in its value to the sailor is Thomson's sounding apparatus, whereby soundings can be taken in 100 fathoms by a ship steaming at 16 knots; and by the employment of piano-wire of a breaking strength of 140 tons per square inch and an iron sinker weighing only 34 ℔, with a self-registering pressure gauge, soundings can be rapidly taken in deep ocean (*ibid.* xxii. 281). Thomson's tide gauge, tidal harmonic analyser, and tide predicter are briefly described in the earlier volumes of this work (xxiii. 371), and among his work in the interest of navigation must be mentioned his tables for the simplification of Sumner's method for determining the position of a ship at sea.

It is impossible within brief limits to convey more than a general idea of the work of a philosopher who has published more than three hundred original papers bearing upon nearly every branch of physical science; who one day is working out the mathematics of a vortex theory of matter on hydrodynamical principles or discovering the limitations of the capabilities of the vortex atom, on another is applying his knowledge of elasticity to tides in the solid earth, or calculating the size of water molecules, and later is designing an electricity meter, a dynamo, or a domestic water-tap. It is only by reference to his published papers that any approximate conception can be formed of his life's work; but the student who has read all these knows comparatively little of Lord Kelvin if he has not talked with him face to face. Extreme modesty, almost amounting to diffidence, is combined with the utmost kindliness in Lord Kelvin's bearing to the most elementary student, and nothing seems to give him so much pleasure as an opportunity to acknowledge the efforts of the humblest scientific worker. The progress of physical discovery during the last half of the 19th century was perhaps as much due to the kindly encouragement which he gave to his students and to others who came in contact with him as to his own researches and inventions; and it would be difficult to speak of his influence as a teacher in stronger terms than this.

One of his former pupils, Professor J. D. Cormack, writes: "It is perhaps at the lecture table that Lord Kelvin displays most of his characteristics. . . . His master mind, soaring high, sees one vast connected whole, and, alive with enthusiasm, with smiling face and sparkling eye, he shows the panorama to his pupils, pointing out the similarities and differences of its parts, the boundaries of our knowledge, and the regions of doubt and speculation. To follow him in his flights is real mental exhilaration."

In 1852 Thomson married Margaret, daughter of Walter Crum of Thornliebank, who died in 1870; and in 1874 he married Frances Anna, daughter of Charles R. Blandy of Madeira. In 1866, perhaps chiefly in acknowledgment of his services to transatlantic telegraphy, Thomson received the honour of knighthood, and in 1892 he was raised to the peerage with the title of Baron Kelvin of Largs. The Grand Cross of the Royal Victorian Order was conferred on him in 1896, the year of the jubilee of his professoriate. In 1890 he became President of the Royal Society. A list of the degrees and other honours which he received during the fifty-three years he held his Glasgow chair would occupy as much space as this article; but any biographical sketch would be conspicuously incomplete if it failed to notice the celebration in 1896 of the jubilee of his professorship. Never before had such a gathering of rank and science assembled as that which filled the halls of the University of Glasgow on 15th, 16th, and 17th of June in that year. The city authorities joined with the university in honouring their most distinguished citizen. About 2500 guests were received in the University buildings, the library of which was devoted to an exhibition of the instruments invented by Lord Kelvin, together with his certificates, diplomas, and medals. The Eastern, the Anglo-American, and the Commercial Cable Companies united to celebrate the event, and from the University Library a message was sent through Newfoundland, New York, Chicago, San Francisco, Los Angeles, New Orleans, Florida, and Washington, and was received by Lord Kelvin seven and a half minutes after it had been despatched, having travelled about 20,000 miles and twice crossed the Atlantic during the interval. It was at the banquet in connexion with the jubilee celebration that the Lord Provost of Glasgow thus summarized Lord Kelvin's character: "His industry is unwearied; and he seems to take rest by turning from one difficulty to another—difficulties that would appal most men and be taken as enjoyment by no one else. . . . This life of unwearied industry, of universal honour, has left Lord Kelvin with a lovable nature that charms all with whom he comes in contact."

Kemble, Frances Anne (1809–1893), English actress and writer, daughter of the actor Charles Kemble (*Ency. Brit.* xiv. 30), was born in London 27th November 1809, and educated chiefly in France. She first appeared on the stage in 1829 as Juliet at Covent Garden. Her attractive personality at once made her a great favourite, her popularity enabling her father to recoup his losses as a manager. Besides playing all the principal women's parts—Julia in *The Hunchback* being perhaps her best—she brought out a play of her own in 1832, entitled *Francis the First,* a piece of no particular merit. In 1833 she went on tour with her father in America, and in 1834 married a Southern planter, Mr Pierce Butler. She was so horrified, however, at the slavery in Georgia, that she eventually refused to live with her husband on his estates, and they separated. She devoted herself largely to literary work. In 1835 she published a volume of her *Journal,* in 1837 another play, *The Star of Seville,* and in 1844, *Poems.* She also returned to the stage, and, following her father's example, had some success as a Shakespearian reader. She travelled in Italy, and in 1847 brought out a book on the subject, *A Year of Consolation.* In 1856 she published *Christmas Tales* (from the German), and in 1863 another volume of her *Journal* (dealing with life on the Georgia plantation), and also a volume of *Plays,* including translations from Dumas and Schiller. In 1877 she returned to England, where she lived—using her maiden name—till her death in London on 15th January 1893. During this later period Fannie Kemble was a prominent and popular figure in the social life of London. She published *Records of a Girlhood* (1878), *Records of Later Life* (1882), *Notes on some of Shakespeare's Plays* (1882), *Far Away and Long Ago* (1889), and *Further Records* (1891). Her various volumes of reminiscences contain much valuable material for the social and dramatic history of the period. (H. CH.)

Kempten, a town of Bavaria, Germany, district of Swabia, 81 miles by rail south-west of Munich, and on the river Iller. The palace of the former abbot princes (1656–74) is now partly used as barracks, and the town hall, in the old town, has been restored. Numerous Roman remains were discovered near here in 1886. There are an agricultural and a technical school. Cotton spinning and weaving, brewing, and manufactures of paper, woodpulp, hosiery, machinery, and matches are carried on. Population (1885), 14,368; (1900), 18,857.

Kendal, a parish, municipal borough, and market town in the Kendal parliamentary division of Westmorland, England, 8 miles from Windermere on the Kendal and Windermere branch of the London and North-Western railway. Recent erections embrace a town hall, market house, new buildings for the grammar school, electric lighting and power station, and many villas and terraces of houses. There are a fine old parish church, Roman Catholic, Wesleyan, and other chapels, public library, baths, and pleasure-grounds. Area, 2622 acres. Population (1891), 14,430; (1901), 14,183.

Kendall, Henry Clarence (1841–1882), Australian poet, son of a missionary, was born in New South Wales, 18th April 1841, and, as a young man, entered a lawyer's office in Sydney. He had always had literary tastes, and sent some of his own verses in 1862 to London to be published in the *Athenæum.* Next year he obtained a clerkship in the Lands Department at Sydney, being afterwards transferred to the Colonial Secretary's office; and he combined this work with the writing of poetry and journalism. His principal volumes of verse were *Leaves from an Australian Forest* (1869) and *Songs from the Mountains* (1880), his feeling for nature, as embodied in Australian landscape and bush-life, being very true and full of charm. In 1869 he resigned his post in the public service, and for some little while he was in business with his brothers. Sir Henry Parkes took an interest in him, and eventually appointed him to an inspectorship of forests. He died on 1st August 1882. In 1886 a memorial edition of his poems was published at Melbourne.

Kenealy, Edward Vaughan Hyde (1819–1880), Irish barrister and author, was born at Cork, 2nd July 1819, being the son of a local merchant. He was educated at Trinity College, Dublin, and was called to the Irish bar in 1840 and to the English bar in 1847, and obtained a fair practice in criminal cases. In 1868 he became a Q.C. and a bencher of Gray's Inn. It was not, however, till 1873, when he became leading counsel for the Tichborne claimant, that he came into any great prominence. He behaved so violently that his conduct in the case became a public scandal, and after the verdict against his client he started a paper to plead his cause and to attack the judges. His behaviour was so extreme that in 1874 he was disbenched and disbarred by his Inn. He then started an agitation throughout the country to ventilate his grievances, and succeeded in 1875 in getting elected to parliament for Stoke; but no member would introduce him when he took his seat. Dr Kenealy (as he was always known) gradually ceased to attract attention, and on 16th April 1880 he died in London. He published a voluminous amount of verse, and also of somewhat mystical theology, but his title to remembrance rests solely on his connexion with the Tichborne case.

Kēng Tūng, the most extensive of the Shan States in the province of Burma. It is in the southern Shan States, and lies almost entirely east of the Salween river. The area of the state is rather over 12,000 square miles. On the N. it is bounded by the states of Mang Lön, Möng Lem, and Kēng Hūng (Hsip Hsawng Pannā), the two latter under Chinese control. On the E. it is bounded by the Mèkhong river, on the farther side of which is French Lao territory; on the S. by the Siamese Shan States, and on the W. in a general way by the Salween river, though it overlaps it in some places.

The state is known to the Chinese as Mêng Kēng, and was frequently called by the Burmese "the 32 cities of the Gôn" (Hkön). Kēng Tūng has expanded very considerably, since the establishment of British control, by the inclusion of the districts of Hsen Yawt, Hsen Mawng, Möng Hsat, Möng Pu, and the cis-Mèkhong portions of Kēng Cheng, which in Burmese times were separate charges. The "classical" name of the state is Khemarata or Khemarata Tungkapuri. About 63 per cent. of the total area of the state lies in the basin of the Mèkhong river and 37 per cent. in the Salween drainage area. The watershed is a high and generally continuous range. Some of its peaks rise to over 7000 feet, and the elevation is nowhere much below 5000 feet. Parallel to this successive hill ranges run north and south. Mountainous country so greatly predominates that the scattered valleys are but as islands in a sea of rugged hills. The chief rivers, tributaries of the Salween, are the Nam Hka, the Hwe Lông, Nam Pu, and the Nam Hsīm. The first and last are very considerable rivers. The Nam Hka rises in the Wa or Vü states, the Nam Hsīm on the watershed range in the centre of the state. Rocks and rapids make both unnavigable, but much timber goes down the Nam Hsīm. The lower part of both rivers forms the boundary of Kēng Tūng state. The chief tributaries of the Mèkhong are the Nam Nga, the Nam Lwe, the Nam Yawng, Nam Līn, Nam Hôk, and Nam Kôk. Of these the chief is the Nam Lwe, which is navigable in the interior of the state, but enters the Mèkhong by a gorge broken up by rocks. The Nam Līn and the Nam Kôk are also considerable streams. The lower course of the latter passes by Chieng Rai in Siamese territory. The lower Nam Hôk or Mē Huak forms the boundary with Siam.

The existence of minerals was reported by the Sawbwa, or chief, to Francis Garnier in 1867, but none are worked or located. Gold is washed in most of the streams. Teak forests exist in Möng Pu and Möng Hsat, and the Sawbwa works them as Government contracts. One-third of the price realized from the sale of the logs at Moulmein is retained as the Government royalty. There are teak forests also in the Mèkhong drainage area in the south of the state, but there is only a local market for the timber. Rice, as elsewhere in the Shan States, is the chief crop. Next to it is sugarcane, which is grown both as a field crop and in gardens. Earthnuts and tobacco are the only other field crops in the valleys. On the hills, besides rice, cotton, poppy, and tea are the chief crops. The cotton goes to China, except what is locally used, and so does the surplus opium, which was formerly chiefly sold in the Upper Lao country, now French territory and a closed market. The tea is carelessly grown, badly prepared, and only consumed locally. A great deal of garden produce is raised in the valleys, especially near the capital. The state is rich in cattle, and exports them to the country west of the Salween. There is no means of estimating the volume of trade. Cotton and opium are exported in large quantities, the former entirely to China, a good deal of the latter to northern Siam, which also takes shoes and sandals. Tea is carried through westwards from Kēng Hūng, and silk from the Siamese Shan States. Cotton and silk weaving are dying out as industries. Large quantities of shoes and sandals are made of buffalo and bullock hide, with Chinese felt uppers and soft hobnails. There is a good deal of pottery work, and the chief work in iron is the manufacture of guns, which has been carried on for many years in certain villages of the Sam Tao district. The gun barrels and springs are rude but effective, though not very durable. The revenue of the state is collected as the Burmese *thathameda*, a rude system of income-tax. From 1890, when the state made its submission, the annual tributary offerings made in Burmese times were continued to the British Government.

Nothing but the roughest enumeration has ever been made of the population. The following estimate was made by Mr Stirling, the political officer in charge of the state, in 1897–98 :—Inhabitants of the valleys, Shans or Shan-Chinese, 116,000 ; inhabitants of the hills, 56,560, giving a total population of 172,560. This is based on a rough enumeration of households. Of the various tribes of Shans, the Hkön and Lü contribute about 36,000 each, the western Shans 32,000, the Lem and Lao Shans about 7000, and the Chinese Shans about 5000. Of the hill tribes, the Kaw or Akha are the most homogeneous with 22,000, but probably the Wa (or Vü), disguised under various gratuitously tribal names, are at least equally numerous. Nominal Buddhists make up a total of 133,400, and the remainder, 39,160, are admitted followers of animistic religion. Spirit worship is, however, very conspicuously prevalent amongst all classes even of the Shans. The present Sawbwa or chief received his patent from the British Government on the 9th February 1897. The early history of Kēng Tūng is very obscure, but Burmese influence seems to have been maintained since the latter half, at any rate, of the 16th century. The Chinese made several attempts to subdue the state, and appear to have taken the capital in 1765–66, but were driven out by the united Shan and Burmese troops. The same fate seems to have attended the first Siamese invasion of 1804. The second and third Siamese invasions, in 1852 and 1854, resulted in great disaster to the invaders, though the capital was invested for a time.

Kēng Tūng, the capital, is situated towards the southern end of a valley about 12 miles long and with an average breadth of 7 miles. The town is surrounded by a brick wall and moat about 5 miles round. Only the central and northern portions are much built over. The population in 1897 was estimated at about 10,000, with 2500 Shan Chinese in a village immediately outside the walls. It is the most considerable town in the British Shan States. In the dry season crowds attend the market held according to Shan custom every five days, and numerous caravans come from China. The assistant political officer has a guard of fifty sepoys, with a British and native officer. The military post is 7 miles west of the town, at the foot of the watershed range. At first the headquarters of a regiment was stationed there; this was reduced to a wing, and it is contemplated to hold the station with military police. The site was badly chosen, and has proved very unhealthy. The rainfall has not been regularly taken, but probably averages between 50 and 60 inches for the year. The temperature seems to rise to nearly 100° Fahr. during the hot weather, falling 30° or more during the night. In the cold weather a temperature of 40° or a few degrees more or less appears to be the lowest experienced. (J. G. SC.)

Kennedy, Benjamin Hall (1804–1889), English scholar and schoolmaster, was born at Summer Hill, near Birmingham, 6th November 1804. He was educated at King Edward's School, Birmingham, and St John's College, Cambridge. At the university he carried off one classical prize after another, until, having graduated as senior classic, he was elected Fellow and Classical Lecturer of St John's College in 1828. Two years later he became an assistant master at Harrow, from where he went to Shrewsbury School as headmaster in 1836. By this time he had been ordained, and had received the degree of D.D. from his university. In 1831 he married Miss Janet Caird. He retained the headmastership of Shrewsbury until 1866, the thirty years of his rule there being marked by a long series of successes won by his pupils, chiefly in the field of classics. During that period he held (from 1841) a prebend at Lichfield and (from 1865 to 1868) the incumbency of West Felton, Salop. When he retired from Shrewsbury, a large sum was collected as a testimonial to him, and was devoted partly to the new school buildings and partly to the founding of a Latin professorship at Cambridge. It is cited as characteristic of him that he added £500 to the fund on the special condition that his name should not appear in the designation by which the new professorship was to be known. In 1867 he was elected Regius Professor of Greek at Cambridge and Canon of Ely; in 1870, member of the Council of the University; in 1880, Hon. Fellow, and in 1885, Ordinary Fellow of St John's College. From 1870 to 1880 he was a member of the Committee for the Revision of the New Testament. He was an enthusiastic advocate for the admission of women to a university education, and took a prominent part in the establishment of Newnham and Girton colleges. He was also a keen politician. Among a number of classical school-books published by him are two, a *Public School Latin Primer* and *Public School Latin Grammar*, which were for long in almost universal use. The former was produced, in accordance with the recommendation of a Royal Commission upon the chief public schools, by a committee of headmasters (of whom he was one), and was based upon an *Elementary Latin Grammar* previously written by him. He published a masterly edition of Sophocles's *Œdipus Tyrannus* with poetic translation, and performed the same office for Aristophanes's *Birds*, Æschylus's *Agamemnon*, and Plato's *Theætetus*. He contributed largely to the collection known as *Sabrinæ Corolla*, and published a collection of verse in Greek, Latin, and English under the title of *Between Whiles*. He died at Torquay, on 6th April 1889. (R. F. S.)

Kenosha, capital of Kenosha county, Wisconsin, U.S.A., on the western shore of Lake Michigan, at an altitude of 611 feet. It is traversed by the Chicago and North-Western railroad. The site of the city is broad and level and its plan fairly regular. It has some lake commerce, and its manufactures include furniture, waggons, and carriages. Population (1880), 5039; (1900), 11,606, of whom 3333 were foreign-born.

Kent, a maritime county in the south-eastern corner of England. The area of the ancient county, as given in the census returns, is 995,344 acres, or 1555 square miles, with a population in 1881 of 977,706, and in 1891 of 1,142,324, of whom 555,718 were males and 586,606 females, the number of persons per square mile being 735, and of acres to a person, 0·87. The population of the ancient county in 1901 was 1,351,849. The area of the administrative county, exclusive of the county borough of Canterbury, is 971,849 acres, with a population of 785,674; and including the county borough its area is 975,820 acres, with a population in 1891 of 807,328, and in 1901 of 936,003. Under the provisions of the Local Government Act, 1888, 20,060 acres of the ancient county were transferred to the county of London, and 536 acres, part of Tunbridge Wells urban sanitary district in the ancient county of Sussex, were added in October 1890. The area of the registration county is 968,879 acres, with a population in 1891 of 806,297, of which 508,647 were urban and 297,650 rural. Within this area the increase of population between 1881 and 1891 was 13·68 per cent. The excess of births over deaths between 1881 and 1891 was 105,557.

The following table gives the number of marriages, births, and deaths, and the number of illegitimate births, in 1880, 1890, and 1899 :—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				Males.	Females.
1880	4794	22,569	12,447	463	438
1890	5242	22,096	12,861	485	441
1899	7029	23,566	14,876	465	464

The following table shows the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years :—

	1870–79.	1880.	1880–89.	1890.	1889–98.	1899.
Marriage-rate	14·0	13·6	13·4	13·1	13·7	15·8
Birth-rate .	32·7	30·6	31·1	27·7	27·1	26·4
Death-rate .	18·4	17·7	16·8	16·1	15·6	16·7
Percentage of illegitimacy	4·6	4·0	4·3	4·2	4·0	3·9

The birth-rate and death-rate are below the average for England. The number of Scots in the county in 1891 was 6395, of Irish 8155, and of foreigners 3727.

Administration.—The ancient county is divided into eight parliamentary divisions, and it also includes the parliamentary boroughs of Canterbury, Chatham, Dover, Gravesend, Hythe, Maidstone, and Rochester. The administrative county includes seventeen municipal boroughs, exclusive of the county borough of Canterbury (24,868), viz., Chatham (40,753), Deal (10,575), Dover (41,782), Faversham (11,290), Folkestone (30,694), Gravesend (27,175), Hythe (5557), Lydd (2615), Maidstone (33,516), Margate (23,067), New Romney (1327), Queenborough (1546), Ramsgate (27,693), Rochester (30,622), Sandwich (3174), Tenterden (3243), Tunbridge Wells (33,388). The administrative county has one court of quarter sessions and fifteen petty sessional divisions. The non-corporate members of the Cinque Ports of Dover and Sandwich and the municipal boroughs of Canterbury, Deal, Dover, Faversham, Folkestone, Gravesend, Hythe, Maidstone, Margate, Rochester, Sandwich, and Tenterden have each separate commissions of the peace and separate courts of quarter sessions, and the boroughs of Lydd and New Romney have separate commissions of the peace only. The central criminal court has jurisdiction over certain parishes adjacent to London. All those civil parishes within the county of Kent of which any part is within twelve miles of, or of which no part is more than fifteen miles from Charing Cross, are within the metropolitan police district. Kent is in the south-eastern or home circuit, and Maidstone is the assize town for the county, but assizes are also held at Canterbury for the city. The administrative county contains 389 entire civil parishes and parts of 14 others, and the county borough of Canterbury, 24 entire civil parishes and parts of 10 others. The ancient county contains, in addition to those parishes now in the county of London, 465 entire ecclesiastical parishes and parts of 5 others situate in the dioceses of Canterbury, Rochester, and Chichester.

Education.—The number of elementary schools in the county on 31st August 1899 was 570, of which 112 were board and 458 were voluntary schools, the latter including 403 national Church of England schools, 11 Wesleyan, 19 Roman Catholic, and 25 "British and others." The average attendance at board schools was 32,094, and at voluntary schools 86,965. The total school board receipts for the year ended 29th September 1898 were over £134,322. The income under the Agricultural Rates Act was over £2788. Dairy schools have been established by the technical education committee of the Kent county council. Lectures on hop-growing, horticulture, fruit culture, bees (extensively kept in Kent), and poultry rearing have also been established throughout the county. The South-Eastern Agricultural College, Wye, is under the control of the county councils of Kent and Surrey. In 1899 there were six reformatory and industrial schools in the county.

Agriculture.—About five-sixths of the area of the county are under cultivation, and of this about five-ninths are in permanent pasture. In the thirty years from 1868 to 1898 woodland had increased from 78,000 acres to 96,927 acres; 6591 acres are occupied by heathland used for grazing. Over 25,000 acres are devoted to orchards and over 22,000 acres to small fruit, and it is estimated that since 1868 the whole area of fruit land has more than doubled. At least 20,000 acres are devoted to the production of vegetables, salads, herbs, and flowers. Owing to the low prices obtained for hops in recent years the acreage has diminished from 38,606 acres in 1868 to 31,988 acres in 1899. The largest hop acreage in Kent was in 1885, when there were 44,834 acres.

The following table gives the main divisions of the cultivated area at intervals from 1880 :—

Year.	Total Area under Cultivation.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	741,384	227,907	84,438	54,221	318,619	13,217
1890	760,780	200,365	77,303	54,139	368,474	11,639
1899	748,157	153,203	70,858	52,949	408,674	7,964

The following table gives particulars regarding the principal live stock during the same years :—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or in Calf.	Sheep.	Pigs.
1880	29,120	76,776	28,821	968,258	56,006
1890	28,150	75,550	32,150	916,214	66,659
1899	27,850	78,572	34,267	942,645	63,133

Industries and Trade.—According to the annual report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 47,089, as compared with 44,677 in 1896. Textile factories employed only 225. In non-textile factories 39,790 persons were employed, as compared with 38,200 in 1896, of which number 16,349 persons were employed in the manufacture of machines, appliances, conveyances, and tools, 7194 in the clay and stone industry, and 6491 in paper-making, printing, &c. The number of persons employed in workshops in 1896 was 7074, of which number 3692 were employed in the clothing industry. The fisheries of Kent are of considerable importance, and are carried on chiefly at Deal, Dover, Folkestone, Margate, Ramsgate; Pegwell Bay, and Gravesend (shrimps), Queenborough, Rochester, Milton, Faversham, and Whitstable (oysters). The county is also famous for its shipbuilding and marine engine yards, iron foundries, breweries, tanneries, &c. The dockyards are at Chatham and Sheerness, packet stations at Dover and Folkestone, and harbours at Ramsgate and Dover.

Authorities.—Lambarde. *Perambulation of Kent.* London, 1576, 1826.—Hasted. *History of Kent*, 4 vols. folio, Canterbury, 1778–99; 2nd edition, 12 vols. 8vo, Canterbury, 1797–1801.—Milne and Gordon. *Indigenous Botany.* London, 1793.—Smith (J. R.). *Bibliotheca Cantiana.* London, 1837. *Archæologia Cantiana* (*Transactions* of the Kent Archæological Society). London, from 1858.—Glynne. *Notes on the Churches of Kent.* London, 1877. (H. B. W*.)

Kenton, capital of Hardin county, Ohio, U.S.A., on the Scioto river, at an altitude of 1015 feet, and on the Ohio Central lines and the Cleveland, Cincinnati, Chicago, and St Louis railroad. Population (1880), 3940; (1900), 6852, of whom 493 were foreign-born and 271 negroes.

Kentucky.—One of the central states of the United States of America. It has an area of 40,400 square miles, 400 square miles of which are estimated to be water surface, including the entire breadth of the Ohio river, over which it has jurisdiction, and half of the Mississippi river, leaving as the land area of the state 40,000 square miles.

Population.—The population of the state in 1880 was 1,648,690; in 1890, 1,858,635; and in 1900, 2,147,174, making it at the last date the twelfth state in the country in population. The rate of increase between 1890 and 1900 was 15·5 per cent., about one-fourth less than the average of the country. In 1900 the density of population was about 54 to the square mile; males were slightly in excess of females, the proportion being 50·8 per cent. males to 49·2 per cent. females. The foreign-born numbered but 50,249, or 2·3 per cent. of the whole population, and the number of negroes was 284,706, or 13·3 per cent. The proportion of negroes is steadily decreasing, owing to their migration to other states both north and south of Kentucky. The urban population in 1900, classing as such all persons in cities of more than 8000 inhabitants, was 16·9 per cent. of the total population, as compared with 14·9 ten years before. The principal cities, with their population in 1900, are: Louisville, at the falls of the Ohio, 204,731; Covington, 42,938; and Newport, 28,301, on the Ohio, opposite Cincinnati; Lexington, 26,369; Paducah, on the Ohio, at the mouth of the Tennessee, 19,446; Owensboro, 13,189; Henderson, 10,272; and Frankfort, the capital, 9487. Of the population over ten years of age in 1890, 21·6 per cent. were illiterate; this illiteracy was in great part confined to the negroes, 55·9 per cent. of whom were classed as illiterates, while only 15·8 per cent. of the whites came under this head. Out of 469,206 white males of voting age in 1900, 65,517 were unable to write; while out of 74,728 negro males of voting age, 36,990 were unable to write.

Agriculture and Mining.—Kentucky is still in the main an agricultural state, its chief industries and avocations relating to that branch. In 1890 there were 179,264 farms, comprising 21,412,229 acres, of which a little more than half, or 11,818,882 acres, 46 per cent. of the total area of the state, was improved. The average size of farm was 119 acres, or a little less than the average of the country. Three-fourths of all farms were owned by their occupants, the remainder being rented for money or a share of the products. The value of farms, implements, and live stock, or, in other words, the farm capital, exceeded $428,000,000, and the value of products was nearly $66,000,000. Tobacco is one of the chief products of the state. In 1896 there were devoted to its cultivation 196,745 acres, and the crop amounted to 143,623,850 ℔, or 36 per cent. of the crop of the entire United States. In 1900, 12,442,846 bushels of wheat were produced, an amount larger than was needed for the supply of the population, leaving a surplus of at least 2,500,000 bushels for export. In the same year 390,064 tons of hay were produced, and 2,807,490 bushels of potatoes; there were 2,701,876 sheep, and the wool clip was 1,675,163 ℔ of scoured wool. The raising of hemp, which was once an important industry, has greatly diminished. The area of woodland is estimated at 22,200 square miles, or 55 per cent. of the area. The forests are mixed, but composed largely of deciduous trees, valuable for lumber. The chief mineral resources are coal and iron, and their development has progressed rapidly. In 1900, 4,113,620 tons of coal were mined, mainly in the eastern field, where large areas of superior coking coal are found. The amount of coal mined quadrupled between 1880 and 1900, giving Kentucky the tenth place among the states in this respect. The amount of pig-iron produced in 1900 was 71,562 tons.

Education, Charities, &c.—The public school system was maintained at a cost of $2,650,190 in 1900. The number of pupils enrolled was 501,893, or about five-eighths of the number of persons (798,027) between five and twenty years of age inclusive. The average attendance was only three-fifths of the enrolment. The number of teachers employed was 9960, and schools were open for an average period of only 115 days in the year. There are thirteen colleges for men, including co-educational institutions, and eleven colleges for women. The number of students in all these institutions in 1899 was 5487. The statistics of church membership show that more than three-fifths of all church members are either Baptists or Methodists. Baptists constituted 37 per cent., Methodists 24 per cent., Roman Catholics 17 per cent., and Disciples of Christ 14 per cent. of all church members. Of charitable and penal institutions there are state prisons at Frankfort and Eddyville, asylums for the blind, deaf and dumb at Louisville and Danville, and insane asylums at Lexington, Hopkinsville, and Anchorage.

Manufactures.—The manufactures are largely comprised in the city of Louisville, where nearly one-half the manufacturing capital of the state is invested. In 1900 the state contained 9559 manufacturing establishments (including those having product of less than $500 each), with a total capital of $104,030,791; they employed 63,206 hands, to whom was paid in wages $22,430,958; the products had a value of $154,590,069. The leading products were manufactured tobacco, whisky, malt liquors, flour, foundry and machine-shop appliances, iron and steel, leather, lumber, carriages and waggons, furniture, agricultural implements, and packed meats.

Railways.—In 1900 the railway mileage was 3083 miles, which was mainly in the hands of the Louisville and Nashville, the Chesapeake and Ohio, and Queen and Crescent companies. These agencies of transportation are supplemented by the Ohio, Mississippi, Cumberland, Tennessee, and other navigable rivers, but altogether the means of intercommunication are not as yet well developed.

Finances.—The finances are in an excellent condition. In 1899 the receipts into the state treasury were $5,013,010, and the expenditure was $4,282,225. The amount of indebtedness was trifling, being less than the sinking fund. There were eighty-one national banks in the state, with a capital of $12,000,000, and 225 state and private banks and trust companies, with a capital of $17,000,000.

Political History.—Politically as well as geographically Kentucky is a border state, political parties being almost equally powerful, with perhaps a slight preponderance in favour of the Democratic party, which has commonly carried the elections. The election of 1900 was so close as to leave the governorship in doubt, and during the controversy which followed, Goebel, the Democratic candidate, was killed. The lieutenant-governor on the Democratic ticket was subsequently declared elected, and was installed as governor. A new constitution was adopted in 1899. (H. G*.)

Kenya, a great volcanic mountain in East Africa, situated just south of the equator in 37° 20′ E. It is one of the highest mountains of Africa, its highest peak reaching an altitude, according to careful triangulation by Captain Smith, R.E., of 17,184 feet. The central core, which consists of several steep pyramids, is that of a very denuded old volcano, which when its crater was complete may have reached a height of 2000 feet above the present summit. Lavas dip in all directions from the central crystalline core, pointing to the conclusion that the main portion of the mountain represents a single volcanic mass. From the central peaks, of which the axis runs from

W.N.W. to S.S.E., ridges radiate outwards, separated by broad valleys, ending upwards in vast cirques. The most important ridges centre in the peak Lenana (16,300 feet) at the eastern end of the central group, and through it runs the chief water-parting of the mountain, in a generally north to south direction. Three main valleys, known respectively as Hinde, Gorges, and Hobley valleys, run down from this to the east, and four—Mackinder, Hausberg, Teleki, and Höhnel—to the west. From the central peaks a series of glaciers, 15 in number, all lying west of the main divide, descends to the north and south, the two largest being the Lewis and Gregory glaciers, each about a mile long, which, with the smaller Kolb glacier, lie immediately west of the main divide. Most of the glaciers terminate at an altitude of 14,800–14,900 feet, but the small César glacier, drained to the Hausberg valley, reaches to 14,450. There is clear evidence that glaciation was formerly much more extensive, old moraines being observed down to 12,000 feet. In the upper parts of the valleys a number of lakes occur, occupying hollows and rock basins in the agglomerates and ashes, fed by springs, and feeding many of the streams that drain the mountain slopes. The largest of these are Lake Höhnel, lying at an altitude of 14,000 feet, at the head of the valley of the same name, and measuring 600 yards by 400; and Lake Michaelson (12,700 feet?) in the Gorges valley. At a distance from the central core the radiating ridges become less abrupt and descend with a gentle gradient, finally passing somewhat abruptly, at a height of some 7000 feet, into the level plateau. These outer slopes are clothed with dense forest and jungle, composed chiefly of junipers and *Podocarpus*, and between 8000 and 9800 feet of huge bamboos. The forest zone extends to about 10,500 feet, above which is the steeper alpine zone, in which pasturages alternate with rocks and crags. This extends to a general height of about 15,000 feet, but in damp sheltered valleys the pasturages extend some distance higher. The only trees or shrubs in this zone are the giant *Senecio* (groundsel) and *Lobelia*, and tree-heaths, the *Senecio* forming groves in the upper valleys. Of the fauna of the lower slopes, tracks of elephant, leopard, and buffalo have been seen, between 11,500 and 14,500 feet. That of the alpine zone includes two species of Dassy (*Procavia*), a coney (*Hyrax*), and a rat (*Otomys*). The bird fauna, which resembles that of Mount Elgon, is of considerable interest, the finest species of the upper zone being an eagle-owl, met with at 14,000 feet. Both the fauna and flora of the higher levels present close affinities with those of other mountains of East Africa and of Cameroon. The true native names of the mountain are said to be Kilinyaga, Doenyo Ebor (white mountain), and Doenyo Egeri (spotted mountain). It was first seen, from a distance, by the missionary Krapf in 1849; approached from the west by Thomson in 1883; partially ascended by Teleki (1889), Gregory (1893), and Kolb (1896); and its summit reached by Mackinder in 1899.

See Gregory. *The Great Rift-Valley.* London, 1896.—Mackinder. "Journey to the Summit of Mount Kenya," *Geogr. Journal*, May 1900. (E. HE.)

Keokuk, a city of Lee county, Iowa, U.S.A., on the west bank of the Mississippi, near the mouth of the Des Moines, at an altitude of 505 feet. It obtains its water-supply from the Mississippi by the Holly pumping system. It has five railways: the Chicago, Burlington, and Quincy; the Chicago, Rock Island, and Pacific; the Keokuk and Western; the Toledo, Peoria, and Western; and the Wabash. These, with the Mississippi, give Keokuk a large trade. Population (1890), 14,101; (1900), 14,641, of whom 1778 were foreign-born and 1192 negroes.

Kerak, the ancient *Kir-Hareseth*, altitude 3300 feet, the chief town of a sanjak of the same name in the Suriya (Syrian) viláyet of Asiatic Turkey, and an important military station; situated east of the Dead Sea, in a fertile district, on a shelving rock-plateau almost encircled by deep ravines. It consists of a walled town, with a castle at its south end, which is isolated by a rock-hewn ditch—the whole forming an interesting specimen of a mediæval fortress. The original entrances were four winding rock-hewn passages, but the town is now entered through breaches in the walls, which were in a perfect state before the bombardment by Ibrahim Pasha in 1840. There are traces of Byzantine, Roman, and earlier occupation, including rock-hewn reservoirs, cisterns, and conduits. But the walls, standing on old foundations, are the work of the Crusaders and of their successors, the Eyúbites and the Memlúk sultans of Egypt. They were repaired by Sultan Bibars in the 13th century. The population (6000 Moslems and 1800 Orthodox Greek Christians) is of very mixed blood. Many of the Christians are of Egyptian origin, and the most influential Moslem families came from Hebron, which from a very early date has had close relations with Moab. The Greeks have two churches and a monastery; the Church Missionary Society, a station with a medical officer; and the Roman Catholics, a small monastery and church. Kerak was occupied and fortified by the Latin kings of Jerusalem in 1142, and was one of the great fortresses which commanded the important caravan routes from Egypt and Arabia to Damascus. It became the chief town of the Seigneurie of Kerak de Montréal, which included Hebron (Renaud, in a charter dated 1177, styles himself *Hebronensis et Montis Regalis dominus*); and whilst held by the notorious Renaud de Chatillon, 1177–87, it was repeatedly attacked by Saladin, to whom at last it surrendered in 1188. It continued to be a place of importance until the Turks occupied Palestine and Egypt. In 1893, after a period of semi-independence, it was strongly garrisoned by the Turks.

See Duc de Luynes. *Exploration de la Mer Morte*, ii. 106–129.—Schlumberger. *Renaud de Chatillon*, 1898.—Tristram. *Land of Moab.* (C. W. W.)

Kerasund, the ancient *Pharnacia*, a town on the north coast of Asia Minor, in the Trebizond viláyet, and the port—an exposed roadstead—of Kara-hissar Sharki, with which it is connected by a carriage road. The town is situated on a rocky promontory, crowned by a Byzantine fortress, and has a growing trade. In 1899 the exports—hazel-nuts, walnuts, hides, and timber—amounted to £187,230, and the imports to £135,010. Its population consists of 4500 Moslems, 4000 Greeks, and 1000 Armenians. Pharnacia was the place from which the wild cherry was introduced into Italy by Lucullus, and it was afterwards called Cerasus by the Romans.

Kerbela, the chief town of a sanjak of the Baghdad viláyet of Asiatic Turkey, built round the spot where Hosein was murdered. It is the principal place of Shíite pilgrimage, and of its population (65,000) about 54,000 are Shíites, chiefly Persians and British Indians.

Kerkuk, altitude 1100 feet, the chief town of the Shehrizor sanjak of the Mosul viláyet of Asiatic Turkey, and an important military station. It is a centre for the purchase of Arab horses for India. The population numbers about 10,000 Sunni Kúrds, with a few Christians and Jews.

Kermánsháh, an important province of Persia, situated west of Hamadán, north of Luristán, and south of Kurdistan, and extending in the west to the Turkish frontier. Its population is about 400,000, and it pays a yearly revenue of over £20,000. Many of its inhabitants are nomadic Kurds and Lurs, who pay little taxes. The province produces much wheat and barley, and could supply great quantities of grain for export if means of transport were better. Kermánsháh (Kermánsháhán), the capital of the province, is situated at an elevation of 5100 feet in 34° 19′ N., and 46° 59′ E., about 220 miles from Baghdad, and 250 miles from Tehran. It has a population of about 35,000, post and telegraph offices, and is situated on the high road between Tehran and Baghdad, and carries on a great transit trade, estimated at £750,000 per annum.

Kerry, a maritime county of Ireland, province of Munster, bounded on the N. by the mouth of the Shannon, on the E. by Limerick and Cork, on the S. by Cork, and on the W. by the Atlantic.

Population.—The area of the administrative county in 1900 was 1,159,356 acres, of which 154,881 were tillage, 533,696 pasture, 161 fallow, 15,019 plantation, 62,819 turf bog, 39,404 marsh, 311,318 barren mountain, and 42,058 water, roads, fences, &c. The new administrative county, under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 201,039, and in 1891, 179,136, of whom 91,017 were males and 88,119 females, divided as follows among the different religions:—Roman Catholics, 173,195; Protestant Episcopalians, 5077; Methodists, 399; Presbyterians, 210; and other denominations, 255. The decrease of population between 1881 and 1891 was 10·89 per cent. The average number of persons to an acre was ·15. Of the total population, 160,742 persons inhabited the rural districts, being an average of 89 persons to each square mile under crops and pasture. The population in 1901 was 165,331 (Roman Catholics, 160,209; Protestant Episcopalians, 4428; Methodists, 317; Presbyterians, 225; others, 152), being a decrease of 7·7 per cent. The following table gives the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R. C.	Pr.Ep.	Presb.	Meth.
Read and write	57,007	51,538	108,545	67·2	91·0	97·0	89·8
Read only	5,961	5,886	11,847	7·5	4·1	0·5	4·6
Illiterate . .	18,099	21,174	39,273	25·3	4·9	2·5	5·6

The percentage of illiterates among Roman Catholics in 1881 was 36·1. In 1891 there were 8 superior schools, with 393 pupils (Roman Catholics 367, and Protestants 26), and 372 primary schools, with 33,779 pupils (Roman Catholics 32,834, and Protestants 945). The number of pupils on the rolls of the national schools on 30th September 1899 was 35,745, of whom 34,907 were Roman Catholics and 838 Protestants.

The following table gives the numbers of births, deaths, and marriages in the years specified:—

Year.	Births.	Deaths.	Marriages.
1881	5121	2731	630
1891	4218	2504	649
1900	3968	2622	660

The birth-rate per thousand in 1900 was 24·1, and the death-rate, 15·9; the rate of illegitimacy was 1·8 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 207,786, of whom 103,797 were males and 103,989 females. The chief towns in the county, with their populations, are:—Tralee, 9318; Killarney, 5656; Listowel, 3800.

Administration.—The county is divided into four parliamentary divisions, north, south, east, and west, the number of registered electors in 1900 being respectively 5675, 5758, 6005, and 5845. The rateable value in 1900 was £304,275. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 3 urban and 6 rural sanitary districts.

Agriculture.—The following table gives the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900:—

Year.	Wheat.	Oats.	Barley, Rye, Beans, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	1032	27,538	4648	31,178	5728	5401	90,060	165,570
1891	2042	25,661	8883	27,906	6071	7158	95,862	168,533
1895	870	28,875	2966	25,283	6050	6718	99,821	165,083
1900	1891	20,747	2285	22,786	5509	7605	94,556	154,879

For 1899 the total value of the cereal and other crops was estimated by the Registrar-General at £1,032,005. The number of acres under pasture in 1881 was 566,950; in 1891, 518,613; and in 1900, 533,696.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	18,868	11,402	242,822	132,196	62,963	26,462	552,812
1891	17,684	8,765	209,739	82,929	45,630	23,442	485,142
1895	18,252	12,304	238,195	115,785	60,199	21,599	557,238
1900	18,377	15,170	251,379	137,943	58,162	24,887	647,966

The number of milch cows in 1891 was 107,111, and in 1900, 108,384. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £3,453,163. In 1900 the number of holdings not exceeding 1 acre was 2287; between 1 and 5, 1928; between 5 and 15, 3176; between 15 and 30, 3886; between 30 and 50, 3790; between 50 and 100, 3899; between 100 and 200, 1698; between 200 and 500, 600; and above 500, 110—total, 21,374. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900 was 1560, amounting to £668,456. The number of loans for agricultural improvements sanctioned under section 31 of the Land Act, 1881, between 1882 and 1900, was 1179, and the amount issued £71,685. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1900, was £479,626, the largest amount issued in any county in Ireland.

Fisheries.—The number of vessels registered in 1899 in the deep sea and coast fishery districts of Valentia and Dingle was 822, employing 3487 men and boys. The number of persons employed in the same year in the salmon fishery districts of Kenmare and Killarney was 903. (W. H. Po.)

Kertch, a seaport of Russia, government of Taurida, on the Kertch Strait, chief town of the Kertch-Yenikale township (*gradonachalstvo*). Its mineral mud-baths, one of which is in the town itself and the other on the Chokrak lake (9 miles), are much visited. The population in 1897 was 28,946. Notwithstanding the deepening of the strait, which now allows ships to enter the Sea of Azov, Kertch retains its importance for the export trade in wheat, which is brought hither by coasting vessels to be mixed with the better sorts of American wheat before it is exported. There is a private museum (Novikoff's) of antiquities.

Very important finds of old Greek art continue to be made in the neighbourhood, as well as at Tamañ, on the east side of the Strait of Kertch. The catacombs on the northern slope of the Mitridates Hill, of which nearly 200 have been explored since 1859, possess considerable interest, not only for the relics of old Greek art which some of them contain (although most were plundered in earlier times), but especially as material for the history and ethnography of the Cimmerian Bosphorus. In 1890 the first Christian catacomb bearing a distinct date, 491, was discovered by Kulakovsky. Its walls proved to be covered with Greek inscriptions and crosses.

Authorities.—Reports of the Imp. Arch. Commission.—*Izvestia* (Bulletin) of the Archives Commission of Taurida.—*Antiquités du Bosphore Cimmérien conservées au Musée Impérial de l'Ermitage.* St Petersburg, 1854. *Inscriptiones antiquae orae septentrionalis Ponti Euxini graecae et latinae*, with a preface by V. V. Latysheff. St Petersburg, 1890.—*Materials for the Arch. of Russia*, published by the Imp. Arch. Commission, No. 6. St Petersburg, 1891. (P. A. K.)

Keshub Chunder Sen [Keshava Chandra Sena] (1838–1884), Indian religious reformer, was born at Calcutta in 1838. His family belonged to one of the highest castes, and boasted a descent which could be traced through eight centuries. At the age of ten he lost his father, and was brought up under his mother's charge. He was sent to an English school, where he made good progress, and afterwards studied at the college of Calcutta, where he became proficient in English literature and history. In accordance with the Indian custom, he was married at eighteen to a child of ten. His family wished him to follow a business career, and a place was found for him in the Bank of Bengal, but his bent was towards literature and philosophy, and he soon resigned his post in order to devote himself exclusively to these pursuits. At that time Sir William Hamilton, Blair, Parker, Cousin, Newman, and Emerson were among his favourite authors. Their works made the deepest impression on him, for, as he expressed it, "Philosophy first taught me insight and reflection, and turned my eyes inward from the things of the external world, so that I began to reflect on my position, character, and destiny." Like many other educated Hindus, Keshub Chunder Sen had gradually dissociated himself from the popular forms of the native religion, without abandoning what he believed to be its spirit. As early as 1857 he had joined the Brahmo Somaj, founded in 1830 by Ram Mohun Roy, who aimed at initiating a religious reform from within, so as to worship Brahma the creator in accordance with what he believed to be the pure theism of the Vedas. His successor, Debendra Nath Tagore, gathered the worshippers into a stricter association with a definite theistic creed and moral code, and disavowed the Vedas because they recognized pantheism, transmigration, and other similar doctrines. Keshub Chunder Sen threw himself with enthusiasm into the work of this society, and in 1862 himself undertook the ministry of a theistic church. In the same year he helped to found the Albert College, and started the *Indian Mirror*, a weekly journal in which social and moral subjects were discussed. He also travelled about the country lecturing and preaching. Little by little he had drifted away from Debendra Nath Tagore, who wanted to revive the Hinduism of the Upanishads, while Chunder Sen's sympathies were more catholic and extended to the teachings of Jesus. He also desired to bring about various reforms, such as the remarriage of widows and the abolition of caste. The result was a split in the society, which broke up into two sections, Chunder Sen putting himself at the head of the reform movement, which took the name Brahmo Somaj of India, and tried to propagate its doctrines by missionary enterprise. Its tenets at this time were the following:—1. The wide universe is the temple of God. 2. Wisdom is the pure land of pilgrimage. 3. Truth is the everlasting scripture. 4. Faith is the root of all religions. 5. Love is the true spiritual culture. 6. The destruction of selfishness is the true asceticism. In 1866 he delivered an address on "Jesus Christ, Europe and Asia," which caused a good deal of stir, and led to the false impression that he was about to embrace Christianity. This helped to call attention to him in Europe, and an invitation to visit England was accepted in 1869. The visit was paid in 1870. The Hindu preacher was warmly welcomed by almost all denominations, particularly by the Unitarians, with whose creed the Brahmo Somaj had most in common, and it was the committee of the British and Foreign Unitarian Association that organized the welcome soiree at Hanover Square Rooms on 12th April. Ministers of ten different denominations were on the platform, and among those who officially bade him welcome were Lord Lawrence and Dean Stanley. He remained for six months in England, visiting most of the chief towns, where he lectured, preached, &c., in all addressing over seventy meetings. His eloquence, delivery, and command of the language won universal admiration. His own impression of England was somewhat disappointing. Christianity in England appeared to him too sectarian and narrow, too "muscular and hard," and Christian life in England more materialistic and outward than spiritual and inward. "I came here an Indian, I go back a confirmed Indian; I came here a Theist, I go back a confirmed Theist. I have learnt to love my own country more and more." These words spoken at the farewell soiree may furnish the key to the change in him which so greatly puzzled many of his English friends. He developed a tendency towards mysticism and a greater leaning to the spiritual teaching of the Indian philosophies. Outwardly, too, he returned in many respects to the customs of his country. He gave his child daughter in marriage to the maharaja of Kuch Behar; he revived the performance of mystical plays, and himself took part in one. These changes alienated many of his followers, who deserted his standard and joined the more conservative section. Two lectures delivered between 1881 and 1883 throw a good deal of light on Chunder Sen's latest doctrines. They were "The Marvellous Mystery, the Trinity," and "Asia's Message to Europe." This latter is an eloquent plea against the Europeanizing of Asia, as well as a protest against Western sectarianism. During the intervals of his last illness he wrote the *New Samhita, or the Sacred Laws of the Aryans of the New Dispensation.* He died in January 1884, leaving many bitter enemies and many warm friends. (A. Z.)

Keswick, a township, market town, and railway station, in the Penrith parliamentary division of Cumberland, England, near Derwentwater, 16 miles west by south of Penrith. Recent erections include a cottage hospital and a pavilion with a large hall and other accommodation. A public park of 28 acres was provided in 1887. Area of township, 718 acres. Population (1881), 3201; (1901), 4451.

Keswick Convention, an annual summer reunion held at Keswick (24 miles from Carlisle), for the main purpose of "promoting practical holiness" by meetings for prayer, discussion, and personal intercourse. Though it has no denominational limits, it is chiefly supported by the "Evangelical" section of the Church of England. The meetings are held in a large tent. Sometimes as many as 10,000 people are present during the week. The rise of the Convention should be viewed in connexion with the religious revival of the 'seventies (various "conferences" on the spiritual life, visit of Moody and Sankey, rise of parochial and numerous home missions, &c.). The revival was primarily concerned with individual piety, but the interest awakened soon expanded into vigorous missionary enthusiasm.

The Convention, started in a private manner by Canon Harford Battersby in 1875, rapidly grew after the first few years, both in numbers and influence, in spite of attacks on the alleged "perfectionism" of some of its leaders and on the novelty of its methods. Its immediate aim has always been to deepen personal religion, but some indication of its success may be seen in the interest taken by its members in foreign missions. As an instance it may be mentioned that, in consequence of the first missionary meeting of the Convention (1887), seventeen women missionaries went out to the foreign field. In the *History of the C.M.S.*, vol. iii. (by Eugene Stock) the missionary influence of the "Keswick men," in Cambridge and elsewhere, may be readily traced. Cf. the brief sketch, PIERSON, *The Story of Keswick.* (G. E. N.)

Ketteler, Wilhelm Emmanuel, BARON VON (1811–1877), German theologian and politician, was born at Harkotten, in Bavaria, 25th December 1811. He studied theology at Göttingen, Berlin, Heidelberg, and Munich, and was ordained priest in 1844. From that period he resolved to consecrate his life to maintaining the cause of the freedom of the Church from the control of the State. This brought him into collision with the civil power, an attitude which he maintained throughout the whole of a stormy and eventful life. Ketteler was rather a man of action than a scholar, and he first distinguished himself as one of the deputies of the Frankfort National Assembly, a position to which he was elected in 1848, and in which he soon became noted for his decision, foresight, energy, and eloquence. In 1850 he was made bishop of Mainz, by order of the Vatican, in preference to the celebrated Professor Leopold Schmidt, of Giessen, who had been duly elected to the post, but whose Liberal sentiments were not agreeable to the Papal party. When elected, Ketteler refused to allow the students of theology in his diocese to attend lectures at Giessen, and ultimately founded an opposition seminary in the diocese of Mainz itself. He carried on his warfare with the State in a manner equally uncompromising. Not content with establishing his seminary for priests, he founded orders of School Brothers and School Sisters, to work in the various educational agencies he had called into existence, and he industriously laboured to institute orphanages and rescue homes. In 1858 he threw down the gauntlet against the State in his pamphlet on the rights of the Catholic Church in Germany. In 1863 he took the further step of espousing the cause of the masses against the classes by adopting Lassalle's Socialistic views, and published his *Die Arbeitfrage und das Christenthum*. When the question of Infallibility arose, he opposed the promulgation of the dogma at first on the ground that such promulgation was inopportune. But he was not very resolute in his opposition. The opponents of the dogma complained at the very outset that he was wavering, half converted by his hosts, the members of the German College at Rome, and further influenced by his own misgivings. He soon deserted his anti-Infallibilist colleagues, and submitted to the decrees in August 1870. He was the warmest opponent of the State in the *Kulturkampf* provoked by Prince Bismarck after the publication of the Vatican decrees, and was largely instrumental in compelling that statesman to retract the pledge he had rashly given, never to "go to Canossa." To such an extent did Bishop von Ketteler carry his opposition, that in 1874 he forbade his clergy to take part in celebrating the anniversary of the battle of Sedan, and declared the Rhine to be a "Catholic river." After this little was heard of him. He died at Burghausen, Upper Bavaria, on 13th July 1877. (J. J. L*.)

Kettering, a market town in the eastern parliamentary division of Northamptonshire, England, 14 miles north-east of Northampton by rail. Recent erections include Established and Roman Catholic churches, a Victoria Hall, a free library, two hospitals for infectious diseases, and a general hospital. There are an endowed grammar-school and a cattle-market. Area of parish (an urban district), 2814 acres. Population (1881), 11,095; (1901), 28,653.

Kettle, Sir Rupert Alfred (1817–1894), English county court judge, was born at Birmingham, 9th January 1817. His family had for some time been connected with the glass-staining business. In 1845 he was called to the bar, and in 1859 he was made judge of the Worcestershire county courts, becoming also a bencher of the Middle Temple (1882). His title to fame rests mainly on his association with the movement for establishing arbitration in trade disputes. He acted as arbitrator in several important strikes, and besides being the first president of the Midland iron trade wages board, he was largely responsible for the formation of similar boards in other staple trades. His name thus became identified with the organization of a system of arbitration between employers and employed, and in 1880 he was knighted for his services in this capacity. In 1851 he married; one of his sons subsequently became a London police magistrate. Sir Rupert Kettle died on 6th October 1894, at Wolverhampton. He was the author of several important books dealing with the settlement of labour disputes.

Kewanee, a town of Henry county, Illinois, U.S.A., on the Chicago, Burlington, and Quincy railroad, at an altitude of 847 feet. Its manufactures in large part are agricultural implements, waggons, and carriages. Population (1880), 4207; (1900), 8382, of whom 2006 were foreign-born.

Key, Sir Astley Cooper (1821–1888), English admiral, son of Charles Aston Key (1793–1849), a well-known surgeon, pupil of Sir Astley Cooper, whose niece he married, was born in London in 1821, and entered the navy in 1833. After distinguishing himself in active service abroad, on the South American station (1844–46), in the Baltic during the Crimean war (C.B. 1855), and China (1857), he was appointed in 1858 a member of the royal commission on national defence, in 1860 captain of the steam reserve at Devonport, and in 1863 captain of H.M.S. *Excellent* and superintendent of the Royal Naval College. He had a considerable share in advising as to the reorganization of administration, and in 1866, having become rear-admiral, was made director of naval ordnance. Between 1869 and 1872 he held the offices of superintendent of Portsmouth dockyard, superintendent of Malta dockyard, and second in command in the Mediterranean. In 1872 he was made president of the projected Royal Naval College at Greenwich, which was organized by him, and after its opening in 1873 he was knighted (K.C.B.) and made a vice-admiral. In 1876 he was appointed commander-in-chief on the North American and West Indian station. Having become full admiral in 1878, he was appointed in 1879 principal A.D.C., and soon afterwards First Naval Lord of the Admiralty, retaining this post till 1885. In 1882 he was made G.C.B. He died at Maidenhead, 3rd March 1888.

Key West, capital of Munroe county, Florida, U.S.A., on a small island of the same name, south-west of the southern point of the peninsula of Florida. Being in a commanding position at the entrance to the Gulf of Mexico, it is the site of a naval station, which is defended by Fort Taylor. Most of the island is occupied by this station, but there are also several extensive cigar factories, in which Cuban leaf is made into "Key West" cigars. This has been the chief, almost the only, business of the inhabitants. In recent years, however, much of this manufacture has removed to Tampa, and with it has gone a part of the population. During the war between the United States and Spain, Key West became a very important rendezvous and supply point. Population (1890), 18,080; (1900), 17,114, of whom 7266 were foreign-born and 5562 negroes.

Kezanlik, or Kasanlik, chief town of a department in the principality of Bulgaria, dominated on the north by the Balkans, at the southern termination of the Shipka pass, on a tributary of the Maritza, about 20 miles north-west of Eski Sagra, and 59 north of Philippopolis. It possesses a higher-class school. The town is the centre of the attar of rose trade in Bulgaria, the whole of the Kezanlik valley being occupied by fields of roses. Cloth is also manufactured. It was from Kezanlik that the Turks during the war of 1877–78 directed their attacks against the Russians who held the Shipka pass. Population (1893), 10,765, of whom about one-seventh are Turks.

Khabarovsk, a town of Asiatic Russia, capital of the Amur region, of the Maritime Province, and of the Khabarovsk district which comprises the lower Amur from its junction with the Usuri to its mouth. It was founded in 1855, and is built on a high cliff on the right bank of the Amur, at its confluence with the Usuri, 48° 28′ N., 135° 6′ E., 5532 miles east of Moscow by railway to Sryetensk, and thence down the Shilka and the Amur. It became a town in 1880, when it was made the seat of the governor-general of the Amur region (provinces —Amur, Maritime, and Sakhalin Island). It is connected by rail with Vladivostock (469 miles), a branch railway being built from this main trunk to Port Arthur. The thick forests surrounding the town, now cleared to some extent, offer no facilities for agriculture, but its position at the junction of two great rivers makes of it an important entrepôt for goods coming from the Usuri and its tributary the Sungacha, as well as a centre of trade and administration. The town is built of wood, and has a great cathedral, barracks, a corps of cadets, a monument to Count Muravieff-Amurskiy, and large storehouses. It has also a branch of the Russian Geographical Society, a good museum, and a rich library, a technical railway school, a gymnasium for girls, various primary schools, and two philanthropic institutions. Population (1897), 15,082.

Khaibar Pass, the most important of the passes which lead from India to Afghanistan. The mountain barrier which separates the Peshawur plains from the Afghan highlands differs in many radical respects from the mountain barrier which intervenes between the Indus plains and the plateau farther south. To the south this barrier consists of a series of flexures folded parallel to the course of the river, through which the plateau drainage breaks down in transverse lines forming gorges and clefts as it cuts through successive ridges. West of Peshawur the strike of the mountain systems is roughly from west to east, and this formation is maintained with more or less regularity as far south as the Tochi river and Waziristan. Almost immediately west of Peshawur, and stretching along the same parallel of latitude from the meridian of Kabul to within 10 miles of the Peshawur cantonment, is the great central range of the Safēd Koh, which forms throughout its long, straight line of rugged peaks the southern wall, or water-divide, of the Kabul river basin. About the meridian of 71 E. it forks, sending off to the north-east what is locally known as a spur to the Kabul river, but which is geographically only part of that stupendous water-divide which hedges in the Kunar and Chitral valleys, and which, under the name of the Shandur range, unites with the Hindu Kush near the head of the Taghdumbash Pamir. The Kabul river does not really terminate this northern spur of the Safēd Koh; it breaks through it, and in breaking through it is forced to the northward in a curved channel or trough, deeply sunk in the mountains between terrific cliffs and precipices, where its narrow waterway affords no foothold to man or beast for many miles. To reach the Kabul river in the Afghan territory it is necessary to pass over this water-divide; and the Khaibar stream, flowing down from the pass at Lundi Kotal to a point in the plains opposite Jamrud, 9 miles to the west of Peshawur, affords the opportunity.

From its commencement amongst the foothills opposite Jamrud to the Lundi Kotal, the road (now a driving road) follows much the same alignment as that adopted in the first Afghan war of 1839–43. It winds amidst mountains, and is flanked by cliffs and dominating hills throughout its course. About half-way between Jamrud and Lundi Kotal the hill fortress of Ali Masjid, perched on a comparatively isolated spur, absolutely bars the way. It is the key to the Khaibar; but as the road approaches, it reaches to a height which very considerably reduces the command of the fort, which is not quite so formidable as it appears. From Ali Masjid to the fortified position at Lundi Kotal the road is more open, but it is everywhere a road of the mountains and not of the plains. At Lundi Kotal (3600 feet) the Khaibar ends, and the drop northwards to Lundi Khana and by the Okha Khwar nullah to Dakka and the Kabul is through Afghan territory.

The Khaibar has been adopted by the British as the main road to Kabul, but its difficulties, before they were overcome by British engineers, were such that it was never so regarded by former rulers of India. The old road to India left the Kabul river near its junction with the Kunar, and crossed the great divide between the Kunar valley and Bajaor; then it turned southwards to the plains. The difficulty which the British authorities experienced with the Khaibar was chiefly in maintaining and guarding it against tribal attack. The tribes occupying the mountains which flank it and the villages in its immediate neighbourhood are the Zakka Khel Afridis. Farther to the north, within the Kabul bend, and clustering in the open spaces and uplands which lie beyond the dominating peaks of Torsappa (5350 feet), are the Mohmands, a tribe of Afghan extraction, who as a rule give little trouble, as they possess commercial and agricultural relations in the Peshawur valley. Of late years the Khaibar has been held by Afridi levies drawn chiefly from other clans than the Zakka, and officered by natives. The failure in 1896 to retain the command of the pass, when the Zakka Afridis combined to attack these other Afridi levies (who were unsupported by British troops), induced the Government of India to alter this system. The Afridi levies who defended the pass with great courage and determination against their fellow tribespeople were still retained as guardians of the Khaibar, but they were commanded by British officers.

See Sir R. Warburton. *Eighteen Years in the Khaibar.* London, 1900. (T. H. H*.)

Khairagarh, a feudatory state of India, in the Chhattisgarh division of the Central Provinces. Area, 940 square miles; population (1881), 166,138; (1891), 181,184; average density, 199 persons per square mile. In 1901 the population was 137,542, showing a decrease of 24 per cent., due to the results of famine. The estimated revenue was Rs.2,25,000; tribute, Rs.70,000. The chief, who is descended from the old Gond royal family, received the title of raja as a hereditary distinction in 1898. The state includes a fertile plain, yielding rice and cotton. Its prosperity has been promoted by the Bengal–Nagpur railway, which has a station at Dongargarh, connected by road with Khairagarh town, the residence of the raja.

Khaireddin (*Khair-ed-Din*="Joy of Religion") (—— -1890), Turkish statesman, was of Circassian race, but nothing is known about his birth and parentage. In early boyhood he was in the hands of a Tunisian slave-dealer, by whom he was sold to Hamuda Pasha, then bey of Tunis, who conceived a great affection for the lad, and gave him his freedom and a French education. When Khaireddin left school the bey made him steward of his estates, and from this position he rose to be minister of finance. When the prime minister, Mahmud ben Ayad, absconded to France with the treasure-chest of the principality, Hamuda despatched Khaireddin on a mission to the French Government to obtain the extradition of the fugitive. The mission failed; but the six years it occupied enabled Khaireddin to make himself widely known in France, to become acquainted with French political ideas and administrative methods, and, on his return to Tunis, to render himself more than ever useful to his Government. Hamuda died while Khaireddin was in France, but he was highly appreciated by the three beys—Ahmet (1837), Mohammed (1855), and Sadok (1859)—who in turn followed Hamuda, and to his influence was due the sequence of liberal measures which distinguished their successive reigns. But although Khaireddin's protracted residence in France had imbued him with liberal ideas, it had not made him a French partisan, and he strenuously opposed the French scheme of establishing a protectorate over Tunis upon which France embarked in the early 'seventies. This rendered him obnoxious to Sadok's prime minister—an apostate Jew named Mustapha ben Ismael—who finding his purposes thwarted by Khaireddin, intrigued against him and succeeded in completely undermining the bey's confidence in him. His position thus became untenable in Tunis, and shortly after the accession of Abdul Hamid he acquainted the sultan with his desire to enter the Turkish service. In 1877 the sultan bade him come to Constantinople, and on his arrival gave him a seat on the Reform Commission then sitting at Tophane. Early in 1879 the sultan appointed him grand vizier, and shortly afterwards he prepared a scheme of constitutional government, but Abdul Hamid refused to have anything to do with it. Thereupon Khaireddin resigned office, on the 28th July 1879. More than once the sultan offered him anew the grand vizierate, but Khaireddin persistently refused it, and thus incurred disfavour. Gouty and otherwise ailing, Khaireddin repeatedly but vainly sought leave of the sultan to go abroad and recruit his health. He died in February 1890, practically a prisoner in his own house.

Khairpur, a native state of India, in the Sind province of Bombay. Area, 6109 square miles; population (1891), 131,937; average density, 22 persons per square mile. In 1901 the population was 199,565, showing an apparent increase of 51 per cent. The estimated revenue was Rs.11,38,000; number of police, 181; number of schools (1897–98), 110, with 3754 pupils. The title of G.C.I.E. was conferred upon the present Mir on the occasion of Queen Victoria's Diamond Jubilee. He takes an active interest in improving his state, and especially in education. KHAIRPUR town is situated in 27° 31′ N. and 68° 48′ E., on a canal about 15 miles east of the Indus; railway station, 20 miles south of Sukkur, on the Kotri–Rohri branch of the North-Western railway, which here crosses a corner of the state. Population (1891), 6240.

Khamgaon, a town of India, in the Akola district of Berar, 340 miles north-east of Bombay. The population in 1881 was 12,390, and in 1891 it was 15,598; the municipal income in 1896–97 was Rs.26,164. It is an important centre of the cotton trade, with nine ginning factories and five presses, turning out 43,000 bales. It was connected in 1870 with the Great Indian Peninsula railway by a branch line ($7\frac{1}{2}$ miles).

Khamseh, a small but important province of Persia, between Kazvín and Tabríz. It consisted formerly of five districts, whence its name Khamseh, "the five," but is now subdivided into seventeen districts. The language of the inhabitants is Turkish. The province pays a revenue of about £20,000 per annum, and its capital is Zanján.

Khandesh, a district of British India, in the Deccan division of Bombay. The present headquarters are at Dhulia, but the railway junction of Bhusawal is the centre of trade. Area, 10,907 square miles; population (1881), 1,252,016; (1891), 1,460,851, showing an increase of 17 per cent.; average density, 134 persons per square mile. In 1901 the population was 1,460,652, showing an increase of less than 2 per cent. The land revenue and rates were Rs.47,33,892, the incidence of assessment being R.1 : 4 : 9 per acre; cultivated area (1897–98), 3,004,057 acres, of which 67,692 were irrigated from wells, &c., including 13,610 acres from Government canals; number of police, 1858; children at school (1897–98), 28,916, being 2·1 per cent. of the total population; registered death-rate (1897), 48·82 per thousand. The principal crops are millet, cotton, pulse, wheat, and oil-seeds. There are 70 factories for ginning and pressing cotton; a cotton-mill at Jalgaon, with 411 looms and 20,000 spindles, employing 1300 hands; and six printing-presses, each issuing a vernacular newspaper of small circulation. The district is traversed for 124 miles by the Great Indian Peninsula railway, which branches at Bhusawal (where there is a bridge over the Tapti) towards Jubbulpore and Nagpur. It is also crossed by the Tapti Valley line from Surat. It suffered somewhat from famine in 1896–97, and more severely in 1899–1900.

Khandwa, a town of British India, in the Nimar district of the Central Provinces, of which it is the headquarters, 353 miles north-east of Bombay by rail. Population (1881), 15,152; (1891), 15,589. Khandwa is an ancient town, with Jain and other temples. As a centre of trade, it has superseded the old capital of Burhanpur. It is an important railway junction, where the Malwa line from Indore meets the main line of the Great Indian Peninsula. There are eight steam factories for ginning and pressing cotton; an unaided high school, and railway school for Europeans; and a printing-press, issuing a vernacular newspaper.

Khár, a small but very fertile province of Persia, known by the ancients as Choara and Choarene. It has a population of about 10,000. The governor of the province resides at Kishlák Khár, a large village situated 62 miles south-east of Tehran, or at Aradán, a village with post and telegraph offices, 9 or 10 miles farther east. The province has an abundant water-supply from the Hableh-rúd, and produces great quantities of wheat, barley, and rice. Of the £6000 which it pays to the State, more than £4000 is paid in kind—wheat, barley, straw, and rice. It is held in fief by the minister of Crown domains (Khalisseh).

Kharkoff, a government of Little Russia, belonging partly to the basin of the Don and partly to that of the Dnieper. Area, 21,041 square miles; population, 2,036,949 in 1882; 2,509,811 in 1897, of whom 1,242,892 were women and 367,602 lived in towns; 63 per cent. of the land is owned by the peasants, 25 per cent. by the nobility, 6 per cent. by owners of other classes, and 6 per cent. by the Crown and other institutions. Agriculture is the chief occupation, and the crops in an average year are wheat, 1,080,000 quarters; rye, 1,805,000; oats, 1,100,000; barley, 724,000; millet, sarrazin, and Indian corn, 380,000; potatoes, 433,000 quarters. There remain in an average year 161,150 tons of grain available for export. Flax, hemp, and tobacco are also widely cultivated. Gardening and kitchen gardening are common pursuits. There were in 1895, 330,000 horses, 610,000 cattle, and about 1,080,000 sheep. Domestic industries are not widely developed, and industries, except sugar, have not a great development, their aggregate yearly returns being about £4,200,000. Sugar works—chiefly about Sumy—are the chief of them (over £2,500,000); but there are also distilleries, wool-cleaning works, steam flour-mills, and tobacco works. Salt is extracted at Slavyansk. The government is divided into eleven districts, the chief towns of which, with their populations in 1897, are Kharkoff (174,846), Akhtyrka (23,390), Bogodukhoff (11,928), Izyum (12,959), Kupyansk (7797), Lebedin (14,206), Starobyelsk (13,128), Sumy (27,575), Valki (8842), Volchansk (11,322), and Zmiyeff (4652).

Kharkoff, capital of the above province, 480 miles by rail south of Moscow. It grew rapidly during the last quarter of the 19th century, and has now 174,846 inhabitants (about 195,000 with its suburbs). Of these, 170,000 are Russians, 16,500 Jews, 3500 Poles, and 2000 Germans. The town has been embellished with new buildings, schools, hospitals, &c. Its factories (wool, flour-mills, tobacco, confectionery, &c.) show an aggregate yearly return of about £600,000. Its importance as an intellectual centre for Little Russia and as a commercial centre for a wide region is steadily growing. Sugar, raw wool, oil, tobacco, wine, crockery, and textile goods, as also cattle hides, tallow, &c., are the chief items of trade.

Kharpút, the most important town in the Memuret el-Azíz viláyet of Asia Minor, altitude 4350 feet, situated a few miles south of the Murad Su or Eastern Euphrates, on the Samsún–Sivas–Diarbekr road. The town is built on a hill-terrace about 1000 feet above a well-watered plain of exceptional fertility which lies to the south and supports a large population. On a rocky eminence east of the town is the castle in which Jocelyn, Count of Edessa, and Baldwin II. were imprisoned. Kharpút is an important station of the American missionaries, who have built a college, a theological seminary, and boys' and girls' schools. In November 1895 Kúrds looted and burned the Armenian villages on the plain; and in the same month Kharpút was attacked, the American schools burned down, and "Euphrates" College shelled by Turkish troops in the presence of the governor of the viláyet. A large number of the Gregorian and Protestant Armenian clergy and people were massacred, and churches, monasteries, and houses were looted. The viláyet was founded in 1888, and is divided into three sanjaks—Kharpút, Malatia, and Dersim. It has much mineral wealth, a healthy climate, and a fertile soil. The population comprises 500,000 Moslems and 80,000 Christians, nearly all Armenians. The seat of government, Mezere, is on the plain, three miles south of Kharpút, and is strongly garrisoned.

Khartum, capital of the Anglo-Egyptian Sudan, and before the Mahdist revolt (1883) administrative centre of the Khedivial possessions in the Upper Nile basin. It takes its Arabic name ("Elephant's Trunk") from the form of the tongue of land at the confluence of the two Niles, about 1340 miles south of Cairo, with which it has been connected by rail since 1899. After its capture in January 1885 it was abandoned by the Mahdi, who established himself at Omdurman on the opposite (left) bank of the White Nile, and this place remained the headquarters of his successor, the Khalifa Abdullah, till September 1898, when it was taken by the Anglo-Egyptian forces under General (afterwards Lord) Kitchener, and the seat of government again transferred to Khartum. It had a population estimated before the revolt at about 70,000, and has once more risen from its ruins and been in great part rebuilt. In 1901 it numbered over 20,000 inhabitants, attracted by the security for life and property guaranteed by the British and Egyptian Government. Conspicuous amongst the new buildings is the Gordon College, which stands on the spot where the hero fell, and was founded in 1899 for the twofold purpose of commemorating his name and affording useful instruction to the surrounding peoples. Lying at an altitude of 1200 feet above sea-level, about the limits of the northern dry and the southern moist zone, Khartum has a moderate annual rainfall of some 40 inches, with a fairly salubrious climate, which has attracted European visitors, especially during the winter season. It is becoming again the headquarters of missionary work, the starting-point of all travellers proceeding by the Nile route to the interior, and the chief centre of commercial enterprise and civilizing influences in Anglo-Egyptian Sudan. (A. H. K.)

Khasi and Jaintia Hills, a district of British India, in the Hills division of Assam. It occupies the central plateau between the valleys of the Brahmaputra and the Surma, rising very abruptly on the south side. The Khasi Hills are inhabited by a tribe of the same name, who still live in primitive communities under elective chiefs in political subordination to the British Government. There are 25 of these chiefs, called *Siems* and by other names, who exercise independent jurisdiction and pay no tribute. The Jaintia Hills used to form a petty Hindu principality, which was annexed in 1835. The inhabitants are a quite distinct tribe, called Panar or Santeng. The headquarters of the district were transferred in 1864 from Cherrapunji to Shillong, which is also the capital of the province. Area, 6041 square miles; population (1881), 169,360; (1891), 197,904, showing an increase of 17 per cent.; average density, 33 persons per square mile. Hill tribes numbered 185,364; Christians, 7144, of whom 164 were Europeans, the remainder representing the work of the Welsh Calvinistic mission among the Khasias. In 1901 the population was 198,989, showing an increase of less than 1 per cent. The land revenue was Rs.1,97,904, the incidence of assessment being nearly Rs.2 per acre; number of police, 178; number of boys at school (1896–97), 4180, being 29·45 per cent. of the male population of school-going age; number of girls at school, 1806, or 11·65 per cent., comparing with 1·33 per cent. for the province generally; registered death-rate in selected areas (1897), 52·94 per thousand. In 1897 there was 1 tea-garden, with 30 acres under tea, yielding 4000 ℔. There are 8 limestone quarries, from which 1,630,000 maunds were exported in 1896–97, yielding to Government an annual revenue of Rs.18,000. There are also a few coal-mines, which are worked on a small scale. A good cart-road runs north from Cherrapunji through Shillong to Gauhati on the Brahmaputra; total length, 94 miles. On the Sylhet border there is a small state railway 8 miles long, on the 2½-feet gauge, for conveying limestone to the river mart, and using local coal. It was wrecked by the earthquake of 12th June 1897, and again damaged by heavy floods; but it was reopened in March 1898. The district was the focus of the great earthquake, which not only destroyed every permanent building, but also broke up the roads and caused many landslips. Among the cliff villages near Cherrapunji the loss of life was about 600.

Kheri, a district of British India, in the Lucknow division of Oudh, which takes its name from an insignificant town; railway station 81 miles north-west of Lucknow. Population (1881), 5996. The administrative headquarters are at Lakhimpur, 3 miles distant; population (1891), 8073. The district has an area of 2965 square miles; population (1881), 831,922; (1891), 903,615, showing an increase of nearly 9 per cent., which has been continuous since 1869; average density, 305 persons per square mile, being far the lowest in the province. In 1901 the population was 905,199, showing only an infinitesimal increase. The land revenue and rates were Rs.8,98,633, the incidence of assessment being nearly 9 annas per acre; cultivated area (1896–97), 716,809 acres, of which 27,003 were irrigated from wells and tanks; number of police, 2740; vernacular schools (1896–97), 63, with 2855 pupils; death-rate (1897), 34·26 per thousand. The district is now traversed by a branch of the Oudh and Rohilkhand railway from Lucknow to Bareilly.

Kherson, a government of south-west Russia, on the north coast of the Black Sea. Area, 27,523 square miles. The population of the government reached in 1897, 2,732,832, of whom 1,332,175 were women and 785,094 lived in towns (including Odessa). Nearly 45 per cent. of the land is owned by the peasants, 31 per cent. by the nobility, 12 per cent. by other classes, and 12 per cent.

by the Crown, the municipalities, and other institutions. The peasants rent as much as 1,730,000 acres more from the landlords. Forests are scarce (176,500 acres). Owing to the fertility of the soil and the proximity of markets, agriculture is well developed and 8,900,000 acres are under crops. Agricultural machinery is widely used. The crops in an average year are wheat 2,274,000, rye 1,830,000, barley 1,191,000, oats 650,000, millet, sarrazin, and Indian corn 491,000 quarters. It is estimated that the available surplus of grain amounts to 412,500 tons every year. Flax is also cultivated and gardening prospers. The vine is widely grown, yielding 1,220,000 gallons of wine; the yearly manufacture of tobacco reaches 5000 cwts. There were in 1895 over 400,000 horses, 3,600,000 horned cattle, and 2,000,000 sheep. The aggregate annual returns of the factories attain £4,500,000, and they give occupation to nearly 11,000 persons. There are a few iron works (£100,000); machinery and especially agricultural machinery works (£175,000), sugar works (£1,020,000), steam flour works (£700,000), chemical works, &c. The traffic on the railways and the rivers is very large, owing to the trade of Odessa. The government is divided into six districts, the chief towns of which are Kherson, capital of the province (69,219), Alexandriya (14,002), Ananieff (16,713), Elisavetgrad (61,841), Odessa (405,041), and Tiraspol (27,585). Odessa with its suburbs constitutes a separate township.

Khingan, Great, a range of mountains of eastern Asia, of considerable length and great orographical importance. It is not a range of the alpine type, but the eastern border ridge of the immense plateau of eastern Asia which may be traced from the Himalaya to Bering Strait and from the Tian Shan to the Khingan. The plateau consisting in the south of the terraces of Tibet, and including in the west the very high terrace of the Pamir, has also, in north-west Mongolia and East Siberia, two well-defined terraces separated from each other by the Kentei range and the Yablonovoi Khrebet. The upper terrace comprises north-west Mongolia, and, beyond the trench of the Selenga, the Vitim plateau, whose continuation beyond the 120th degree of longitude is only partially explored. The lower terrace of the plateau, from 2500 to 3000 feet of average altitude, includes eastern Mongolia, the Gobi (see MONGOLIA), the Nerchinsk prairies of Transbaikalia, and the region watered by the upper Zeya, a tributary of the Amur.

The Great Khingan is well known from the 50th degree of latitude, where it was crossed by the present writer, to Kalgan, where it is crossed by the highway leading from Urga to Peking. It appears on this stretch as a border ridge of the Mongolian plateau, having very great orographical importance, since it represents an important climatic and geographic botanical boundary, constituting as it does the western limits of the Manchurian flora. The base of its western slope, which is very gentle, lies at altitudes of from 3000 to 3500 feet. Its crest rises to from 4800 to 6000 feet; and its eastern slope is extremely rapid as it falls to the plains of Manchuria, which have only from 1500 to 2000 feet of altitude. On this stretch one or two subordinate ridges parallel to the main border ridge and separated from it by longitudinal valleys are found to fringe its eastern slope, thus marking two different terraces and giving to the whole system a width of from 80 to 100 miles. Basalts, trachytes, and other volcanic formations are found in the main border ridge and on its south-eastern slopes.

To the south-west of Peking the Great Khingan is continued by the Inshan mountains, which exhibit similar characters to those of the Great Khingan, and represent the like terrace-shaped escarpment of the Mongolian plateau. Moreover, it appears from the map of the Russian General Staff (surveys of Skassi, Obrucheff, Potanin, &c.) that similar terrace-shaped escarpments—but considerably wider apart than in Manchuria—occur in the Shan-si province of China, along the southern border of the South Mongolian plateau. These escarpments are pierced by the Yellow river or Hoang-ho south of the Great Wall, between the 39th and 38th degrees of latitude, and in all probability it will be found that a border range homologous to the Great Khingan separates the upper tributaries of the Hoang-ho (namely the Dao-ho) from those of the Yang-tse-kiang. It must, however, be noticed that, according to Obrucheff, the escarpments of the Wei-tsi-shan and Lu-huang-lin, by which the southern Ordos falls towards the Wei-ho (tributary of the Hoang-ho), can hardly be taken as corresponding to the Kalgan escarpment. They fall with gentle slopes only towards the high plains lying to the south of them, while a steep fall towards the low plains seems to be found only farther south, between the 32nd and 34th degrees of latitude. It thus remains to be discovered whether the southern continuations of the Great Khingan, southwards of the 38th degree, are not wider than in higher latitudes, and do not consist of two separate escarpments. At its northern end the place where the Great Khingan is pierced by the Amur has not yet been ascertained by direct observation. The reasons why the present writer considers that the upper Amur emerges from the high plateau and its border-ridge, the Khingan, below Albazin and above Kumara have been stated in his sketch of the orography of East Siberia published in 1876 (French translation, with addenda, published by the Institut Géographique of Brussels in 1902). If this view prevail, and Petermann has adopted it for his map of Asia, and it has been maintained in all the Gotha publications, it will appear that the Great Khingan joins the Stanovoi ridge or Jukjur, in that portion of it which faces the western coast of the Sea of Okhotsk. At any rate the Khingan, separating as it does the Mongolian plateau from the much lower plains of the Sungari and the Nonni, is perhaps the most important division-line in eastern Asia. It sharply separates the Mongolian plateau from the Manchurian plains, and the dry Mongolian landscape and flora from those of Manchuria and the Pacific.

See the earlier bibliography in SEMENOFF'S *Geographical Dictionary*.—D. V. PUTIATA. *Expedition to the Khingan in 1891*. St Petersburg, 1893.—POTANIN. "Journey to the Khingan," in *Izvestia Russ. Geog. Soc.*, 1901. (P. A. K.)

Khingan, Little, a name indiscriminately applied to two distinct mountain ranges. The proper application of this name—if it be used at all—would be to reserve it for the typical mountain range which the Amur pierces for 40 miles below Ekaterino-Nikolsk, and which is also known as the Bureya mountains (*Bureinskiy Khrebet* in Russian) and also Dousse-alin. This great range, which may be traced from the Amur to the Sea of Okhotsk, seems to be pierced twice by the Sungari and to be continued under different local names in the same south-westerly direction to the peninsula of Lao-tung (see MANCHURIA). However, the same name of Little Khingan was also often applied, during the war in Manchuria, to the Ilkhuri-alin mountains, which run in a north-westerly direction between the upper Nonni and the Amur, in the west of Blagovestchensk.

Khiva, formerly an important kingdom of central Asia, now a small khanate, vassal to Russia, and limited to the delta of the Amu-daria. Its frontier runs down the left bank of the Amu, from 40° 15′ N., and down its left branch to Lake Aral; then, for about 40 miles along the south coast of Lake Aral to Cape Urgu, where it goes southwards, following the escarpment of the Ust-Urt. From the Transcaspian territory (Russia) Khiva is separated by a line running almost W.N.W.–E.S.E. under the 40° 30′ parallel, from the Uzboi to the Amu-daria. The length of the khanate from north to south is 200 miles, and its greatest width 300 miles. The area of the Khiva oasis is 5210 square miles, while the area of the steppes is estimated at about 17,000 square miles. The population of the former is estimated at 300,000, and that of the latter at 400,000 (nomadic). The water of the Amu is brought by a number of large irrigation canals to the lands of the Khiva oasis, the general declivity of the soil westwards facilitating the irrigation. The chief of them are Pohlwan-ata (57 miles), beginning 8 miles below Pitnyak and passing by Khiva, Hazar-asp, Ishan, and Bagat; Kaz-abad (60 miles); Shah-abad (90 miles, 100 feet wide); Kilich-niaz-bai (64 miles); and Kara-göz (53 miles). Several old beds of the Amu intersect the territory. The water of the Amu and the very thin layer of fertile ooze which it deposits render the oasis very fertile. Millet, rice, wheat, oats, peas, flax, hemp, madder, and all sorts of vegetables and fruit are grown, as also the vine and the cotton tree. The whitewashed houses scattered amidst the elms and poplars and the fields produce the most agreeable impression on the traveller crossing the steppes. Cattle-breeding is carried on on a great scale by the nomads.

The population is composed of four nationalities: the Uzbegs (150,000 to 200,000), who are the dominating race among the settled inhabitants of the oasis, and from whom the officials are recruited; the Sarts and the Tajiks, who are the best agriculturists, and the tradespeople; the Turkomans, who live in the steppes, south and west of the oasis, and formerly plundered the settled inhabitants by their raids; and the Karakalpaks, or Black Bonnets, who were known to the Russian annalists as having helped the Russians against the Polovtsy, and probably are near of kin to the Pechenyegues, if not their direct descendants. They live in the south of Lake Aral, and in the towns—Kungrad, Hojeili, and Kipchak; they are the prevailing element. They cultivate the soil, breed cattle, and their women make carpets. There are also about 10,000 Kirghiz, and when the Russians took Khiva there were 29,291 Persian slaves, stolen by Turkoman raiders, and 6515 liberated slaves. The former were at once set free and the slave trade abolished. Of domestic industries, the embroidering of cloth, silks, and leather is worthy of notice. The trade of Khiva is rather considerable: cotton, wool, rough woollen cloth, and silk cocoons are exported to Russia, and various animal products to Bokhara. Cottons, velveteen, hardware, and pepper are imported from Russia, and silks, cotton, china, and tea from Bokhara. Khivan merchants habitually attend the Orenburg and Nijni-Novgorod fairs.

The khan of Khiva is a vassal of Russia, and is rapidly losing the last vestiges of his autonomy. He keeps about 2000 soldiers. The khanate, burdened since 1873 by a heavy war indemnity, which has never been paid, must gradually fall under the complete dominion of Russia. The capital is KHIVA, to the left of and 20 miles from the Amu-daria, 235 miles west of Bokhara. It is surrounded by a low earthen wall, and has a citadel, the residence of the khan and the higher officials. There are seventeen mosques built in brick, of which the one containing the tomb of Polvan is the best, and four large medresses (Mahommedan schools). Wide gardens are spread in the western part of the town. A small Russian quarter has also grown up. Population, about 12,000. The other towns are Hazar-asp, 50 miles south-east of Khiva, enclosed by high walls, with nearly 4000 inhabitants and a great number of shops; Shah-abad, where is situated the palace of the khan; Kunya Urghench (Old Urghench) on the Daria-lyk, 95 miles north-west of Khiva, devastated by Turkomans and now in ruins, and New Urghench (3000); Hojeili, opposite to Russian fort Nukus (8000); and Kungrad (7000, mostly in tents), 160 miles north-west of Khiva. (P. A. K.)

Khokand, a district town of Russian central Asia, province of Fergana, on the railway from Samarkand to Andijan, 85 miles west-south-west of the latter and 20 miles south of the Syr-daria; altitude, 1300 feet. It has a severe continental climate, the average temperatures being: Year, 56°; January 22°, July 65°. Yearly rainfall only 3·6 inches. It is the centre of a fertile irrigated oasis, and consists of a citadel, enclosed by a wall nearly 12 miles long, and of suburbs containing rich gardens. The town itself is a labyrinth of narrow and winding streets, and has fifteen medresses, many mosques, ten caravanserais, and an animated bazaar. The former palace of the khans, which recalls by its architecture the mosques of Samarkand, is the best building in the town. Khokand is now one of the chief centres of trade in Turkestan. Raw cotton and silk are the main items of export, while manufactured goods are imported from Russia and distributed from Khokand. Population (1897), 82,054.

The khanate of Khokand was a powerful state which grew up in the 18th century. Its early history is not yet well known, but it is certain that the town was founded in 1732 by Abdu-raïm, under the name of Iski-kurgan, or Kali-i-Raïm-bai. This must relate, however, to the fort only, because the Arab travellers of the 10th century already mentioned Hovakend or Hokand, whose position has been identified with that of Khokand. Many other populous and wealthy towns are known to have existed in this region at the time of the Arab conquest of Fergana. In the years 1758–59 the Chinese conquered Dzungaria and East Turkestan, and the beks of Fergana recognized Chinese suzerainty. In 1807 or 1808 Alim, son of Narbuta, succeeded in bringing all the beks of Fergana under his authority, and conquered Tashkend and Chimkent. However, his several attacks on the Bokharan fortress of Ura-tube were unsuccessful, and the country rose against Alim, who was killed in 1817 by the adherents of his brother Omar. Omar was a poet and encourager of learning, but continued also to enlarge his kingdom, taking the sacred town of Azret (Turkestan), and in order to protect the agricultural Fergana from the raids of the nomad Kirghiz, a series of fortresses was built on the Syr-daria, which became a basis for raids of the Khokand people into Kirghiz land. This was the origin of a conflict with Russia. A series of small wars was undertaken by the Russians after 1847 in order to destroy the Khokand forts, and to take possession, first, of the Ili and next of the Syr-daria region—the result being that in 1866, after the occupation of Ura-tube and Gizakh, the khanate of Khokand was separated from Bokhara. During the forty-five years after the death of Omar (he died in 1822) the khanate of Khokand was the seat of continuous internal wars, the essence of which was a struggle between the settled Sarts and the nomad Kipchaks, the two parties securing the upper hand in turns, and Khokand falling under the dominion or the suzerainty of Bokhara, which supported Khudoyar-Khan, the representative of the Kipchak party, in the years 1858–66; while Alim-kul, representative of the Sarts, stood at the head of the Gazawat (Holy War) proclaimed in 1860, and bravely fought against the Russians until he was killed at Tashkent in 1865. In 1868 Khudoyar-Khan, now separated from Bokhara, concluded a commercial treaty with the Russians, but was compelled to flee in 1875, when a new Holy War against Russia was proclaimed. It ended in the taking of the strong fort Mahram, the occupation of Khokand and Marghelan (1875), and the recognition of Russian superiority by the emir of Bokhara, Nasr-ed-din, who conceded to Russia all the territory to the north of the Naryn river. The war, however, broke out again next year, and ended, in February 1876, in the taking of Andijan and Khokand and the annexation of the Khokand khanate to Russia. The Fergana province was made out of it.

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Kholm (Polish *Chełm*), a district town of Russian Poland, government and 56 miles east-south-east of Lublin. It is a very old city, formerly the see of a bishop. It has now an archæological museum for church antiquities and a committee for the description of the churches of the Chelm-Warsaw bishopric. Population, 19,236.

Khorassan, one of the five great provinces of Persia. Its administrative divisions are: 1, Nishápúr; 2, Sabzvár; 3, Jovain and Asfaráïn; 4, Bujnúrd; 5, Kúchán; 6, Derrehgez; 7, Kelát; 8, Chinárán; 9, Meshed; 10, Jám, Bákharz, Rádkán; 11, Serrakhs; 12, Sarjám; 13, Bám and Safíábád; 14, Turbat i Haidari; 15, Turshíz; 16, Kháf; 17, Tún and Tabbas; 18, Káïn; 19, Sístán. Until a few years ago the division of Nishápúr was under the governor-general of Khorassan, but it is now a separate province, with a governor appointed by the central government at Tehran. The population is estimated at about a million, and its revenues (cash and kind) at £180,000 a year. About £40,000 of this amount is supposed to reach the Tehran treasury. The value of the exports and imports from and into the whole province for 1890–91 was estimated at £290,190 and £544,570. Later consular reports give figures for Meshed and northern Khorassan only:—

1891–92 .	Exports £190,834 .	Imports £357,758
1893–94 .	,, 117,919 .	,, 327,671
1897–98 .	,, 136,543 .	,, 290,440

The province produces 20,000,000 ℔ of wool. About a third of this quantity, valued at £50,000 to £60,000, is exported *viâ* Russia to the markets of western Europe, notably to Marseilles, Russia keeping only 200,000 to 300,000 ℔. Other important articles of export, all to Russia, are cotton, carpets, shawls, and turquoises. With the exception of the agents of the Imperial Bank of Persia at Meshed, there was not in 1901 a single representative of British trade and commerce in the province, while Russian firms had agents, mostly Armenians, at all cities.

Khulna, a town and district of British India, in the Presidency division of Bengal. The town is on the river Bhairab; terminus of the Bengal Central railway, 109 miles east from Calcutta. Population (1891), 8667. Government high school, with 197 pupils in 1896–97. Khulna is the most important centre of river-borne trade in the delta. The district of KHULNA lies in the middle of the delta of the Ganges, including a portion of the Sundarbans or seaward fringe of swamps. It was formed out of Jessore in 1882. Area (excluding the Sundarbans), 2077 square miles; population (1881), 1,079,948; (1891), 1,177,652, showing an increase of 9 per cent.; average density, 567 persons per square mile. Classified according to religion, Hindus numbered 572,665; Mahommedans, 603,995; Christians, 963, of whom 17 were Europeans; "others," 29. In 1901 the population was 1,253,405, showing a further increase of 6 per cent. The land revenue and rates were Rs.7,46,595; number of police, 453; number of boys at school (1896–97), 28,954, being 31·2 per cent. of the male population of school-going age; registered death-rate (1897), 34·2 per thousand. There are twelve factories of sugar from the date-palm, with an out-turn valued at Rs.3,53,000. The district is entered by the Bengal Central railway, but by far the greater part of the traffic is still carried by water.

Khurja, a town of British India, in the Bulandshahr district of the North-West Provinces; 27 miles north-west of Aligarh, on the main line of the East Indian railway. Population (1891), 26,349; municipal income (1896–97), Rs.28,592. It is an important centre of trade, with a new Jain temple, many handsome public buildings, and a Victoria Jubilee school.

Khuzistan. See ARABISTAN.

Khyber. See KHAIBAR.

Kiaochow Bay, a large inlet on the south side of the promontory of Shantung, in China. It had no special importance until it was seized in November 1897 by the German fleet, in order to secure reparation for the murder of two German missionaries in the province of Shantung. In the course of the negotiations which followed, it was arranged that the bay and the land on both sides of the entrance within certain defined lines should be leased to Germany for 99 years. During the continuance of the lease Germany is to exercise all the rights of territorial sovereignty, including the right to erect fortifications. The size of the area leased is about 117 square miles, and a further area, comprising a zone of some 32 miles, measured from any point on the shore of the bay, is reserved, within which the Chinese Government may not issue any ordinances without the consent of Germany. The native population in the ceded area is about 60,000. The German Government in 1899 declared Kiaochow a free port open to the commerce of all nations. By arrangement with the Chinese Government a branch of the imperial maritime customs has been established there for the collection of duties upon goods coming from or going to the interior, in accordance with the general treaty tariff. Trade centres at a small town named Tsingtao situated within the bay. The country in the neighbourhood is mountainous and bare, but the lowlands are well cultivated.

Kidderminster, a parish, municipal and parliamentary borough, and market town of Worcestershire, England, on the Stour, 14 miles north of Worcester by rail. The infirmary has been extended, a technical school erected, and a public recreation ground opened (1887). There is a free library. Area of municipal borough, 1213 acres. Population (1881), 24,270; (1901), 24,692.

Kieff, or KIEV, a government of Little Russia, in south-western Russia. It represents a deeply ravined plateau, from 600 to 800 feet in altitude, reaching 950 to 1050 feet in the west, taking a steppe character in the middle, and gently sloping northwards to the marshy regions of the Pripet, while on the east it falls abruptly to the valley of the Dnieper, which has only from 250 to 300 feet of altitude. General A. Tillo has shown that neither geologically nor tectonically can "spurs of the Carpathians" penetrate into Kieff. Many useful minerals are extracted, such as granites, gabbro, labradorites of a rare beauty, also syenites and gneiss, marble, grinding stones, pottery clay, phosphorites, iron ore, and mineral colours. The climate is more moderate than in middle Russia, the average temperatures at Kieff being—year, 44°; January, 21°; July, 68°; yearly rainfall, 21 inches. The lowlands of the north are covered with woods; they have the flora of the Polyesiye, and are peopled with animals belonging to higher latitudes. (Schmahlhausen's *Flora of South-West Russia,* Kieff, 1886, contains a good description of the flora of the province.) The population, which was 2,017,262 in 1863, reached 3,576,125 in 1897; 1,791,503 were women, and 147,878 lived in towns. According to religion, there were (out of a total of 3,277,019), 2,738,977 Orthodox Greeks, 14,888 Nonconformists, 91,821 Catholics, 423,875 Jews, and 6820 Protestants.

No less than 41 per cent. of the land is in large holdings, 4 per cent. belongs to various institutions, 3 per cent. to the Crown, and 45 per cent. to the peasants. Out of an area of 11,819,000 acres, 11,085,000 acres are available for cultivation, 4,758,000 acres are under crops, 650,000 acres under meadows, and 1,880,000 acres under woods. About 290,000 acres are under beetroot, for sugar, giving a crop of 1,500,000 tons. The average crop of the various grains is 1,150,000 tons and 162,000 tons of potatoes, which affords an available surplus of 306,000 tons of grain and 24,000 tons of potatoes. There were in 1897, 368,455 horses, 608,400 horned cattle, 925,000 sheep, and 447,000 swine. Camels have been used for agricultural work. Bee-keeping and gardening are very general. The chief factories are sugar works (63) and distilleries. The former produce about 2,800,000 cwts. of sugar and over 1,000,000 cwts. of treacle. Every year 870,500 cwts. of sugar are refined. The distilleries (76) show yearly returns of about £1,100,000. The factories include machinery works, tanneries, steam flour-mills, naphtha-refineries, &c. The government is well provided with railways. Two main lines, starting from Kieff and Cherkasy respectively, cross it from north-east to south-west, and two lines cross its southern part from the north-west to the south-east, parallel to the Dnieper, with small side branches. Steamers ply on the Dnieper and some of its tributaries, and the shipping within the government shows a tonnage of 225,000 (£1,060,000). Wheat, rye, oats, barley, and flour are exported (210,000 tons in years of good crops). There are two great fairs, at Kieff and Berdicheff, and many of minor importance. Trade is very brisk. The government is better provided with schools than many other provinces of Russia. It is divided into twelve districts, the chief towns of which are Kieff, Berdicheff (53,728 inhabitants), Cherkasy (29,619), Chighirin (9870), Kanev (8892), Lipovets (6068), Radomysl (11,154), Skvira (16,265), Tarascha (11,452), Umañ (28,628), Vasilkov (17,824), and Zvenigorodka (16,972). The plains on the Dnieper have been inhabited probably since the Palæolithic period, and the burial-grounds used since the Stone Age. The burial mounds (*kurgans*) both of the Scythians and the Slavonians, the traces of old forts (*gorodische*), the stone statues, and the more recent caves offer a rich material for anthropology and ethnography.

Authorities. — The *Archæological Map of the Government* by Professor Antonovitch. 1887.—Count Bobrinsky. *Kurgans of Smiela.* 1897. (Both contain bibliographical indications.) — N. Byelyashevsky. *The Mints of Kieff.*— A. Selivanoff's article in the *Russian Encycl. Dictionary.* The last two form valuable sources of information. (P. A. K.)

Kieff, capital of the above government, situated on the right bank of the Dnieper (observatory — 50° 27′ 12″ N., 30° 30′ 18″ E.; altitude, 594 feet; level of Dnieper, 288 feet); 626 miles by rail (*viâ* Kursk) south-west of Moscow, and 405 miles by rail north-east of Odessa. Population rapidly increasing: (1862) 70,341, (1874) 127,250, (1893) 193,150, (1897) 247,432. Kieff covers an area of about 13,500 acres, and has a circumference of 32 miles. Altogether it is one of the most beautifully built cities in Russia, while its neighbourhood is also picturesque. Electric and steam tramways have been built for a length of more than 25 miles, and a network of telephones has been established all over the city. Kieff is connected by rail with all the main cities of south-west Russia, as well as with Poland and Austria, the railway bridge across the Dnieper being the third largest in Russia. Steamers ply in summer to Krementchug, Ekaterinoslav, Moghilev, Pinsk, and Chernigov. Its educational and scientific institutions are next to those of the two capitals. Its university has 2773 students (1897), and is well provided with observatories, laboratories, libraries, and museums; five scientific societies and two societies for aid to poor students are attached to it. There are besides a theological academy; a society of church archæology, which possesses a museum, very rich in old ikons, crosses, &c. (both Russian and Eastern); several lyceums for boys and high schools for girls; university courses for ladies; several technical schools both for boys and girls; a large polytechnic and numbers of primary schools. There are also many scientific, technical, musical, artistic, and social societies, ten libraries, three theatres, an opera house, and a considerable number of philanthropic institutions, hospitals, schools for medical help to children, &c.

Kieff is also an industrial city, and its 119 factories show yearly returns exceeding £1,000,000. It is the main centre for the sugar industry of Russia, as well as for the general trade of the region. Its Sryetenskaya fair, although showing small returns of goods brought in and sold, is an important centre for commercial transactions, which are estimated at more than £1,700,000 a year. Most interesting archæological finds have been made. More than twenty caves were discovered on the slope of a hill (Kiriloff Street), and one of them, excavated in 1876, proved to have belonged to Neolithic troglodytes. Numerous graves, both from the pagan and the Christian periods, the latter containing more than 2000 skeletons, with a great number of various small articles, were discovered in the same year in the same neighbourhood. Many colonial Roman coins from the 3rd to the 4th centuries, and silver *dirgems*, stamped at Samarkand, Balkh, Merv, &c., were also found in 1869.

The Russian literature concerning Kieff, its history and antiquities, is very voluminous. Its bibliography will be found in the *Russian Geographical Dictionary* of P. Semenoff, and in the *Russian Encyclopædic Dictionary*, published by Brocklaus and Effron, vol. xv., 1895. (P. A. K.)

Kiel, the chief naval port of Germany on the Baltic, Prussia, province of Schleswig-Holstein, at the head of Kiel Bay, 70 miles by rail north from Hamburg. Including the suburb of Wik, the town stretches along the west side of the harbour ($\frac{1}{4}$ to $4\frac{1}{4}$ miles in width and 11 miles long) as far as the entrance of the North Sea and Baltic (Kaiser Wilhelm) Canal, a distance of $2\frac{3}{4}$ miles. The harbour has a general depth of at least 40 feet, and even close to the shore it is in many parts as deep as 20 feet. Its defences, which include a couple of forts on the west side and four on the east side, all situated about 5 miles from the head of the harbour, at a place where its shores approach one another, make it a place of great strategic strength. The imperial docks (five in all) and shipbuilding yards are on the east side between Gaarden and Ellerbeck; and in 1901 it was resolved to extend them still farther towards the north—that is, into the fishing village of Ellerbeck — by the construction of a spacious basin to accommodate the biggest warships. The imperial naval yard employs nearly 6500 hands, and another 5500 are employed in two large private shipbuilding works, both engaged principally in building warships, torpedo-boats, and docks. Each of the latter has constructed a new shipbuilding yard, and one of them (the Krupp Company) has also put up machinery works here. In 1901 the town authorities voted £55,000 for the construction of an outer commercial harbour at Wik, just south of the entrance into the North Sea and Baltic Canal. On the same shore of the harbour, between the old ducal castle and Wik, there stand several of the most important edifices in Kiel, namely, the university (attended by 780 students, with 100 professors in 1900–01), the imperial admiralty, and the naval academy. Kiel was in 1897 the scene of a memorable naval exhibition. The town and adjacent villages, *e.g.*, Wik, Heikendorf, Laboe, are resorted to for sea-bathing, and in June a famous regatta usually takes place. The waters of the harbour yield sprats (*Kieler Sprotten*), which are in much repute. Kiel is connected daily and nightly with Korsör in Denmark by express passenger boats. The church of St Nicholas was restored in 1877–84; the church of St James was built in 1886. Kiel possesses an art exhibition, a museum of antique sculptures, the Thaulow Museum (rich in Schleswig-Holstein wood-carving of the 16th and 17th centuries), the Schleswig-Holstein Museum of National Antiquities (in the old university buildings), a university infirmary, zoological and mineralogical museums, a botanical garden, and a school of forestry; also monuments to the Emperor William I. (1896), Bismarck (1897), Duke Frederick William of Mecklenburg (1898), and Löwe (1896), the composer. In addition to the naval academy, the imperial naval institutions include a naval school, a school for petty officers, engineers' school, and seamen's school; there are further an agricultural college, attached to the university, and technical, commercial, and music schools. The principal industries are those connected with the imperial navy and shipbuilding, but embrace also flour-mills, oil-mills, iron-foundries, printing-works, breweries, brick-works, fish-curing, &c. Kiel owns a mercantile fleet of about 100 vessels, measuring about 25,000 tons. There is an important trade in coal, timber, cereals, fish, butter, and cheese. The port is entered annually by over 3000 vessels of about 515,000 tons. Population (1885), 51,706; (1890), 69,172; (1900), 107,938; or including Gaarden, which was united with Kiel on 1st April 1901, 121,761. (J. T. Be.)

Kielce, a government in the south-west of Russian Poland. Its surface is an elevated plateau from 800 to 1000 feet in altitude, intersected in the north-east by a range of hills reaching 1350 feet and deeply ravined in the south. It is watered by the Vistula on its south-east border, and its tributaries, Nida and Pilica, which have a very rapid fall and occasion inundations. Silurian and Devonian quartzites, dolomite, limestones, and sandstones prevail in the north, and contain rich iron ores, which are worked to a considerable extent, as well as lead and copper ores. Carboniferous deposits containing rich coal seams occur chiefly in the south, and spread to Piotrków; Permian limestones and sandstones are found in the south. The Trias deposits contain very rich zinc ores of considerable thickness, and lead. The Jurassic deposits consist of iron-clays and limestones, in which large caves are found near Oićow. The Cretaceous deposits contain, besides gypsum and chalk, sulphur (the richest near Czarkowa). White and black marble are also extracted. The soil is of great variety and fertile in parts, but owing to the proximity of the Carpathians, &c., the climate is more severe than might have been expected. Rye, wheat, oats, barley, and sarrazin are grown; modern intensive culture is spreading, and land fetches high prices, the more so as the peasants' allotments were small at the outset and are steadily decreasing. In 1893 there were 106,608 horses, 243,784 horned cattle, and 131,944 sheep. Grain is exported. Industries are widely developed: 54,400 tons of zinc ores are extracted, and 1000 tons of iron are obtained. The factories employ nearly 5000 persons, and show a yearly return of about £500,000. Tiles, metallic goods, leather, timber goods, and flour are their chief products. Kielce is divided into seven districts, the chief towns of which are Kielce, Jędrzejow (Russian, *Andreyev*, 5010), Miechow (4156), Olkusz (3491), Pinczów (8095), Stopnica (4659), and Wloszczowa (23,065).

Kielce, capital of the above government, 107 miles by rail south of Warsaw, *viâ* the Ivangorod junction, and 103 miles from Dombrovo on the Austrian frontier. It is situated in a picturesque hilly country. It has an old castle, which was built in 1638 and for some time was inhabited by Charles XII., and which was renowned for its portrait gallery and the library of Zalusski, which was taken to St Petersburg. The lyceum for boys has a good library and museum. The squares and boulevards of the town are well kept, and adorned with several handsome modern buildings. The aggregate yearly returns of several factories (hemp-spinning, cotton-printing, cement works) attain £100,000. Population (1890), 12,775; (1897), 23,189.

Kilbarchan, a burgh of barony of Renfrewshire, Scotland, 12 miles west by south of Glasgow. It has stations on two sections of the Glasgow and South-Western railway. Silk and cotton manufactures are carried on, and the parish contains coal and iron mines, and quarries. Water is supplied, and there are two libraries and a public park. The churches are Established and United Free, and the public school had in 1898–99 an average attendance of 453. Population (1881), 2548; (1901), 2886.

Kildare, an inland county of Ireland, province of Leinster, bounded on the N. by Meath, on the E. by Dublin and Wicklow, on the S. by Carlow, and on the W. by Queen's county and King's county.

The area of the administrative county in 1900 was 418,496 acres, of which 101,628 were tillage, 260,290 pasture, 199 fallow, 6288 plantation, 30,581 turf bog, 2891 marsh, 1474 barren mountain, and 15,145 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 75,804, and in 1891, 70,206, of whom 38,407 were males and 31,799 females, divided as follows among the different religions: Roman Catholics, 59,034; Protestant Episcopalians, 9096; Presbyterians, 1310; Methodists, 573; and other denominations, 193. The decrease of population between 1881 and 1891 was 7·38 per cent. The average number of persons to an acre was ·17. Of the total population, 58,378 persons inhabitated the rural districts, being an average of 107 persons to each square mile under crops and pasture. The population in 1901 was 63,469 (Roman Catholics, 54,794; Protestant Episcopalians, 7454; Presbyterians, 666; Methodists, 383; others, 172), being a decrease of 9·6 per cent. The following table gives the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R. C.	Pr. Ep.	Presb.	Meth.
Read and write	27,052	21,298	48,350	72·0	94·9	96·3	98·7
Read only .	3,315	3,175	6,490	11·7	2·3	2·5	·4
Illiterate .	4,783	4,209	8,992	16·3	2·8	1·2	·9

The percentage of illiterates among Roman Catholics in 1881 was 22·6. In 1891 there were 6 superior schools with 880 pupils (Roman Catholics, 873, and Protestants, 7), and 139 primary schools with 8877 pupils (Roman Catholics, 7767, and Protestants, 1110). The number of pupils on the rolls of the national schools on 30th September 1899 was 8873, of whom 8192 were Roman Catholics and 681 Protestants.

The following table gives the number of births, deaths, and marriages in different years:—

Year.	Births.	Deaths.	Marriages.
1881	1861	1363	351
1891	1541	1172	298
1900	1342	1310	315

In 1900 the birth-rate per thousand was 21·1, and the death-rate 20·6; the rate of illegitimacy was 1·8 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 35,748, of whom 19,729 were males and 16,019 females. The chief towns in the county, with their populations in 1891, are Athy, 4886; Naas, 3774; Newbridge, 3318.

Administration.—The county is divided into two parliamentary divisions, North and South; the number of registered electors in 1900 being respectively 6541 and 7573. The rateable value in 1900 was £362,276. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises two urban and five rural sanitary districts.

Agriculture.—The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900:—

Year.	Wheat.	Oats.	Barley, Rye, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	4125	24,206	13,791	9846	11,513	2590	55,889	120,960
1891	1365	20,440	12,769	7559	10,863	2162	51,473	106,631
1895	435	21,502	11,509	7341	10,732	2310	57,536	110,865
1900	776	17,656	12,292	6390	9,687	2051	52,776	101,628

In 1899 the total value of the cereal and other crops was estimated by the Registrar-General at £630,198. The number of acres under pasture in 1881 was 235,061; in 1891,249,934; and in 1900, 260,290:—

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	14,345	4155	92,249	117,770	12,986	3835	224,810
1891	14,320	4188	97,880	176,369	14,942	3991	209,263
1895	16,019	4235	92,553	126,881	13,758	3369	222,558
1900	13,239	4282	104,077	155,157	11,902	2810	243,050

The number of milch cows in 1891 was 14,050, and in 1900 12,281. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £1,659,118. In 1900 the number of holdings not exceeding 1 acre was 1814; between 1 and 5, 1604; between 5 and 15, 1658; between 15 and 30, 1134; between 30 and 50, 821; between 50 and 100, 966; between 100 and 200, 721; between 200 and 500, 361; and above 500, 43—total, 9122. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900 was 697, amounting to £541,367. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1900 was 219, and the amount issued was £25,584. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1900 was £146,252.

(W. H. Po.)

Kilia, a town and custom-house of Russia, government of Bessarabia, district Ismail, 100 miles south-west of Odessa, on the Kilia branch of the Danube. It has steam flour-mills and a rapidly increasing trade. Population, 11,703.

Kilimanjaro, a great mountain in East Africa, its centre lying in 3° 5′ S. and 37° 23′ E. It is the highest known summit of the continent, rising as an isolated volcanic cone from a plateau of about 3000 feet to 19,700 feet at its highest point. The major axis of the mountain runs almost east and west, and on it rise the two principal summits, Kibo in the west, Mawenzi in the east. Kibo, the higher, is a truncated cone with a nearly perfect extinct crater, and marks a comparatively recent period of volcanic activity; while Mawenzi (17,050 feet) is the very ancient core of a former summit, of which the crater walls have been removed by denudation. The two peaks, which are about 7 miles apart, are connected by a saddle or plateau, about 14,000 feet in altitude, below which the vast mass slopes with great regularity in a typical volcanic curve, especially in the south, to the plains below. The sides are furrowed on the south and east by a large number of narrow ravines, down which flow streams which feed the Pangani and Lake Jipe in the south and the Tzavo tributary of the Tana in the east. South-west of Kibo, the Shira ridge seems to be of independent origin, while in the north-west a rugged group of cones, of comparatively recent origin, has poured forth vast lava-flows. In the south-east the regularity of the outline is likewise broken by a ridge running down from Mawenzi. The lava slopes of the Kibo peak are covered to a depth of some 200 feet with an ice-cap, which, where ravines occur, takes the form of genuine glaciers. The crater walls are highest on the south, three small peaks, uncovered by ice, rising from the rim on this side. To the central and highest of these, the culminating point of the mountain, the name Kaiser Wilhelm Spitze has been given. The rim here sinks precipitously some 600 feet to the interior of the crater, which measures rather over 2000 yards in diameter, and is in part covered by ice, in part by a bare cone of ashes. On the west the rim is breached, allowing the passage of an important glacier formed from the snow which falls within the crater. Lower down this cleft, which owed its origin to dislocation, is occupied by two glaciers, one of which reaches a lower level (13,800 feet) than any other on Kilimanjaro. On the north-west three large glaciers reach down to 16,000 feet. Mawenzi peak has no permanent ice-cap, though at times snow lies in patches. The rock of which it is composed has become very jagged by denudation, forming stupendous walls and precipices. On the east the peak falls with great abruptness some 6500 feet to a vast ravine, due apparently to dislocation and sinking of the ground. Below this the slope is more gradual and more symmetrical. Like the other high mountains of eastern Africa, Kilimanjaro presents well-defined zones of vegetation. The lowest slopes are arid and scantily covered with scrub, but higher up, between 4000 and 6000 feet on the south side of the mountain, are well watered and cultivated. The forest zone begins, on the south, at about 6500 feet, and extends to 9500, but in the north it is narrower, and in the north-west, which is the driest quarter of the mountain, almost disappears. In the alpine zone, marked especially by tree lobelias and *Senecio,* flowering plants extend up to 15,700 feet on the sheltered south-west flank of Mawenzi, but elsewhere vegetation grows only in dwarfed patches beyond 13,000 feet. The special fauna and flora of the upper zone are akin to those of other high African mountains, including Cameroon. The southern slopes, between 4000 and 6000 feet, form the well-peopled country of Chagga, divided up into small districts. The best known of these is Moshi, where a German station has been established for some years. Kilimanjaro, first seen by the German Rebmann in 1849, and since visited by von der Decken, New, Thomson, Johnston, and others, has been the special study of Dr Hans Meyer, who made four expeditions to it, accomplishing the first ascent to the summit in 1889.

See especially JOHNSTON. *The Kilimanjaro Expedition.* London, 1886.—MEYER. *Across East African Glaciers.* London, 1891; *Der Kilimanjaro.* Berlin, 1900. (E. HE.)

Kilindria, the ancient *Kelenderis,* a small town on the south coast of Asia Minor. After having been almost deserted, it has rapidly revived under the influence of trade with Cyprus since the British occupation.

Kilkenny, an inland county of Ireland, province of Leinster, bounded on the N. by Queen's county, on the E. by Carlow and Wexford, on the S. by Waterford, and on the W. by Tipperary.

The area of the administrative county in 1900 was 509,245 acres, of which 140,216 were tillage, 313,021 pasture, 417 fallow, 9963 plantation, 2539 turf bog, 5125 marsh, 13,537 barren mountain, and 24,427 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, includes the county of the city of Kilkenny and one electoral division formerly situated in Waterford, but does not include the portion of the town of New Ross formerly situated in Kilkenny. The population in 1881 was 99,531, and in 1891, 87,496. The decrease of population between 1881 and 1891 was 12·33 per cent. The average number of persons to an acre for the whole county was ·17. Of the total population 75,928 persons inhabited the rural districts, being an average of 109 persons to each square mile under crops and pasture. The population in 1901 was 78,821, of whom 39,933 were males and 38,888 females (Roman Catholics, 74,572; Protestant Episcopalians, 3930; Presbyterians, 141; Methodists, 116; others, 62), being a decrease of 9·9 per cent. The following table gives the degree of education in 1891 (excluding the city of Kilkenny):—

	Males.	Females.	Total.	Percentage.			
				R.C.	Pr.Ep.	Presb.	Meth.
Read and write	26,083	24,923	51,006	72·6	90·7	97·0	94·4
Read only .	3,341	4,166	7,507	11·1	4·8	1·0	2·8
Illiterate .	5,209	5,734	10,943	16·3	4·5	2·0	2·8

The percentage of illiterates among Roman Catholics in 1881 was 22·9. In 1891 (including the city of Kilkenny) there were 9 superior schools with 414 pupils (Roman Catholics, 338; Protestants, 76), and 211 primary schools with 14,901 pupils (Roman Catholics, 14,246; Protestants, 655). The total number of pupils on the rolls of the national schools on 30th September 1899 was 13,912, of whom 13,380 were Roman Catholics and 532 Protestants.

The following table gives the number of births, deaths, and marriages in various years:—

Year.	Births.	Deaths.	Marriages.
1881	1957	1722	333
1891	1770	1563	409
1900	1602	1619	283

The birth-rate per thousand in 1900 was 20·3, and the death-rate 20·5; the rate of illegitimacy was 2·3 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1899 was 73,023, of whom 37,734 were males and 35,289 females. The chief towns in the county, with their populations in 1891, are Kilkenny, 11,048 (1901, 10,493); Cullan, 1973; Castlecomer, 1019.

Administration.—The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1900 being respectively 6170 and 5141. The rateable value in 1900 was £334,919. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises one urban and eight rural sanitary districts.

Agriculture.—The accompanying tables show the acreage under crops, including meadow and clover, and the amount of live stock

Year.	Wheat.	Oats.	Barley, Rye, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	11,843	35,878	17,511	18,258	9,943	3794	62,077	159,304
1891	5,197	30,612	16,517	15,616	9,586	4053	61,207	142,788
1895	1,156	32,749	18,037	14,813	10,869	3826	65,055	146,505
1900	2,167	27,630	19,897	13,186	10,629	4432	62,275	140,216

in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county.

In 1899 the total value of the cereal and other crops was estimated by the Registrar-General at £945,746. The number of acres under pasture in 1881 was 290,470, in 1891, 304,873, and in 1900, 313,021.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	17,987	5345	120,604	85,393	39,777	6176	410,484
1891	20,529	5893	129,066	121,520	44,791	8619	449,113
1895	21,747	5801	125,815	105,080	89,114	7388	439,160
1900	19,962	6381	133,866	102,288	35,636	6438	514,061

The number of milch cows in 1891 was 37,106, and in 1900, 38,093. It is estimated that the total value of cattle, sheep, and pigs in 1899 was £1,894,077. In 1900 the number of holdings not exceeding one acre was 1974; between 1 and 5, 1684; between 5 and 15, 2492; between 15 and 30, 2460; between 30 and 50, 2171; between 50 and 100, 2115; between 100 and 200, 806; between 200 and 500, 210; and above 500, 21—total, 13,933. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 1155, amounting to £588,502. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1900 was 287, and the amount issued was £19,201. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1900 was £76,825. (W. H. PO.)

Kilkenny, an inland city and parliamentary borough, capital of the above county, on the river Nore, 73 miles south-west of Dublin by rail. Under the Local Government (Ireland) Act, 1898, it retains its mayor and corporation, which, however, has now practically the status of an urban district council. The manufacture of blankets, coarse woollens, and linens has declined. The municipal borough comprises 921 acres. Population (1881), 12,182; (1891), 11,048; (1901), 10,493.

Kilmarnock, a parliamentary burgh and important railway centre (Kilmarnock group) of Ayrshire, Scotland, on Kilmarnock water, 24 miles south-west of Glasgow by rail. The engineering and iron trades have displaced carpet-weaving as the staple industry, though tweed-making has been added to the other woollens; the workshops of the Glasgow and South-Western railway are situated here, and hydraulic machinery is a speciality of the town. A large cotton factory and another for the making of lace curtains are among the industrial features. The grounds of Kilmarnock House were presented to the town in 1893, and have been laid out as a public park. Eight acres have been added to Kay Park, where a Reformers' Monument was unveiled in 1885. The town hall has been renovated, and recent erections include a new academy, a corporation art gallery, and a spacious institute containing a free library and a museum. The academy is under the School Board. Population (1881), 23,901; (1901), 34,161.

Kilsyth, a police burgh and burgh of barony of Stirlingshire, Scotland, 13 miles north-east of Glasgow by rail. The Forth and Clyde Canal passes near the straggling town. The quarrying of whinstone, which abounds in the neighbourhood, is carried on to a considerable extent. Recent erections are United Free and Wesleyan churches, and a public school, besides which there is a large academy with an elementary department. Population (1881), 5402; (1901), 7331.

Kimberley, John Wodehouse, 1st Earl (1826–1902), English statesman, was born 7th January 1826, being the eldest son of the Hon. Henry Wodehouse and grandson of the 2nd Baron Wodehouse, whom he succeeded in 1846. He was educated at Eton and Christ Church, Oxford, where he took a first-class degree in classics in 1847; in the same year the new Lord Wodehouse married Lady Florence FitzGibbon (d. 1895), daughter of the last earl of Clare. He was by inheritance a Liberal in politics, and in 1852–56 and 1859–61 he was Under Secretary of State for Foreign Affairs in Lord Aberdeen's and Lord Palmerston's ministries. In the interval (1856–58) he had been envoy-extraordinary to Russia; and in 1863 he was sent on a special mission to Copenhagen on the forlorn hope of finding a peaceful solution of the Schleswig-Holstein question. The mission was a failure, but probably nothing else was possible. In 1864 he became Under Secretary for India, but towards the end of the year was made Lord-Lieutenant of Ireland. In that capacity he had to grapple with the first manifestations of Fenianism, and in recognition of his vigour and success he was created (1866) earl of Kimberley. In July 1866 he vacated his office with the fall of Lord Russell's ministry, but in 1868 he became Lord Privy Seal in Mr Gladstone's cabinet, and in July 1870 was transferred from that post to be Secretary of State for the Colonies. It was the moment of the great diamond discoveries in South Africa, and the new town of Kimberley was named after the Colonial Secretary of the day. After an interval of Opposition from 1874 to 1880, Lord Kimberley returned to the Colonial Office in Mr Gladstone's next ministry; but at the end of 1882 he exchanged this office first for that of Chancellor of the Duchy of Lancaster and then for the Secretaryship of State for India, a post which he retained during the remainder of Mr Gladstone's tenure of power (1882–86, 1892–94), though in 1892–94 he combined with it that of the Lord Presidency of the Council. In Lord Rosebery's cabinet (1894–95) he was Foreign Secretary. Lord Kimberley was an admirable departmental chief, but it is difficult to associate his own personality with any ministerial act during his occupation of all these posts. He was at the Colonial Office when responsible government was granted to Cape Colony, when British Columbia was added to the Dominion of Canada, and during the Boer war of 1880–1881, with its conclusion at Majuba; and he was Foreign Secretary when the misunderstanding arose with Germany over the proposed lease of territory from the Congo Free State for the Cape to Cairo route. He was essentially a loyal Gladstonian party man. His moderation, common-sense, and patriotism had their influence, nevertheless, on the policy from time to time agreed upon in concert with his colleagues. As leader of the Liberal party in the House of Lords he acted with undeviating dignity; and in Opposition he was a courteous antagonist and a critic of weight and experience. He took considerable interest in education, and after being for many years a member of the senate of London University, he became its chancellor in 1899. He died in London, 8th April 1902, being succeeded in the earldom by his eldest and only surviving son, Lord Wodehouse (b. 1848). After Mr Gladstone's retirement from politics, the value of Lord Kimberley's moderating influence on the counsels of his party became more than ever marked, owing to the dissensions which hampered its activity. He took sides with no section, but did his best to keep the party together. It was this element in his character, rather than any special ability, which made him a notable personality in English politics. (H. CH.)

Kimberley, a town of Cape Colony, centre of the Griqualand West diamond industry. Next to Cape Town and Johannesburg, it is the largest place in South Africa, with a population which rose from about 20,000 in 1881 to 28,718 in 1891. It lies on the main railway running from the Cape towards the Zambezi, about midway between Cape Town and Bulawayo, being 646 miles distant from the former and 714 from the latter place. The mine which gives its name to the town is one of the great "pipes," as they are called—Kimberley, De Beers, Du Toit's Pan, and Bulfontein—which are clustered together on the plateau near the converging frontiers of Cape Colony, the Orange River Colony, and Transvaal, and have collectively for some years controlled and supplied the diamond markets of the world. The pipes are natural "chimneys," perhaps extinct craters, which were at first supposed to taper downwards, but are now known to broaden out to depths of over 2000 feet, penetrating through limestones, diorites, porphyries, basalts, and other formations down to the granite and gneiss bed-rocks. The diamonds occur in the yellow, and lower down in the blue eruptive matter which fills the pipes and was probably forced up by the pressure of underground forces. The supply appears to be practically unlimited, but is regulated by the De Beers corporation, which has bought up all minor claims, and is thus able to control the market. Since 1895 the annual output has averaged over £4,500,000 (£4,567,000 in 1898), and the total value of diamonds exported between the years 1867 and 1898 was estimated at £87,878,000. On the outbreak of hostilities in 1899 the Boers laid siege to Kimberley, and held it closely invested from 12th October of that year till 15th February 1900, when it was relieved by General Sir John French.

Kincardineshire, or THE MEARNS, a maritime county of east Scotland, is bounded on the E. by the German Ocean, on the N.W. by Aberdeenshire, and on the S.W. by Forfarshire.

Area and Population.—In 1891 alterations were made in the boundary between Kincardineshire and Aberdeenshire in the parishes of Banchory-Ternan and Drumoak, the first being placed wholly in Kincardine, and the second in Aberdeen. The area of the county (foreshore excluded) is 245,259 acres, or 383·2 square miles. The population was in 1881, 34,464; in 1891, 35,647; in 1891, on the above area, 35,492; in 1901, 40,918, of whom 20,067 were males and 20,851 females. On the old area, taking land only (245,347 acres, or 383·3 square miles), the number of persons to the square mile in 1891 was 93, and the number of acres to the person 6·9. In the registration county the population increased between 1881 and 1891 by 3·4 per cent. Between 1881 and 1891 the excess of births over deaths was 6444, and the increase of the resident population 1197. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899:—

Year.	Deaths.	Marriages.	Births.	Percentage of Illegitimate.
1880	542	204	1073	11·9
1890	556	154	1055	13·08
1899	642	201	1202	10·6

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years:—

	1880.	1881–90.	1890.	1891–98.	1899.
Birth-rate . .	30·25	30·00	28·58	29·27	32·76
Death-rate . .	15·29	14·98	15·06	14·87	17·64
Marriage-rate .	5·75	5·15	4·17	5·57	5·52

There were 116 Gaelic-speaking persons in the county in 1891, and 14 foreigners. Valuation in 1889–90, £251,889; 1899–1900, £246,819.

Administration.—The county returns a member to Parliament. Bervie (2523) is the only royal burgh, and is one of the Montrose group of parliamentary burghs. Stonehaven (4565), the county town, is a police burgh. There are 19 civil parishes, with a combination poorhouse at Stonehaven, and the number of paupers and dependants in September 1899 was 567. Kincardine is united in one sheriffdom with Aberdeen and Banff shires, and one of the Aberdeen sheriffs-substitute sits at Stonehaven.

Education.—Nineteen school boards manage 48 schools, which had an average attendance of 5402 in 1898–99, while 8 voluntary schools, of which 4 are Episcopal, had 433. There is an academy at Stonehaven, and three other public schools earned grants in 1898 for giving higher education. The county council hands over the "residue" grant to the county secondary education committee, which expends it in technical education grants to a number of schools and school boards. At Blairs, near the Dee in the north-east corner of the county, is a Roman Catholic college at which young men are trained for the priesthood by a rector, and four clerical and three lay professors.

Agriculture.—Oats are the principal corn crop, although the acreage has declined of late years with the increase of the barley acreage due to the demands of distilling. Cattle are bred, but the bulk of the stock is kept for feeding. The percentage of cultivated area in 1898 was 49·2; and in 1895, 25,795 acres were under wood, of which ·1586 had been planted since 1881. The average size of the 1698 holdings in 1895 was 71 acres. The percentage under 5 acres was 12·43; between 5 and 50 acres, 42·34; and over 50 acres, 45·23. The number between 50 and 100 acres was 336; between 100 and 300, 389; between 300 and 500, 36; and over 500, only 7. The following table gives the principal acreages at intervals of five years from 1880:—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	120,322	44,936	22,662	46,134	6,448	141
1885	121,496	44,373	21,675	46,674	8,704	68
1890	122,848	43,465	21,420	47,427	10,281	148
1895	120,993	42,647	21,073	48,528	8,611	54
1899	120,685	44,446	21,159	48,257	8,742	2

The following table gives particulars of the live stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or Calf.	Sheep.	Pigs.
1880	4903	25,207	6736	32,308	2196
1885	4651	25,922	7032	29,987	2894
1890	4733	26,627	7358	39,437	3138
1895	5433	26,133	6918	37,535	2680
1899	5009	25,752	6970	44,483	2544

At the census of 1891, 4685 men and 164 women were returned as being engaged in agriculture.

Industries and Trade.—Apart from agriculture the principal industry is fishing. Stonehaven is the centre of a fishery district which is not exactly conterminous with the county. The following table gives particulars of the district:—

Boats.			Value.	Value of Gear.	Resident Fishermen and Boys.	Total Value of all Fish.
Year.	No.	Tons.				
1880	230	1864	£2119	£12,500	517	£26,608
1890	165	1714	£8673	£10,391	403	£18,264
1899	153	1538	£8067	£10,863	377	£19,565

In 1898, 783 persons were engaged in the district in connexion with the various branches of the sea fisheries. Persons connected with industry numbered 4130 in 1891.

See A. C. CAMERON. *The History of Fettercairn.* Paisley, 1899.—F. C. EELES. *The Bells of Kincardineshire.* Stonehaven, 1899.—J. ANDERSON. *The Black Book of Kincardineshire.* Stonehaven, 1879.—J. A. HENDERSON. *History of Banchory-Devenick.* Aberdeen, 1890.—W. R. FRASER. *History of Laurencekirk.* Edinburgh, 1880.—C. A. MOLLYSON. *The Parish of Fordoun.* Aberdeen, 1893. (W. WA.)

Kinglake, Alexander William (1809–1891), English historian and traveller, was born at Taunton 5th August 1809. His father was a respected and successful solicitor, and intended his son for a legal career. Kinglake went to Eton and Trinity College, Cambridge, where he matriculated in 1828, being a contemporary and friend of Tennyson and Thackeray. He took his B.A. degree in 1832, and his M.A. in 1836. After leaving Cambridge he joined Lincoln's Inn, and was called to the bar in 1837. While still a student he travelled, in 1835, throughout the East, and the impression made upon him by his experiences was so powerful that he was seized with the desire to record them in literature. The task, however, proved difficult to his fastidious taste, and he was engaged for seven years in elaborating his manuscript, which he actually rewrote three times. *Eothen*, a sensitive and witty record of impressions keenly felt and remembered, was published in 1844, and enjoyed considerable reputation. In 1854 he went to the Crimea, and was present at the battle of the Alma. During the campaign he made the acquaintance of Lord Raglan, who was so much attracted by his talents that he suggested to Kinglake the plan for an elaborate *History of the Crimean War*, and placed his private papers at the writer's disposal. For the rest of his life Kinglake was engaged upon the task of completing this monumental history. Thirty-two years elapsed between its commencement and the publication of the last volume, and eight volumes in all appeared at intervals between 1863 and 1887. During the course of its composition Kinglake lived principally in London, and sat in Parliament for Bridgwater from 1857 until the disfranchisement of the borough in 1868. He died 2nd January 1891, in his eighty-second year. Kinglake's life-work, *The History of the Crimean War*, is in scheme and execution too minute and conscientious to be altogether in proportion, but it is a wonderful example of painstaking and talented industry. It is not without errors of partisanship, and its criticisms and eulogies cannot always be accepted. But it shows remarkable skill in the moulding of vast masses of despatches and technical details into an absorbingly interesting narrative; it is illumined by natural descriptions and character-sketches of great fidelity and acumen; and, despite its length, it remains one of the most picturesque, most vivid, and most actual pieces of historical narrative in the English language. (A. WA.)

King's County, an inland county of Ireland, province of Leinster, bounded on the N. by Westmeath, on the E. by Kildare, on the S. by Queen's county, and on the W. by the Shannon.

The area of the administrative county in 1900 was 493,263 acres, of which 108,647 were tillage, 239,858 pasture, 400 fallow, 6870 plantation, 96,129 turf bog, 14,744 marsh, 5752 barren mountain, 20,833 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 72,852, and in 1891, 65,563, of whom 33,777 were males and 31,786 females, divided as follows among the different religions: Roman Catholics, 58,264; Protestant Episcopalians, 6432; Methodists, 463; Presbyterians, 291; and other denominations, 113. The decrease in population between 1881 and 1891 was 10·01 per cent. The average number of persons to an acre was ·13. Of the total population, 55,988 persons inhabited the rural districts, being an average of 104 persons to each square mile under crops and pasture. The population in 1901 was 60,129 (Roman Catholics, 53,778; Protestant Episcopalians, 5520; Methodists, 363; Presbyterians, 328; others, 140), being a decrease of 8·3 per cent. The following table gives the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R.C.	Pr.Ep.	Presb.	Meth.
Read and write	21,975	20,430	42,405	68·7	92·4	93·0	94·6
Read only .	3,449	3,784	7,233	13·3	3·6	3·9	3·3
Illiterate .	5,190	4,557	9,747	18·0	4·0	3·1	2·1

The percentage of illiterates among Roman Catholics in 1881 was 24·2. In 1891 there were 6 superior schools with 131 pupils (Roman Catholics 97, and Protestants 34), and 135 primary schools with 9285 pupils (Roman Catholics 8317, and Protestants 968). The number of pupils on the rolls of the national schools on 30th September 1899 was 10,209, of whom 9429 were Roman Catholics and 780 Protestants.

The following table gives the number of births, deaths, and marriages in various years:—

Year.	Births.	Deaths.	Marriages.
1881	1683	1234	287
1891	1404	1081	257
1900	1175	1175	257

In 1900 the birth-rate per thousand was 19·5, and the death-rate 19·5; the rate of illegitimacy was 1·7 per cent. of the total births. The total number of emigrants who left the county between 1st May 1857 and 31st December 1899 was 57,765, of whom 29,697 were males and 28,068 females. The chief towns in the county are: Tullamore (4639 in 1901); Parsonstown, 4438; Edenderry, 1611.

Administration.—The county is divided into two parliamentary divisions, Birr and Tullamore, the number of registered electors in 1900 being respectively 4792 and 4939. The rateable value in 1900 was £246,251. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises two urban and five rural sanitary districts.

Agriculture.—The following table gives the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900:—

Year.	Wheat.	Oats.	Barley, Rye, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	1437	23,082	15,746	15,753	9,862	3564	50,308	119,752
1891	317	19,898	19,168	14,411	10,326	3464	46,255	113,839
1895	119	21,210	16,761	13,652	10,424	3903	50,265	116,334
1900	382	18,620	15,394	12,645	9,320	3835	48,451	108,647

For 1899 the total value of the cereal and other crops was estimated by the Registrar-General at £744,288. The number of acres under pasture in 1881 was 231,744; in 1891, 232,780; and in 1900, 239,858.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	14,714	6221	68,165	97,570	20,526	3910	271,879
1891	16,233	6950	79,136	124,264	28,384	6307	300.858
1895	16,631	6735	74,158	96,516	24,589	5712	282,856
1900	14,572	7231	82,273	101,730	26,746	5200	306.961

The number of milch cows in 1891 was 16,534, and in 1900, 15,569. It is estimated that the total value of cattle, sheep, and pigs for 1899 was £1,278,869. In 1900 the number of holdings not exceeding 1 acre was 1892; between 1 and 5, 1620; between 5 and 15, 2285; between 15 and 30, 2074; between 30 and 50, 1336; between 50 and 100, 1135; between 100 and 200, 548; between 200 and 500, 254; and above 500, 53—total, 11,197. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1900, was 383, amounting to £145,204. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1900, was 270, and the amount issued was £20,456. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1900, was £71,524. (W. H. PO.)

Kingsley, Mary Henrietta (1862–1900), English traveller and author, daughter of George Henry Kingsley, was born in Islington, London, 13th October 1862. A delicate child, not considered strong enough to face school life, her early years were spent at home. Her father, though less widely known than his celebrated brothers, Charles and Henry,[1] was a man of versatile abilities, and had a passion for travelling, which he managed to indulge in combination with his professional care of individual patients. Mary Kingsley's reading in history, poetry, and philosophy was wide if desultory, but she was most attracted to natural history. Her family, which had settled in Highgate in 1862, removed to Bexley in 1879 and to Cambridge in 1886, and this last change proved beneficial to her health. From 1888 to 1892 the illness of her mother developed those qualities of self-reliance which stood her afterwards in such good stead. The loss of both parents in 1892 left her free to pursue her own course, and she resolved to travel and investigate the forms of religion and law among uncivilized races. She started for West Africa in August 1893, with a few introductions to Portuguese colonists, and making her way across much country hitherto untrodden by Europeans, went up the Congo as far as Kabinda and Matadi, and returned to England in June 1894. She gained sufficient knowledge of the native customs to contribute afterwards an introduction to Mr Dennett's *Notes on the Folk Lore of the Fjort*, 1898. Miss Kingsley made careful preparations for a second exploration of the same region, and at the end of 1894 she proceeded *vià* Old Calabar to French Congo, and ascended the Ogowé river. From this point her journey was a long series of adventures and hairbreadth escapes, at one time from the dangers of land and water, at another from the cannibal Fans. The story is vividly told in her *Travels in West Africa*. The book aroused a wide interest, and she lectured to scientific gatherings on the fauna, flora, and folklore of West Africa, and to commercial audiences on the trade of that region and its possible developments, always with a protest against the lack of detailed knowledge characteristic of modern dealings with new fields of trade. In both cases she spoke with authority, for she had brought back a considerable number of new specimens of plants and fishes, and had herself traded in rubber and oil in the districts through which she passed. With undaunted energy Miss Kingsley was again on her way in 1900 to the West Coast, but she proceeded in the first instance to South Africa, and she died at Simon's Town, where she was engaged in nursing Boer prisoners, on 3rd June 1900.

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[1] Henry Kingsley (1830–1876), was born in Notts, 2nd January 1830, and after being educated at King's College, London, and Worcester College, Oxford, went in 1853 to live in Australia. In 1858 he returned to England, and in the next year published a novel, *Geoffrey Hamlyn*, full of stirring scenes of colonial life. In 1861 appeared his most famous story, *Ravenshoe*, and in 1865 *The Hillyars and the Burtons*. These, his best-known works, are characterized by much vigour and a healthy, robust taste for incident and sentiment. Henry Kingsley died in Sussex, 24th May 1876.

King's Mountain, a mountainous ridge in Gaston county, North Carolina, and York county, South Carolina, U.S.A. It is an outlier of the Blue Ridge, running parallel with it, *i.e.*, north-east and south-west, and its highest point, Mount Crowder, has an altitude of some 3000 feet. One of the battles of the American Revolution, known as King's Mountain, was fought near the southern end of this ridge, in South Carolina, 7th October 1780. The American loss was 28 killed, 60 wounded; the British loss, 389 killed, 716 prisoners.

Kingston, the chief city of Frontenac county, Ontario, Canada, at the north-eastern extremity of Lake Ontario, 260 feet above the sea. It is an important station on the Grand Trunk railway, and terminus of the Kingston and Pembroke railway, and has steamboat communication with other ports on Lake Ontario, on the St Lawrence and the Rideau canal. It contains a fine stone graving-dock, 280 feet long, 100 feet wide, and with a depth of 16 feet at low water on the sill. The fortifications, which at one time made it one of the strongest fortresses in Canada, are now out of date, and would offer little resistance to modern artillery. It is the seat of an archbishopric, Queen's University, the Royal Military College, and an artillery school. Vessels entered inwards in 1900–1901, 1253, of 405,499 tons; exports, $133,696; imports, $1,245,841; total assessment of the city in 1899, $7,809,554. Population (1881), 14,091; (1891), 19,263; (1901), 17,961.

Kingston, capital of Ulster county, New York, U.S.A., on the west bank of the Hudson, 90 miles above New York, at an altitude of 185 feet. It is on the West Shore, the Ulster and Delaware, and the Wallkill Valley railways, has ferry communication with Rhinecliff, on the opposite bank of the Hudson, and regular steamboat communication with New York, Albany, and other river points. In 1900 it had 344 manufacturing establishments, with $3,657,551 capital, employing 2685 hands and producing goods valued at $5,280,478. Of its manufactures, cigars, cigarettes, and tobacco formed the largest item, with a value of $1,188,555. The manufacture of lime and cement was also important. Population (1890), 21,261; (1900), 24,535, of whom 3551 were foreign-born and 545 negroes.

Kingston-on-Thames, a parish, municipal borough, and market town of England, 12 miles west of London Bridge, on the right bank of the Thames, in the Kingston parliamentary division of Surrey. It is a station on the London and South-Western railway. Besides All Saints' Church, restored in 1888, there are in Kingston four parish churches, and Roman Catholic, Presbyterian, Congregational, Baptist, Friends', and other places of worship. Recent public buildings are the Albany Hall (1883), the Free Library (1883), and the County Hall (1893). At Norbiton, within the borough, is the Royal Cambridge Asylum for soldiers' widows (1854). At Kingston Hill is an industrial and training school for girls, opened in 1892. The Victoria Hospital was erected in 1898. The municipal borough has an area of 1114 acres. Population (1881), 20,648; (1891), 27,059; (1901), 34,375.

Kingstown, a seaport and urban sanitary district in the county of Dublin, Ireland, on Dublin Bay, 6 miles east-south-east of Dublin by rail. An electric tramway now runs through the township. In 1899, 134 vessels were registered in the fishery district, employing 546 hands. Population (1881), 18,230; (1901), 17,356.

King William's Town, a town of Cape Colony, on the Buffalo river, a few miles north-west of East London, with which it is connected by rail. "King," as it is locally called, is an important administrative centre, and has become a flourishing trading place and depôt for the traffic between the neighbouring Kaffres and the white settlers. Many of these settlers are Germans, descendants of the Anglo-German legion which was disbanded after the Crimean war. Most of the farmsteads dotted along the banks of the river are inhabited by them; hence such names as *Berlin*, *Potsdam*, *Braunschweig*, *Frankfurt*, given to settlements in this part of the country. Population (1881), 6000; (1901), 7226.

Kinning Park, a police burgh of the lower ward of Lanarkshire, Scotland, on the south bank of the Clyde between Glasgow and Govan; it is connected with the city by tramway and subway. Since 1850 it has grown from a rural village to a busy industrial centre, populated by artisans and labourers, and sharing in the activities of the burghs which enclose it. Its industries are engineering, bread and biscuit baking on a considerable scale, soap-making, and paint-making. The Police Commission maintains a police force and a small fire brigade, and Glasgow gas and water are used. Area, 108 acres; population (1901), 13,851.

Kinross-shire, an inland county of Scotland, next to Clackmannan the smallest in the country, bounded on the N. and W. by Perthshire, on the E. and on the S. by Fifeshire.

Area and Population.—In 1891 Kinross resigned part of the parish of Portmoak to Fife and parts of Arngask and Forgandenny to Perth, receiving from Fife parts of the parishes of Dunfermline, Ballingry, and Kinglassie, and from Perth a portion of its own parish of Fossoway and Tulliebole. The area of the county is 55,849 acres, or 87·2 square miles. The population was in 1881, 6697; in 1891, 6280; in 1891, on the above area, 6673; in 1901, 6980, of whom 3342 were males and 3638 females. On the old area, taking land only (46,487 acres, or 72·6 square miles), the number of persons to the square mile in 1891 was 86, and the number of acres to the person 7·4. In the registration county the population decreased between 1881 and 1891 by 8·2 per cent. Between 1881 and 1891 the excess of births over deaths was 521, but the resident population decreased by 603. The table on the next page gives particulars of births, deaths, and marriages in 1880, 1890, and 1899.

Year.	Deaths.	Marriages.	Births.	Percentage of Illegitimate.
1880	143	36	204	11·2
1890	124	57	173	7·51
1899	104	40	173	4·6

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years:—

	1880.	1881–90.	1890.	1891–98.	1899.
Birth-rate . . .	27·67	24·53	25·55	26·40	27·94
Death-rate . .	19·39	17·11	18·31	17·20	16·79
Marriage-rate . .	4·88	5·91	8·42	6·08	6·46

There were 58 Gaelic-speaking persons in the country in 1891, and one foreigner. Valuation in 1889–90, £64,004; 1899–1900, £67,030.

Administration.—The county unites with Clackmannan to return a member to Parliament. The only towns are Kinross (2136), the county town and a police burgh, which has a town hall, a county hall, two railway stations, and several textile factories; and Milnathort. There are five civil parishes, which had 101 paupers and dependants in September 1899. The county forms a sheriffdom with Fife, and a sheriff-substitute sits at Kinross.

Education.—Five school boards manage 6 schools, which had in 1898–99 an average attendance of 733, while a private school in Orwell parish had 133. The county committee provides bursaries for scholars attending Dollar Institution, and the county council spends part of the "residue" grant in agricultural experiments.

Agriculture.—In 1898, 63 per cent. of the area was under cultivation, the county ranking fifth in Scotland in this regard. The standard of farming is high, though the climate is cold and wet. In 1895 the average size of the 302 farms in the county was 119 acres; only 13·58 per cent. were under 5 acres; 23·51 between 5 and 50, and 62·91 were over 50 acres. Fifty-four farms were between 50 and 100 acres, 112 between 100 and 300, 21 between 300 and 500, and there were 3 over 500. Stock-raising is the staple industry. The following table gives the principal acreages at intervals of five years from 1880:—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	31,372	7417	3773	12,288	7,872	22
1885	32,246	6558	3339	11,689	10,645	15
1890	32,278	5924	3138	10,350	12,854	6
1895	35,846	6892	3526	11,633	13,761	19
1899	35,357	6939	3481	12,576	12,323	19

The following table gives particulars of the live stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or Calf.	Sheep.	Pigs.
1880	1051	5763	1045	27,966	461
1885	944	6475	1284	30,518	548
1890	894	6106	1110	35,539	520
1895	1179	6948	1196	36,239	515
1899	1106	7091	1321	40,920	671

In 1895, 3258 acres were under wood. At the census of 1891, 727 men and 68 women were engaged in agriculture.

See Æ. J. G. Mackay. *History of Fife and Kinross.* Edinburgh, 1896.—J. Jaffrey and C. Howie. *The Trees and Shrubs of Fife and Kinross.* Leith, 1879.—W. J. N. Liddall. *The Place Names of Fife and Kinross.* Edinburgh, 1895; *The Concise Hand-book and Map of Fife and Kinross.* Cupar.—C. Ross. *Antiquities of Kinross-shire.* Perth, 1886.—R. B. Begg. *The Witches of Kinross-shire.* Kinross; *History of Lochleven Castle.* Kinross, 1887. (W. Wa.)

Kinsale, a maritime town, urban sanitary district, and formerly (until 1885) a parliamentary borough in the county of Cork, Ireland, on the estuary of the Bandon, 24 miles south of Cork by rail. The number of vessels registered in the fishery district in 1899 was 220, employing 1064 men and boys. A fishery pier has been constructed at a cost of £22,000. Population (1881), 4976; (1901), 4250.

Kiôtô, or Kyôtô, the former capital of Japan, in the province of Yamashiro, in 35° 01′ N. and 135° 46′ E., with a population of 353,139, being thus the third of the empire's chief cities (*fu*). The Kamo-gawa, upon which it stands, is a mere rivulet in ordinary times, trickling through a wide bed of pebbles; but the city is traversed by several aqueducts, and was connected with Lake Biwa in 1890 by a canal $6\frac{7}{8}$ miles long, which carries an abundance of water for manufacturing purposes, brings the great lake and the city into navigable communication, and forms with the Kamo-gawa canal and the Kamo-gawa itself a through route to Osaka, from which Kiôtô is 25 miles distant by rail. Founded in the year 793, Kiôtô remained the capital of the empire during nearly eleven centuries. The Emperor Kuwammu, when he selected this remarkably picturesque spot for the residence of his court, caused the city to be laid out with mathematical accuracy, after the model of the Tang dynasty's capital in China. Its area, 3 miles by $3\frac{1}{2}$, was intersected by 18 principal thoroughfares, 9 running due north and south, and 9 due east and west, and the two systems being connected at intervals by minor streets. At the middle of the northern face stood the palace, its enclosure covering $\frac{3}{4}$ of a square mile, and from it to the centre of the south face ran an avenue 283 feet wide and $3\frac{1}{2}$ miles long. Conflagrations and subsequent reconstructions modified the regularity of this plan, but much of it still remains, and its story is perpetuated in the nomenclature of the streets. In its days of greatest prosperity Kiôtô contained only half a million inhabitants, thus never even approximating to the size of the Tokugawa metropolis, Yedo, or the Hôjô capital, Kamakura. The Emperor Kuwammu called it Heian-jô, or the "city of peace," when he made it the seat of government; but the people knew it as "Miyakô," or "Kyôtô," terms both of which signify "capital," and in modern times it is often spoken of as "Saikyô," or western capital, in opposition to "Tôkyô," or "eastern capital." Having been for nearly eleven centuries the imperial, intellectual, political, and artistic metropolis of the realm, the city abounds with evidences of its unique career. Magnificent temples and shrines, grand monuments of architectural and artistic skill, beautiful gardens, gorgeous festivals, and numerous *ateliers* where the traditions of Japanese art are obeyed with attractive results, offer to the foreign visitor a mine of exhaustless interest. Clear water ripples everywhere through the city, and to this water Kiôtô owes something of its importance, for nowhere else in Japan can fabrics be bleached so white or dyed in such brilliant colours. The people, like their Osaka neighbours, are full of manufacturing energy. Not only do they preserve, amid all the progress of the age, their old-time eminence as producers of the finest porcelain, faience, embroidery, brocades, bronze, *cloisonné* enamel, fans, toys, and metal work of all kinds, but they have also adapted themselves to the foreign market, and are now weaving and dyeing quantities of silk fabrics, for which a large and constantly growing demand is found in Europe and America. Nowhere else can be traced with equal clearness the part played in Japanese civilization by Buddhism, with its magnificent paraphernalia and imposing ceremonial spectacles; nowhere else, side by side with this luxurious factor, can be witnessed in more striking juxtaposition the austere purity and severe simplicity of the Shintô cult; and nowhere else can be more intelligently observed the fine faculty of the Japanese for utilizing, emphasizing, and enhancing the beauties of nature. The citizens' dwellings and the shops, on the other hand, are insignificant and even sombre in appearance, their exterior conveying no idea of the pretty chambers within or of the tastefully-laid-out grounds upon which they open behind. Kiôtô is celebrated equally for its cherry and azalea blossoms in the spring, and for the colours of its autumn foliage. (F. BY.)

Kipling, Rudyard. See ENGLISH LITERATURE.

Kirchhoff, Custav Robert (1824–1887), German physicist, was born at Königsberg (Prussia) on 12th March 1824, and was educated at the university of his native town, where he graduated Ph.D. in 1847. After acting as *privat-docent* at Berlin for some time, he became extraordinary professor of physics at Breslau in 1850. Four years later he was appointed professor of physics at Heidelberg, and in 1875 he was transferred to Berlin, where he died on 17th October 1887. Kirchhoff's contributions to mathematical physics were numerous and important, his strength lying in his powers of stating a new physical problem in terms of mathematics, not merely in working out the solution after it had been so formulated. A number of his papers were concerned with electrical questions. One of the earliest was devoted to electrical conduction in a thin plate, and especially in a circular one, and it also contained a theorem which enables the distribution of currents in a network of conductors to be ascertained. Another discussed conduction in curved sheets; a third the distribution of electricity in two influencing spheres; a fourth the determination of the constant on which depends the intensity of induced currents; while others were devoted to Ohm's law, the motion of electricity in submarine cables, induced magnetism, &c. In others papers, again, various miscellaneous topics were treated—the thermal conductivity of iron, crystalline reflection and refraction, certain propositions in the thermodynamics of solution and vaporization, &c. An important part of his work was contained in his *Vorlesungen über Mathematische Physik* (1876), in which the principles of dynamics, as well as various special problems, were treated in a somewhat novel and original manner. But his name is best known for the researches, experimental and mathematical, in radiation which led him, in company with Bunsen, to the development of spectrum analysis as a complete system in 1859–60. He can scarcely be called its inventor, for not only had many investigators already used the prism as an instrument of chemical inquiry, but considerable progress, to say the least, had been made towards the explanation of the principles upon which spectrum analysis rests. But to him belongs the merit of having, most probably without knowing what had already been done, enunciated a complete account of its theory, and of thus having firmly established it as a means by which the chemical constituents of celestial bodies can be discovered through the comparison of their spectra with those of the various elements that exist on this earth.

Kirk, Sir John (1832-——), British naturalist and administrator, was born at Barry, near Arbroath, on 19th December 1832, and was educated for the medical profession. He graduated M.D. at Edinburgh in 1854, and, after serving on the civil medical staff throughout the Crimean war, was appointed physician and naturalist to Dr Livingstone's second exploring expedition in February 1858. He was by Livingstone's side in most of his journeyings and adventures, and was one of the first four white men to behold Lake Nyasa (16th September 1859). He was finally invalided home on 9th May 1863. His African experience qualified him for the post of vice-consul at Zanzibar, bestowed upon him in 1866. In 1873 he became consul, and shortly afterwards concluded a treaty with the sultan providing for the extinction of the slave trade in his dominions. Sir John Kirk retired from the consular service in 1887, and subsequently represented the British Government at the African conferences held at Brussels in 1888–90, as commissioner on the Niger coast in 1895, and as a member of the committee for constructing the Uganda railway. Besides being foreign secretary to the Royal Geographical Society, he received its gold medal in 1882. Sir John Kirk married Miss Helen Cooke in 1867, and was made K.C.B. in 1881, and subsequently G.C.M.G.

Kirkcaldy, a royal and parliamentary burgh (Kirkcaldy group) and seaport town of Fifeshire, Scotland, on the Firth of Forth, 26 miles north of Edinburgh by rail (Forth Bridge route). Although within recent years no addition has been made to the harbour accommodation, the shipping trade—chiefly with Baltic ports—continues to increase. In 1885, 2293 vessels of 586,543 tons entered, and 2386 of 227,673 tons cleared; in 1900, 3190 vessels of 1,328,500 tons entered, and 3308 of 1,388,410 tons cleared. In the latter year the exports were valued at £1,678,650, and the imports at £280,100. Several important public buildings have been erected: sheriff court buildings in 1893, high school—succeeding the burgh school—in 1894, the Swan memorial hall, with rooms for the Young Men's Christian Association, the Adam Smith memorial hall, and the Beveridge public hall and free library (1894). A beautiful park, at the north-west end, with an area of 110 acres, was presented in 1892. Population (1891), 27,151; (1901), 34,064.

Kirkcudbright, a royal and parliamentary burgh (Dumfries group), and the county town of Kirkcudbrightshire, Scotland, on the river Dee, 6 miles from the sea. Its first charter dates from 1455. There are county buildings, a town hall, and a museum. There is a regular water-supply. The river is spanned by an iron bridge, which can be opened for the purpose of allowing the passage of vessels. The harbour is excellent, but shipping is inconsiderable, as also are manufactures. The churches are Established, two United Free (one 1880), Episcopal (1870), and Roman Catholic (1880). Besides an academy, there are four public schools, and the average attendance at elementary classes in 1898–99 was 445; an Old Church school had 156, and a Roman Catholic school 134. Population (1881), 2571; (1891), 2533; (1901), 2386.

Kirkcudbrightshire, or the STEWARTRY of KIRKCUDBRIGHT, a maritime county of south-west Scotland, bounded on the N. and N.W. by Ayrshire, on the E. and N.E. by Dumfriesshire, on the S. by the Solway Firth and the Irish Sea, and on the W. by Wigtownshire and Wigtown Bay.

Area and Population.—According to the latest official estimate, the area of the county (foreshore excluded) is 582,251 acres, or about 909 square miles. The population was, in 1881, 42,127; in 1891, 39,985; in 1901, 39,407, of whom 18,759 were males and 20,648 females. Taking the land area only (574,588 acres or 897·8 square miles), the number of persons to the square mile was 45 and the number of acres to the person 14·0. Between 1881 and 1891 the population of the registration county decreased by 5 per cent. Between 1881 and 1891 the excess of births over deaths was 4335, and the decrease of the resident population 2143. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899:—

Year.	Deaths.	Marriages.	Births.	Per cent. of Illegitimate.
1880	707	207	1291	15·6
1890	729	232	1044	14·18
1899	663	221	978	11·8

The following table gives the birth-rate, death-rate, and marriage-rate per thousand of the population for a series of years:—

	1880.	1881–90.	1890.	1891–98.	1899.
Birth-rate . .	30·54	28·19	25·89	26·24	25·50
Death-rate . .	16·73	17·71	18·07	17·14	17·28
Marriage-rate .	4·90	5·45	5·75	5·44	5·76

There were 69 Gaelic-speaking persons in the county in 1891, and 16 foreigners. Valuation in 1889–90, £346,477 ; 1899–1900, £341,728.

Administration.—The county returns one member to Parliament, and Kirkcudbright (2386), the county town, is one of the Dumfries group of parliamentary burghs; New Galloway was, with the other burghs of the Wigtown group, merged in its county for parliamentary representation in 1885. There are 28 civil parishes in the county, with a combination poorhouse at Kirkcudbright, and the number of paupers and dependants in September 1899 was 1107. Kirkcudbright forms a part of the sheriffdom of Dumfries and Galloway, and there is a resident sheriff-substitute at Kirkcudbright, who sits also at Castle Douglas, Maxwelltown, New Galloway, and Creetown.

Education.—Thirty school boards manage 63 schools, which had an average attendance of 5990 in 1898–99, while 6 voluntary schools (of which four are Roman Catholic, and one Episcopal) had 505. There is an academy at Kirkcudbright, and the county committee subsidizes also high schools at Dumfries and Newton-Stewart, while 13 other public schools in the county earned grants in 1898 for giving higher education. Part of the "residue" grant is handed over by the county council to the secondary committee, and is expended on technical classes at Kirkcudbright, Dalbeattie, Castle Douglas, and Dumfries, and part is spent by the council directly in supporting a dairy association, manuring experiments and lectures, and cookery classes.

Agriculture.—The percentage of the area under cultivation in 1898 was 32·9. The greater part of the land is either waste or poor pasture. Green crops rather than grain are favoured by the climate, and cattle breeding and feeding, and dairying (with cheese-making as a staple) are the leading agricultural industries. The average size of the 1605 holdings in 1898 was 119 acres. The percentage under 5 acres was 14·70, between 5 and 50 acres 29·85, and over 50 acres 55·45. Farms between 50 and 100 acres numbered 234 ; between 100 and 300, 486 ; between 300 and 500, 142, and over 500, 28. The following table gives the principal acreages at intervals of five years from 1880 :—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	177,079	32,672	17,171	67,680	59,418	138
1885	182,490	32,176	16,953	69,482	63,530	349
1890	186,580	29,107	17,395	68,269	71,644	132
1895	191,028	27,860	16,808	60,998	85,109	221
1899	191,626	27,529	15,782	63,348	84,845	100

The following table gives particulars of the live stock during the same years :—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or Calf.	Sheep.	Pigs.
1880	5476	42,463	11,685	381,874	5019
1885	5673	43,926	14,489	357,361	7025
1890	5719	46,933	14,699	402,033	7729
1895	6190	48,213	16,256	381,115	7892
1899	5476	49,539	16,246	399,338	8265

In 1895, 19,285 acres were under wood, of which 1203 had been planted since 1881. The number of persons returned at the census of 1891 as connected with the pursuit of agriculture was 5281 men and 531 women.

Industries and Trade.—Industries apart from agriculture are not of great importance. Kirkcudbright comes next to Aberdeen as a granite-producing county ; the output was 55,388 tons valued at £35,358 in 1895, and 53,633 tons valued at £28,429 in 1899. Kirkcudbright, Creetown, and Gatehouse are the principal ports, and the exports are mainly agricultural produce, the imports coal and miscellaneous. The fishing industry can scarcely be said to exist. The number of persons connected with industrial pursuits in 1891 was 6000.

See Sir Herbert Maxwell. *History of Dumfries and Galloway.* Edinburgh, 1896.—P. H. M'Kerlie. *History of the Lands and their Owners in Galloway.* Edinburgh, 1870–79 ; *Galloway Ancient and Modern.* Edinburgh, 1891.—J. A. H. Murray. *Dialect of the Southern Counties of Scotland.* London, 1873.—J. M'Andrew. *List of the Flowering Plants of Dumfriesshire and Kirkcudbrightshire.* Dumfries, 1882.—*Proceedings* of the Society of Antiquaries of Scotland, *passim.*—Thomas MacLelland. "The Agriculture of the Stewartry," *Trans.* of H. and A. Soc., 1875.—J. Biggar. *The Agriculture of Kirkcudbrightshire.* Castle Douglas, 1876. (W. Wa.)

Kirkintilloch, a burgh of barony and police burgh of Dumbartonshire, Scotland, on the Forth and Clyde Canal, 8 miles north-north-east of Glasgow by rail. Iron-founding, muslin-weaving, and chemical-manufactures are the chief industries. A drainage system has been laid, and a memorial erected (1891) to Miss Beatrice Clugston, to whom was largely due the foundation of the Broomhill Homes in the burgh. In 1898 the burgh acquired as a public park the Peel, containing traces of the Roman wall, a fort, and the foundation of Comyn's Castle. Baptist and Original Secession chapels have been erected. Population (1881), 8029 ; (1891), 10,312 ; (1901), 10,502. The suburb of Lenzie, partly included in the burgh, is inhabited chiefly by Glasgow business men. It has a public hall, academy, and an asylum of the Glasgow City Lunacy Board. Population (1891), 1916 ; (1901), 1879.

Kirk-Kilisseh, a town in the sanjak of Adrianople, European Turkey, 35 miles east of Adrianople. The name signifies "four churches," and the town possesses many mosques and Greek churches. It has an important trade with Constantinople in butter and cheese, and other articles of commerce are wine, brandy, cereals, and tobacco. Population, 18,000, of whom 3000 are Turks, 9000 Greeks, 5400 Bulgarians, and 600 Jews.

Kirksville, capital of Adair county, Missouri, U.S.A., on the Omaha, Kansas City and Eastern, and the Wabash railways, at an altitude of 975 feet. Situated in an agricultural region, its manufactures consist in great part of agricultural tools and machines. Population (1880), 2314 ; (1900), 5966, of whom 112 were foreign-born and 291 negroes.

Kirkwall, a royal and parliamentary burgh (Wick group) and the county town of Orkney, Scotland, on a bay of the island of Pomona, the largest of the group. It is 51 miles north of Wick in a straight line, and 225 from Leith by steamer. Municipal buildings have been erected, and there are county buildings. A United Free church has been built. A second pier was erected to improve the harbour in 1885. The industries are those connected with fishing and shipping, and there are two distilleries adjacent. At the end of 1900 the port register contained 39 vessels of 2287 tons. In 1888, 2414 vessels of 214,710 tons entered ; in 1900, 2385 vessels of 226,124 tons. The total trade barely exceeds £10,000 in value annually. Population (1881), 3923 ; (1901), 3660.

Kirmán (Kermán, Karmán), the capital of the Persian province of the same name, situated in 30° 17′ N. and 56° 59′ E., at an elevation of 6080 feet. Its population is estimated at 45,000, including about 2000 Zoroastrians, 150 Jews, and a few Shikárpúri Indians. Kirmán has post (since 1878) and telegraph (since 1879) offices, and a British consulate and an agency of the Imperial Bank of Persia have been established. Kirmán and neighbouring districts produce little grain, and have to get their supplies from districts far away for four or five months of the year. A well-known traveller once said it was easier to get a mann (6½ ℔) of saffron at Kirmán than a mann of barley to feed his horse, and the writer in 1879 was ordered by the authorities to curtail his trips in the province, "because his horses and mules ate up all the stock." (A. H.-S.)

Kirriemuir, a police burgh, manufacturing town, and railway station of Forfarshire, Scotland, 5 miles west-north-west of Forfar. It is the "Thrums" of J. M. Barrie, the novelist, who was born here. It has two large linen factories. There are a public hall and a public park. The Original Secession chapel (Barrie's "Auld Licht kirk"), founded 1806, was rebuilt 1893. Population (1881), 4390 ; (1901), 4096.

Kir-shehr, the ancient *Mocissus-Justinianopolis,* the chief town of a sanjak of the same name in the Angora viláyet of Asia Minor, situated on a tributary of the Kizil Irmak, on the Angora–Kaisaríeh road. The town gives its name to the excellent carpets made in the vicinity. It is on the line of the projected railway from Angora to Kaisaríeh. Population (1900), 9000 (900 Christians).

Kishangarh, a native state of India, in the Rajputana Agency. Area, 874 square miles; population (1881), 112,633; (1891), 125,516, showing an increase of 11 per cent.; average density, 144 per square mile. In 1901 the population was 88,200, showing a decrease of 30 per cent., due to the results of famine. The revenue (1896–97) was Rs.5,68,097; no tribute; number of schools, 20. The chief, whose title is maharaja, is a Rajput of the Rahtor clan. The reigning maharaja, Sardul Singh, G.C.I.E., was born in 1857, and succeeded his father in 1879. He is connected by marriage with all the great houses of Rajputana. The administration, under the Diwan, is highly spoken of. Irrigation from tanks and wells has been extended; factories for ginning and pressing cotton have been started; and the social reform movement, for discouraging excessive expenditure on marriages, has been very successful. The state is traversed by the Rajputana railway. It suffered severely from the famine of 1899–1900. In 1897–98 rupees were coined at the mint to the value of Rs.1,03,379, bearing on the obverse the name of Queen Victoria in Persian characters. The town of Kishangarh is 18 miles north-east of Ajmir by rail. Population (1881), 14,824; (1891), 15,363. It is the residence of many Jain merchants.

Kishinev, a town of Russia, capital of the government of Bessarabia, 120 miles by rail north-west of Odessa and 30 miles from the Rumanian frontier. Population, which is very mixed, and contains many Moldavians and Jews (1862), 91,532; (1897), 108,796. It has now a considerable number of schools, including a gardening school; a museum of natural sciences, agriculture, and domestic industries; a public library, and a botanic garden. Fruit-gardens, vineyards, and plantations of silk-worm trees and tobacco cover its suburbs. Factories, chiefly distilleries, develop but slowly, but the trade in corn, wine, tobacco, fruit, tallow, hides, wool, and cattle (exported abroad), is rapidly growing, and its yearly fair is of importance.

Kissingen, a town and watering-place of Bavaria, Germany, district Lower Franconia, on the Franconian Saale, 43 miles by rail north by east of Würzburg. It is visited annually by 14,000 persons. A marble statue of Ludwig I. of Bavaria was placed in the spa garden in 1891. Population (1900), 4755.

Kistna, a district of British India, in the north-east of the Madras Presidency. Masulipatam, the district headquarters, was the first British settlement on the Coromandel coast (1611), and was captured from the French in 1758. Linguistically, almost all the inhabitants speak Telugu. Area, 8397 square miles; population (1881), 1,548,480; (1891), 1,855,582, showing an increase of 20 per cent.; average density, 221 persons per square mile. In 1901 the population was 2,155,199, showing a further increase of 16 per cent. The land revenue and rates were Rs.64,25,525, the incidence of assessment per acre being Rs.2 : 4 : 0 on *ryotwari* and Rs.0 : 10 : 9 on *zamindari* lands; number of police, 1097. In 1897–98, out of a total cultivated area of 2,129,559 acres, 432,960 were irrigated, including 384,457 from Government canals. Upon the Kistna delta system of canals, which are available also for navigation, connecting with the Godavari system, the capital expenditure has been Rs.1,31,91,665, and the profit in 1897–98, after allowing for interest and all indirect charges, was Rs.12,52,028, or more than 10 per cent. The surplus rice thus raised in the delta serves to protect the other portions of the district from the effects of drought, to which it has always been liable. The principal crops are rice, millet, other food grain, pulse, oil-seeds, cotton, indigo, tobacco, and a little sugar-cane. There are 11 factories for ginning and pressing cotton. The cigars known in England as Lunkas are partly made from tobacco grown on *lankas* or islands in the Kistna. The manufacture of chintzes at Masulipatam is a decaying industry, but cotton is woven everywhere for domestic use. Salt is evaporated, as a Government monopoly, along the coast. The diamond mines visited by Tavernier, which are said to have yielded the Kohinoor stone, are no longer worked. Bezwada, at the head of the delta, is a place of growing importance, as the central junction of the East Coast railway system, which crosses the inland portion of the district in three directions. Some sea-borne trade, chiefly coasting, is carried on at the open roadsteads of Masulipatam and Nizampatam, both in the delta. In 1897–98 the total was valued at Rs.27,51,324. The Church Missionary Society supports a college at Masulipatam, and the American Lutheran Mission a smaller one at Guntur—total students in 1896–97, 109. In that year there were 1828 schools, attended by 45,653 pupils, the proportion of boys at school to the male population of school-going age being 26 per cent., and the proportion of girls 6·6 per cent. There are 7 printing-presses, issuing two English and three vernacular periodicals, and several reading-rooms, clubs, and literary institutes. Death-rate (1897), 22 per thousand. (J. S. CO.)

Kites, Military.—A kite, consisting of a framework of sticks spreading a light sail of cloth or other material, and held by a string against the pressure of the wind, forms so extremely simple a method of lifting anything to a height in the air, that it has naturally been suggested as being suitable for various military purposes (Fig. 1)—for instance, for signalling to a long distance,

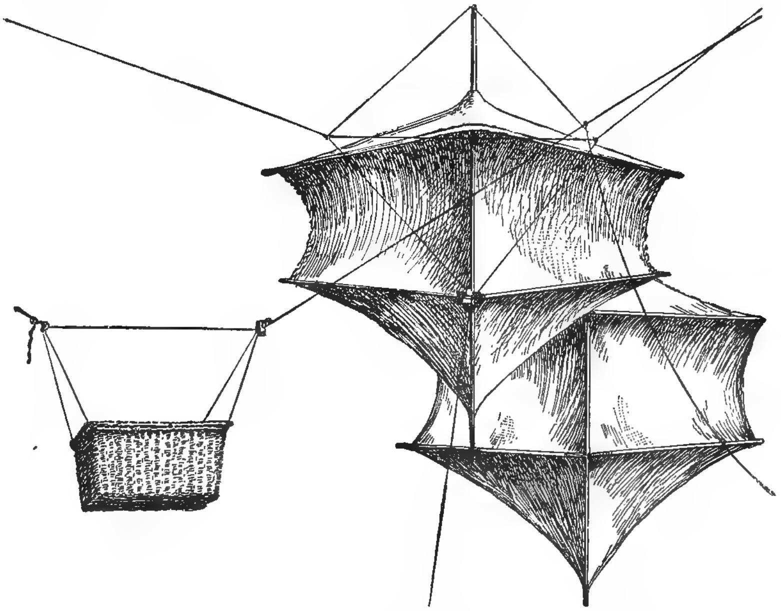


Fig. 1.—Military Kite and Basket.

carrying up flags, or lamps, or semaphores. Trials have been made both in the British army (at Aldershot and elsewhere) and navy, in the latter case for floating torpedoes on hostile positions. As much as two miles of line have been paid out. For purposes of photography a small kite carrying a camera to a considerable height may be caused to float over a fort or other place of which a bird's-eye view is required, the shutter being operated by electric wire, or slow match, or clockwork. Many successful photographs have been thus obtained in England and America.

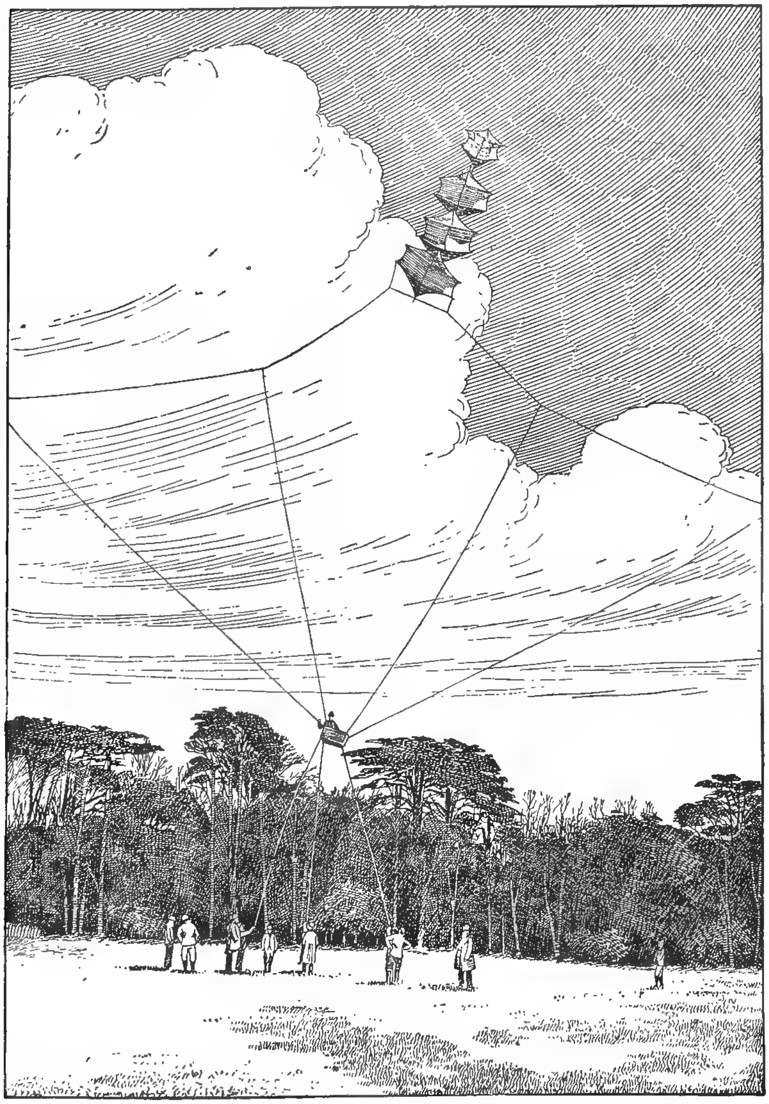


Fig. 2.—Military Kite lifting a Man.

The problem of lifting a man by means of kites instead of by a captive balloon is a still more important one. The chief advantages to be gained are: (1) less transport is required; (2) they can be used in a strong wind; (3) they are not so liable to damage, either from the enemy's fire or from trees, &c., and are easier to mend; (4) they can be brought into use more quickly; (5) they are very much cheaper, both in construction and in maintenance, not requiring any costly gas.

Early in the 19th century one Pocock suggested the use of man-lifting kites for military purposes, and an apparatus was tested at Chatham in 1876, but it failed to lift a man. Captain Baden-Powell, of the Scots Guards, in June 1894 constructed, at Pirbright Camp, a huge kite 36 feet high, with which he successfully lifted a man on different occasions (Fig. 2). He has since improved the contrivance, using five or six smaller kites attached together in preference to one large one. With this arrangement he has frequently ascended as high as 100 feet. The kites were hexagonal, being 12 feet high and 12 feet across. The apparatus, which could be packed in a few minutes into a simple roll, weighed in all about 1 cwt. This appliance was proved to be capable of raising a man even during a dead calm, the retaining line being fixed to a waggon and towed along. Lieut. H. D. Wise made some trials in America in 1897 with some large kites of the Hargrave pattern (Hargrave having previously himself ascended in Australia), and succeeded in lifting a man 40 feet above the ground. In the Russian army a military kite apparatus has also been tried, and was in evidence at the manœuvres in 1898. Experiments on a small scale have also been carried out by most of the European Powers. (B. F. S. B.-P.)

Kivu, a considerable lake lying in the Central African rift valley, about 60 miles north of Tanganyika, into which it discharges its waters by the Rusizi river, thus belonging to the Congo system. On the north it is separated from the basin of the Nile by a line of volcanic peaks. The length of the lake is about 55 miles, and its greatest breadth over 30, giving an area, including islands, of about 1100 square miles. It is roughly triangular in outline, the longest side lying to the west. The coast-line is much broken, especially on the south-east, where the indentations present a fjord-like character. The lake is deep, and the shores are everywhere high, rising in places in bold precipitous cliffs of volcanic rock. A large island, Kwijwi or Kwichwi, oblong in shape and traversed by a hilly ridge, runs in the direction of the major axis of the lake, south-west of the centre, and there are many smaller islands. The lake has many fish, but no crocodiles or hippopotami. South of Kivu the rift valley is blocked by huge ridges, formed of the same eruptive rocks of which the plateaux to the east and west are composed. Through these the Rusizi now breaks its way in a succession of deep gorges, emerging from the lake in a foaming torrent, and descending 2000 feet to the lacustrine plain at the head of Tanganyika. There is evidence that the lake was not always drained thus, the ancient water-parting having probably been formed by the eruptive ridge above referred to. The lake fauna is a typically fresh-water one, presenting no affinities with the marine or "halolimnic" fauna of Tanganyika, but similar to that shown by fossils to have once existed in the more northern parts of the rift valley. The former outlet or extension in this direction seems to have been blocked in recent geological times by the elevation of the volcanic peaks which dammed back the water, causing it finally to overflow to the south. The whole of the region to the north is of great interest. The volcanoes (sometimes known generally as the Kirunga mountains) form two groups, separated by a vast lava-field. In the west are the still active peaks, Kirunga-cha-gongo and Kirunga-cha-moto, the former 11,350 feet high. The eastern peaks are still higher, and are snow-clad for part at least of the year. The principal are Sabyin, Karisimbi (13,000 feet), and at the eastern end of the line, that formerly known as Mfumbiro (and sometimes also as Kirunga), which reaches some 14,000 feet. It has a small crater filled with water on the summit. Mfumbiro is said to be the name of a district to the north containing many hundreds of low peaks and craters, now extinct. The eastern

Kirunga separates the basins of the principal feeders of the Albert Edward and Victoria Nyanzas, the Ruchuru and Kagera. Lake Kivu and Mfumbiro were first heard of by Captain Speke in 1861, but not visited by a European until 1894, when Count von Götzen passed through the country on his journey across the continent. The lake and its vicinity have been carefully explored by Dr Kandt, Captain Bethe, Mr E. S. Grogan, Mr J. S. Moore, and Major Gibbons. The ownership of the region has for some time been in dispute between Germany and the Congo State. In the map accompanying the agreement between the two parties in 1885, the boundary was shown as the Rusizi, while in other maps and documents of the same and later dates it was defined as running in a direct line from the head of Tanganyika to the intersection of 30° E. with 1° 20′ S., thus giving the whole of the Kivu region to the Congo State. The difference was, in 1901, in process of settlement on the spot by the labours of a mixed commission.

See Kandt, in *Mitt. aus den Deutschen Schutzgebieten*, No. 3, 1900.—Grogan, in *Geographical Journal* for August 1900.—Moore, *ibid.*, January 1901; *To the Mountains of the Moon*, London, 1901. (E. He.)

Kizil Irmak, *i.e.*, "Red River," the ancient *Halys*, the largest river in Asia Minor, rising in the Kizil Dagh at an altitude of 6500 feet, and running south-west past Zara to Sivas. Below Sivas it flows south to the latitude of Kaisaríeh, and then curves gradually round to the north. Finally, after a course of about 600 miles, it discharges its waters into the Black Sea between Sinope and Samsún, where it has formed a large delta. The only important tributaries are the Delije Irmak on the right and the Geuk Irmak on the left bank.

Kjerulf, Halfdan (1815–1868), Norwegian musical composer, born at Christiania in 1815, was the son of a high Government official. His early education was almost entirely aimed at fitting him for a legal career. In his 19th year he graduated at Christiania University, and not till he was nearly 26—on the death of his father—was he able to devote himself entirely to music, for which he had longed throughout his whole life. As a fact, he actually started on his career as a music teacher and composer of songs before ever having seriously studied music at all, and not for ten years did he attract any particular notice. Then, however, his Government paid for a year's instruction for him at Leipzig. For many years after his return to Norway Kjerulf tried in vain to establish serial classical concerts, while he himself was working with Björnson and other writers at the composition of lyrical songs. His fame rests almost entirely on his beautiful and manly national part songs and solos; but his pianoforte music is equally charming and simple. Kjerulf died at Grefsen, 11th August 1868.

Kladno, a mining town in Bohemia, 15 miles west-north-west of Prague. The iron and steel works of the Prague Iron Industry Association employ over 3000 hands, while nearly as many more are engaged in the company's coal mines, and another 3000 find occupation in the six pits worked by the Austro-Hungarian State railway. The production of iron and steel in 1893 was over 200,000 tons, and of coal 1,426,000 tons. Population (1890), 17,215; (1900), 18,600, Czechs.

Klagenfurt (Slovene, *Celovec*), the capital of the Austrian duchy of Carinthia, 41 miles north by west of Laibach, on the Glan, near Lake Wörth. Population (1890), 19,756, German and mostly Catholic; (1900), after the incorporation of some suburbs, 24,314. The town has an exceptionally high rate of illegitimacy. In 1892 it was 61 per cent. In 1888 the illegitimate births were 512 and the legitimate 173. The death-rate declined from 32·6 in 1890 to 21·9 in 1895.

Klattau (Czech, *Klatovy*), chief town of a district of the same name in Bohemia, Austria, 25 miles west by south of Pilsen. It has a machine factory and foundry, steam corn and saw mills, breweries, and manufactories of chicory, lucifer matches, underlinen, &c. Population (1890), 10,811; (1900), 12,793, mostly Czech.

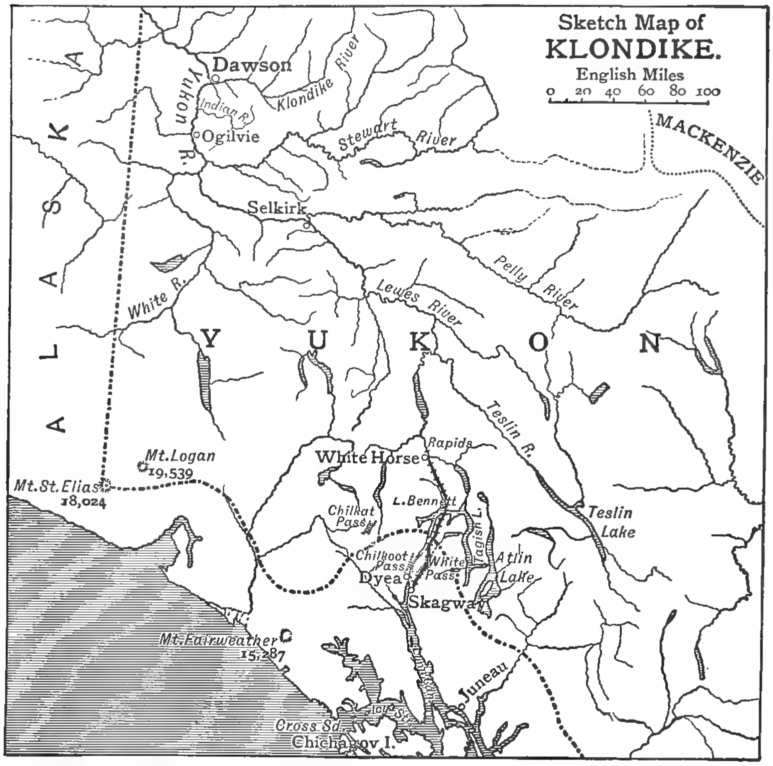
Klausenburg. See Kolozsvár.

Klausthal, or Clausthal, a town of Hanover, Prussia, the chief mining town in the Upper Harz Mountains, 50 miles by rail west-south-west of Halberstadt. Its own mines are silver and lead, but it also smelts copper and a little gold. Four or five sanatoria are in the neighbourhood. The museum of the Upper Harz is at Zellerfeld. Population (1885), 8871; (1900), 8565.

Klintsy, a town of Russia, government and 95 miles north-east of Chernigov, on the railway to Bryansk. It has several woollen-cloth and sackcloth mills, knitting factories, tanneries, and various smaller factories, the yearly returns from which amount to about £200,000. Many artisans are engaged in shoemaking and the weaving of cloth, while the merchants carry on an important trade in furs, hides, hemp-seed, and cattle. Population (1897), 11,625.

Klondike, a district in Yukon territory, north-western Canada, approximately in 64° N. and 140° W. The limits are rather indefinite, but the district includes the country about the course of Klondike river, a right-hand branch of the Yukon, together with its tributaries; and in popular usage also the mining region of Indian river, a second branch of the Yukon, flowing into it some distance above the Klondike. It is thus some 40 miles square and includes an area of approximately 1500 square miles. It is an area of hills, or low mountains, rising in the highest summits to altitudes of about 2200 feet above the Yukon or 3600 feet above the sea. Gold was discovered in this region in 1896, by one J. W. Carmach, aided, it is said, by his Indian wife. This discovery was made on Bonanza Creek, where it joins the Klondike just above its mouth. The discovery was followed by a stampede of miners from all the camps for hundreds of miles round, and the creek and its many branches were covered with claims from head to mouth. The "clean-up" of the following year, 1897, was a revelation to the world, and the arrival of a steamer at Seattle, bearing a ton of the yellow metal, was the signal for an exodus from all parts to this new Eldorado. The routes chiefly used were by the inside passage to the head of Lynn Canal, to Dyea, and Skagway, thence over the Chilkoot and White passes to the Yukon and down that stream. The city of Dawson was founded in 1897 as the metropolis of the district, and quickly became a large and flourishing city, with a most heterogeneous population. The Canadian Government, by the aid of its mounted police, maintained excellent order from the first. During 1897 and 1898 prices of labour and the necessaries of life were extravagantly high, but with the development of transportation lines on the Yukon, and the construction of the railway from Skagway, over White Pass and down the Yukon to White Horse rapids, freights were greatly reduced and prices approached a normal level.

The production of gold in the Klondike district was in 1897, $2,500,000; 1898, $11,000,000; 1899, $16,000,000; 1900, $20,000,000; 1901, estimated at over $20,000,000. This production is entirely from placers. The placers were of two kinds, gulch and bench claims. The gulch claims are on branches of Klondike river—not on the main stream, which has been found almost barren—and mainly on Bonanza and Eldorado creeks, the latter a branch of the former, although gold has been found on many other streams. The gold is found mainly at the bottom of the gravel, on the bedrock, requiring the removal of the overlying gravel. As this material is frozen throughout the year, thawing only near the surface in summer, mining involves a slow and laborious process of artificially melting the frozen gravel. This process is commonly carried on in the winter, and the gravel is sluiced in the spring and summer. The laws of the Dominion, under which claims are obtained, are very complicated, and have been changed many times since the opening of the district. At present they permit the location of claims 250 feet long, with the full width of the gulch, or, on rivers, with the half width of the valley. Terrace claims are 250 feet square. Every alternate claim belongs to the Government, and a certain percentage, formerly 10 per cent. of the gross products of the claim, is paid to the Government. Aliens, as well as citizens, may take up mining claims. In 1901 the population of the city of Dawson was 9142. (H. G*.)



Knowles, James (1831–——), English architect and editor, was born in London in 1831, and was educated, with a view to following his father's profession as an architect, at University College and in Italy. His literary tastes also brought him at an early age into the field of authorship. In 1860 he published *The Story of King Arthur*. In 1867 he was introduced to Tennyson, whose house, "Aldworth," on Blackdown, he designed; this led to a close friendship, Mr Knowles assisting Tennyson in business matters, and among other things helping to design scenery for *The Cup*, when Irving produced that play in 1880. Mr Knowles became intimate with a number of the most interesting men of the day, and in 1869, with Tennyson's co-operation, he started the "Metaphysical Society," the object of which was to attempt some intellectual *rapprochement* between Religion and Science by getting the leading representatives of Faith and Unfaith to meet and exchange views.

The members from first to last were as follows:—Dean Stanley, Seeley, Roden Noel, Martineau, W. B. Carpenter, Hinton, Huxley, Pritchard, Hutton, Ward, Bagehot, Froude, Tennyson, Tyndall, Alfred Barry, Lord Arthur Russell, Gladstone, Manning, Knowles, Sir John Lubbock, Alford, Alex. Grant, Bishop Thirlwall, F. Harrison, Father Dalgairns, Sir G. Grove, Shadworth Hodgson, H. Sidgwick, E. Lushington, Bishop Ellicott, Mark Pattison, duke of Argyll, Ruskin, Robert Lowe, Grant Duff, Greg, A. C. Fraser, Henry Acland, Maurice, Archbishop Thomson, Mozley, Dean Church, Bishop Magee, Croom Robertson, FitzJames Stephen, Sylvester, J. C. Bucknill, Andrew Clark, W. K. Clifford, St George Mivart, M. Boulton, Lord Selborne, John Morley, Leslie Stephen, F. Pollock, Gasquet, C. B. Upton, William Gull, Robert Clarke, A. J. Balfour, James Sully, and A. Barratt.

Papers were read and discussed at the various meetings on such subjects as the ultimate grounds of belief in the objective and moral sciences, the immortality of the soul, &c. An interesting description of one of the meetings was given by Magee (then Bishop of Peterborough) in a letter of 13th February 1873:—

> Archbishop Manning in the chair was flanked by two Protestant bishops right and left; on my right was Hutton, editor of the *Spectator*, an Arian; then came Father Dalgairns, a very able Roman Catholic priest; opposite him Lord A. Russell, a Deist; then two Scotch metaphysical writers, Freethinkers; then Knowles, the *very* broad editor of the *Contemporary;* then, dressed as a layman and looking like a country squire, was Ward, formerly Rev. Ward, and earliest of the perverts to Rome; then Greg, author of *The Creed of Christendom*, a Deist; then Froude, the historian, once a deacon in our Church, now a Deist; then Roden Noel, an actual Atheist and red republican, and looking very like one! Lastly Ruskin, who read a paper on miracles, which we discussed for an hour and a half! Nothing could be calmer, fairer, or even, on the whole, more reverent than the discussion. In my opinion, we, the Christians, had much the best of it. Dalgairns, the priest, was very masterly; Manning, clever and precise and weighty. Froude, very acute, and so was Greg. We only wanted a Jew and a Mahommedan to make our Religious Museum complete (*Life*, vol. i. p. 284).

The last meeting of the Society was held on 16th May 1880. Huxley said that it died "of too much love"; Tennyson, "because after ten years of strenuous effort no one had succeeded in even defining Metaphysics." According to Dean Stanley, "We all meant the same thing if we only knew it." The Society formed the nucleus of the distinguished list of contributors who supported Mr Knowles in his capacity as an editor. In 1870 he became associated with the *Contemporary Review*, but left it in 1877 and founded the *Nineteenth Century* (to the title of which, in 1901, were added the words *And After*). Both periodicals became very influential under him, and formed the type of the new sort of monthly Review which came to occupy the place formerly held by the Quarterlies.

Knoxville, capital of Knox county, Tennessee, U.S.A., on the north bank of the Tennessee, at an altitude of 891 feet. It is the chief city of the valley of east Tennessee, and is third in size in that state. Its site is undulating and its plan irregular; it is well built, is divided into 11 wards, and is paved with brick and macadam. It is on two railways, the Southern and the Atlanta, Knoxville and Northern. It is near the famous marble quarries of east Tennessee, and it has large and rapidly increasing iron manufactures. In 1900 its manufacturing establishments numbered 218, with a total capital of $5,151,130. They employed 4714 hands, and the product was valued at $6,943,595. The University of Tennessee, situated here, was opened in 1794, and had in 1899, 65 professors and other instructors and 670 students, 75 of whom were women. Knoxville College, a Presbyterian institution founded in 1875, had in 1899, 23 instructors and 264 students. The assessed valuation of real and personal property in 1900 was $11,210,200; the net debt was $1,407,191; and the rate of taxation was $24.80 per $1000. Population (1880), 9693; (1890), 22,535; (1900), 32,637—895 foreign-born and 7359 negroes.

Knutsford, an ancient market town and parish in the Knutsford parliamentary division of Cheshire, England, 24 miles east-north-east of Chester by rail. Over Knutsford was in 1894 incorporated with the township of Knutsford. The grammar school was reorganized in 1885, the present building dating from 1887. There are, besides, the Egerton Schools, erected by Lord Egerton (1893), a market hall, a literary institute, and a sessions-house. The town (which is the "Cranford" of Mrs Gaskell's novel of that name) and its outskirts are the residence of many Manchester merchants. Its industries comprise cotton, worsted, and leather manufactures. Area of Knutsford, including Nether and Over Knutsford, 1760 acres. Population (1881), 4305; (1891), 4643; (1901), 5172. Knutsford was the birthplace in 1788 of Sir Henry Holland, Bart., the famous physician and writer; and in 1888 its name was taken for his title by his son, the second Sir Henry Holland, 1st BARON KNUTSFORD (1825- ——), who was Secretary of State for the Colonies from 1887 to 1892.

Kobdo, a town of the Chinese Empire, north-west Mongolia, at the northern foot of the Mongolian Altai, on the right bank of the Buyantu river, 13 miles from its entrance into Lake Khara-usu; 500 miles east-south-east of Biysk (Russian), and 470 miles west of Ulyasutai. It is situated amidst a dreary plain, and consists of a fortress, the residence of the governor of the Kobdo district, and a small trading town, chiefly peopled by Chinese and a few Mongols. It is, however, an important centre for trade between the cattle-breeding nomads and Peking. It was founded by the Chinese in 1731, and pillaged by the Musulmans in 1872. The district of KOBDO occupies the north-western corner of Mongolia, and is peopled chiefly by Mongols, and also by Kirghiz and a few Soyotes, Uryankhais, and Khotons. It is governed by a Chinese commissioner, who has under him a special Mongol functionary (Mongol, *dzurgan*). The chief monastery is at Ulangom. Considerable numbers of sheep (about 1,000,000), sheepskins, sheep and camel wool are exported to China, while Chinese cottons, brick tea, and various small goods are imported. Leather, velveteen, cotton, iron and copper goods, boxes, &c., are imported from Russia in exchange for cattle, furs, and wool. The absence of a cart road to Biysk hinders the development of this trade.

Koch, Robert (1843- ——), German bacteriologist, was born at Klausthal, Hanover, on 11th December 1843. He studied medicine at Göttingen, and it was while he was practising as a physician at Wallstein that he began those bacteriological researches that have made his name famous. In 1876 he obtained a pure culture of the anthrax bacillus, announcing a method of preventive inoculation against that disease seven years later. In 1882, largely as the result of the improved methods of bacteriological investigation he was able to elaborate, he discovered the bacillus of tuberculosis; and in the following year, having been sent on an official mission to Egypt and India to study the ætiology of Asiatic cholera, he identified the comma bacillus as the specific organism of that malady. In 1890 great hopes were aroused by the announcement that in tuberculin he had prepared an agent which exercised an inimical influence on the growth of the tubercle bacillus, but the expectations that were formed of it as a remedy for consumption were not fulfilled, though it came into considerable vogue as a means of diagnosing the existence of tuberculosis in animals intended for food. But even its utility in this respect would be nullified if it should be found, as he stated at the Congress on Tuberculosis held in London in 1901, that tuberculosis in man and in cattle is not the same disease, and is not transmissible from one to the other. This statement, however, was not regarded as properly proved, and pending further inquiry is regarded with general scepticism. Dr Koch also investigated the nature of rinderpest in South Africa in 1896, and of bubonic plague in India in the following year. He became a member of the Sanitary Commission at Berlin and a professor at the School of Medicine in 1880.

Koesfeld, a town of the province of Westphalia, Prussia, 38 miles by rail north-north-west of Dortmund. Here are the ruins of the Ludgeri Castle, formerly the residence of the bishops of Münster (19 miles to the east), and also the castle of Varlar the residence of the counts of Salm-Horstmar. The leading industries include mixed linen goods, woven and dyed, saw-mills, &c. Population (1900), 7445.

Köflach, a market-place in the government district of Voitsberg, 17 miles west of Gratz, in Styria, Austria. It is the centre of an extensive lignite deposit and of a number of iron-works. There are about 4000 hands employed in the mines, the annual product amounting to 700,000 tons of lignite. There are also some tanning, glass-making, and brewing, and the manufacture of cellulose, together with a number of saw-mills. Population (1890), 2927; (1900), 3345, chiefly German.

Kohat, a town and district of British India, in the Peshawur division of the Punjab. The town is 37 miles south of Peshawur by the Kohat pass, along which a military road was opened in 1901. Population (1881), 18,179; (1891), 27,003; municipal income (1897–98), Rs.48,701. In the Tirah campaign of 1897–98 Kohat was the headquarters of the expedition that operated against the Orakzais and Afridis. The district of KOHAT has an area of 2771 square miles; population (1881), 181,540; (1891), 203,175; average density, 73 persons per square mile. In 1901 the population was 218,174, showing an increase of 7 per cent. The land revenue and rates were Rs.1,42,144, the incidence of assessment being Rs.0:6:9 per acre; cultivated area (1896–97), 218,516 acres, of which 39,166 were irrigated; number of police, 457; number of schools (1896–97), 58, with 1437 pupils, the proportion of boys at school to male population of school-going age being 5·2 per cent.; registered death-rate (1897), 22·90 per thousand. The salt-mines produced in 1897–98 salt to the amount of 322,404 maunds, yielding a net revenue of Rs.3,85,955. In July 1896 the rate of duty was raised from 8 annas to Rs.2 per maund, the standard rate for the rest of India. There are no railways in the district, nor any Government canals. The length of metalled roads is 94 miles, and the Indus is navigable for 84 miles.

Kokomo, capital of Howard county, Indiana, U.S.A., on the Wildcat river, and on the Lake Erie and Western, the Pittsburg, Cincinnati, Chicago and St Louis, and the Toledo, St Louis and Kansas City railways, at an altitude of 821 feet. It is in an agricultural region, and produces a variety of manufactured goods. Population (1880), 4042; (1890), 8261; (1900), 10,609, of whom 499 were foreign-born and 359 negroes.

Kolaba, a district of British India, in the Konkan division of Bombay. It includes the hill fort of Raigarh, Sivaji's capital. The headquarters are at Alibag; population (1891), 5888. Since the census of 1891 the district has been enlarged by the transfer of about 200 villages from Thana. Present area, 2128 square miles; population (1891), 594,872; average density, 279 persons per square mile. In 1901 the population was 605,165, showing an increase of 2 per cent. The land revenues and rates were Rs.17,30,703, the incidence of assessment being

R.1 : 11 : 10 per acre; cultivated area (1897–98), 393,819 acres, of which 2418 were irrigated from wells, &c.; number of police, 558; children at school (1897–98), 10,060, being 1·9 per cent. of the total population; registered death-rate (1897), 37·87 per thousand. The staple crop is rice. A considerable number of the people support themselves by fishing, and the forests yield valuable timber and other produce. Salt is largely made along the coast by evaporation. There are five printing-presses, and two vernacular newspapers. There is no railway, but communication with Bombay is maintained by a steam ferry. Owing to its proximity to Bombay, the district has suffered severely from plague. Down to July 1898, the total number of deaths reported from plague was 1834. Kolaba district takes its name from a little island off Alibag, which was one of the strongholds of Angria, the Mahratta admiral of the 18th century. The same island has given its name to Kolaba Point, the spur of Bombay Island running south that protects the entrance to the harbour. On Kolaba Point are the terminus of the Bombay and Baroda railway, European barracks, lunatic asylum, and observatory.

Kolar, a town and district of India, in the native state of Mysore. The town is 43 miles east of Bangalore. Population (1881), 11,172; (1891), 12,148. The district of KOLAR has an area of 2845 square miles; population (1881), 461,129; (1891), 591,030, showing an increase of 28 per cent.; average density, 193 persons per square mile. In 1901 the population was 722,751, showing a further increase of 22 per cent. The district is traversed by the Bangalore line of the Madras railway, with a branch 10 miles long, known as the Kolar Goldfields railway. Gold prospecting in this region first began in 1876, and the industry is now settled on a secure basis. Here are situated the mines of the Mysore, Champion, Ooregum, Nundydroog, and other companies, which are among the most profitable in the world. In 1898 the total out-turn exceeded 400,000 ounces, yielding to the Mysore state Rs.13,14,560 in rent and royalties. The municipality called the Gold Fields had in 1901 a population of 37,964. It has suffered severely from plague. Electricity from the falls of the Cauvery (93 miles distant) will be used as the motive power in the mines. The capital expenditure on this work is estimated at £288,000.

Kolbe, Hermann (1818–1884), German chemist, was born on 27th September 1818 at Elliehausen, near Göttingen, where in 1838 he began to study chemistry under Wöhler. In 1842 he became assistant to Bunsen at Marburg, and three years later to Playfair at the School of Mines, London. From 1847 to 1851 he was engaged at Brunswick in editing the *Dictionary of Chemistry* started by Liebig, but in the latter year he went to Marburg as successor to Bunsen in the chair of chemistry. In 1865 he was called to Leipzig in the same capacity, and he died in that city on 25th November 1884. Kolbe had an important share in the great development of chemical theory that occurred about the middle of last century, especially in regard to the constitution of organic compounds, which he viewed as derivatives of inorganic ones, formed from the latter—in some cases directly—by simple processes of substitution. Unable to accept Berzelius's doctrine of the unalterability of organic radicals, he also gave a new interpretation to the meaning of copulæ under the influence of his fellow-worker Frankland's conception of definite atomic saturation-capacities, and thus contributed in an important degree to the subsequent establishment of the structure theory. Kolbe was a very successful teacher, a ready and vigorous writer, and a brilliant experimentalist whose work revealed the nature of many compounds the composition of which had not previously been understood.

Kolberg, or COLBERG, a seaport town and seaside resort of Prussia, province of Pomerania, 81 miles by rail north-east of Stettin, near the shore of the Baltic. Except on the side next the sea, its fortifications were razed in 1873. The church of St Mary (begun in 1258 and restored in 1890) is a good Gothic building of brick, with fine aisles and paintings, &c., of the 14th century. The sea-bathing, and brine and mud baths, attract from 10,000 to 11,000 visitors annually. Sea-fishing, wool-spinning, brewing, saw-milling, manufacture of tobacco, and iron-founding are the chief industries. The harbour is 16 feet deep; its entrance, 15 feet. Population (1885), 16,557; (1900), 20,241.

Kolding, a market town of Denmark, county of Vejle, 13 miles by rail west by south of Fredericia. The ruins of the castle have been converted into an antiquarian and historical museum (1892). There are large slaughter-yards for killing cattle for export. In 1899 the port was entered by 1131 vessels of 82,668 tons, and cleared by 1172 of 91,257 tons. The chief imports are iron, coal, and groceries. The harbour throughout has a depth of over 20 feet. Population (1880), 7141; (1890), 9658; (1900), 12,516.

Kolhapur, a native state of India, within the Deccan division of Bombay. Together with its *jagirs* or feudatories, it covers an area of 2816 square miles; population (1881), 800,189; (1891), 913,131, showing an increase of 14 per cent.; average density, 324 persons per square mile. In 1901 the population was 910,175. The estimated gross revenue is Rs.45,70,000; military force, 700 officers and men. In recent years the state has been conspicuously well governed, on the pattern of British administration. The present raja, Shahu Chhatrapati, G.C.S.I., is entitled to a salute of 19 guns. In 1897–98 the net revenue was Rs.18,09,389, and the expenditure Rs.22,53,421, of which Rs.5,92,555 was devoted to public works, Rs.2,48,145 to famine relief, and Rs.1,39,-025 to education. There were 227 schools, with 13,830 pupils; and 16 dispensaries. The principal institutions are the Rajaram College, with 116 students; the high school, with 334 pupils; a technical school; an agricultural school; and training-schools for both masters and mistresses. The state railway from Miraj junction to Kolhapur town, 30 miles, is worked by the Southern Mahratta line. In recent years the state has suffered from both famine and plague. The town of KOLHAPUR, or Karvir, is situated in 16° 42′ N. and 74° 16′ E., the terminus of a branch of the Southern Mahratta railway, 30 miles from the main line. Population (1881), 38,599; (1891), 45,815; municipal income (1897–98), Rs.59,503.

Kölliker, Rudolph Albert (1817–——), Swiss anatomist and physiologist, was born at Zürich on 6th July 1817. His father and his mother were both Zürich people, and he in due time married a lady from Aargau, so that Switzerland can claim him as wholly her own, though he has lived the greater part of his life in Germany. His early education was carried on in Zürich, and he entered the university there in 1836. After two years, however, he moved to the University of Bonn, and later to that of Berlin, becoming at the latter place the pupil of Johannes Müller and of Henle. He graduated in philosophy at Zürich in 1841, and in medicine at Heidelberg in 1842. The first academic post which he held was that of prosector of anatomy under Henle; but his tenure of this office was brief, for in 1844 his native city called him back to its university to occupy a chair as professor extraordinary of physiology and comparative anatomy. His stay here too, however, was brief, for in 1847 the University of Würzburg, attracted by his rising fame, offered him the post of professor of physiology and of microscopical and comparative anatomy. He accepted the appointment, and at Würzburg he remained thenceforth, refusing all offers tempting him to leave the quiet academic life of the Bavarian town.

Kölliker's name will ever be associated with that of the tool with which during his long life he so assiduously and successfully worked, the microscope. The time at which he began his studies coincided with that of the revival of the microscopic investigation of living beings. Two centuries earlier the great Italian Malpighi had started, and with his own hand had carried far, the study, by the help of the microscope, of the minute structure of animals and plants. After Malpighi this branch of knowledge, though continually progressing, made no remarkable bounds forward until the second quarter of the 19th century, when the improvement of the compound microscope on the one hand, and the promulgation by Schwann and Schleiden of the "cell theory" on the other hand, inaugurated a new era of microscopic investigation, which has lasted until the present day. Into this new learning Kölliker threw himself with all the zeal of youth, wisely initiated into it by his great teacher Henle, whose sober and exact mode of inquiry went far at the time to give the new learning a right direction and to counteract the somewhat fantastic views which, under the name of the cell theory, were tending to be prominent. Henle's labours were for the most part limited to the microscopic investigation of the minute structure of the tissues of man and of the higher animals, the latter being studied by him mainly with the view of illustrating the former. But Kölliker had another teacher besides Henle, the even greater Johannes Müller, whose active mind was sweeping over the whole animal kingdom, striving to pierce the secrets of the structure of living creatures of all sorts, and keeping steadily in view the wide biological problems, of function and of origin, which the facts of structure might serve to solve. We may probably trace to the influence of these two great teachers, strengthened by the spirit of the times, the threefold character of Kölliker's long-continued and varied labours. In all of them, or in almost all of them, the microscope has been the instrument of inquiry, but the problem to be solved by means of the instrument has belonged now to one branch of biology, now to another.

At Zürich, and afterwards at Würzburg, the title of the chair which he held laid upon him the duty of teaching comparative anatomy, and very many of the numerous memoirs which he published, including the very first paper which he wrote, and which appeared in 1841 before he graduated, "On the Nature of the so-called Seminal Animalcules," are directed towards elucidating, by help of the microscope, the structure of animals of the most varied kinds—that is to say, are zoological in character. Notable among these are his papers on the Medusæ and allied creatures. His activity in this direction led him to make zoological excursions in the Mediterranean Sea and on the coasts of Scotland, as well as to undertake, conjointly with his friend Siebold, the editorship of the *Zeitschrift für Wissenschaftliche Zoologie*, which, founded in 1848, continued, under his hands, to be one of the most important zoological periodicals.

At the time when Kölliker was beginning his career, the influence of von Baer's embryological teaching was already being widely felt. Men were learning to recognize the importance to morphological and zoological studies of a knowledge of the development of animals; and Kölliker plunged with enthusiasm into the relatively new line of inquiry. His earlier efforts were directed to the invertebrata, and his memoir on the development of cephalopods, which appeared in 1844, is a classical work; but he soon passed on to the vertebrata, and studied not only the amphibian embryo and the chick, but also the mammalian embryo. He was among the first, if not the very first, to introduce into this branch of biological inquiry the newer microscopic technique—the methods of hardening, section-cutting, and staining. By doing so, not only was he enabled to make rapid progress himself, but he also placed in the hands of others the means of a like advance. The remarkable strides forward which embryology made during the middle and during the latter half of the 19th century will always be associated with his name. His *Lectures on Development*, published in 1861, at once became a standard work.

But neither zoology nor embryology furnishes Kölliker's chief claim to fame. If he has done much for these branches of science, he has done still more for histology, the knowledge of the minute structure of the animal tissues. This he made emphatically his own. It may indeed be said that there is no fragment of the body of man and of the higher animals on which he has not left his mark, and in more places than one his mark has been a mark of fundamental importance. Among his earlier results may be mentioned the demonstration in 1847 that smooth or unstriated muscle is made up of distinct units, of nucleated muscle-cells. In this work he followed in the footsteps of his master Henle. A few years before this, men were doubting whether arteries were muscular, and no solid histological basis as yet existed for those views as to the action of the nervous system on the circulation which were soon to be put forward, and which have since had such a great influence on the progress of physiology. By the above discovery Kölliker completed that basis.

Even to enumerate, certainly to dwell on, all his contributions to histology would be unfitting here: smooth muscle, striated muscle, skin, bone, teeth, blood-vessels, and viscera were all investigated by him; and he touched none of them without striking out some new truths. The results at which he arrived are recorded partly in separate memoirs, partly in his great text-book on microscopical anatomy, which first saw the light in 1850, and by which he has advanced histology no less than by his own researches. In the case almost of every tissue our present knowledge contains something great or small which we owe to Kölliker; but it is on the nervous system that his name is written in largest letters. So early as 1845, while still at Zürich, he supplied what was as yet still lacking, the clear proof that nerve-fibres are continuous with nerve-cells, and so furnished the absolutely necessary basis for all sound speculations as to the actions of the central nervous system. From that time onward he continually laboured, and always fruitfully, at the histology of the nervous system, and more especially at the difficult problems presented by the intricate patterns in which fibres and cells are woven together in the brain and spinal cord. In his old age, at a time when he had fully earned the right to fold his arms and to rest and be thankful, he still enriched neurological science with results of the highest value. From his early days a master of method, he saw at a glance the value of the new Golgi method for the investigation of the central nervous system, and, to the great benefit of science, took up once more in his old age, with the aid of a new means, the studies for which he had done so much in his youth. It may truly be said that much of that exact knowledge of the inner structure of the brain, which is rendering possible new and fruitful conceptions of its working, has come from his hands.

Lastly, Kölliker was in his earlier years professor of physiology as well as of anatomy; and not only did his histological labours almost always carry physiological lessons, but he also enriched physiology with the results of direct researches of an experimental kind, notably those on urari and some other poisons. In fact, we have to go back to the science of centuries ago to find a man of science of so many-sided an activity as he. His life constituted in a certain sense a protest against that specialized differentiation, which, however much it may under certain aspects be regretted, seems to be one of the necessities of modern development. In Johannes Müller's days no one thought of parting anatomy and physiology; nowadays no one thinks of joining them together. Kölliker did in his work join them together, and indeed said himself that he thought they ought never to be kept apart.

Naturally a man of so much accomplishment was not left without honours. Formerly known simply as Kölliker, the title "von" was added to his name. He was made a member of the learned societies of many countries; in England, which he visited more than once, and where he became well known, the Royal Society made him a fellow in 1860, and in 1897 gave him its highest token of esteem, the Copley medal.

Koło, a district town of Russian Poland, government and 46 miles north-east of Kalisz, on an island of the Warta. It has several factories, and china and pottery works. Population (1897), 9400.

Kolomea (Polish, *Kołomyja*), the chief town of a district of the same name, on the Pruth, 45 miles north-west of Czernowitz, in the Austrian province of Galicia. The population in 1900 was 34,188, half Jews, the rest Poles and Ruthenians.

Kolomna, a district town of Russia, on the right bank of the Moskva, government of Moscow, 72 miles by rail from the capital. It has several old churches of great archæological interest. Since it was connected by rail with Moscow its trade importance has decreased, but it remains an entrepôt for grain, coal, and timber; its factories (silk, saw-mills, rope-mills), however, have grown considerably. Population (1897), 20,970.

Kolozsvár (KLAUSENBURG), a municipal town of Hungary, capital of the county of Kolozs, on the Szamos, 80 miles east by south of Nagy-Várad (*Grosswardein*). The Transylvanian Hungarian Association for Public Culture, situated here, has 20,000 members and property worth 3 million crowns. The house of the Hungarian king, Matthias Corvinus, still stands in good preservation, and contains an ethnographical museum. On the chief square there is an equestrian statue of this famous king, a work of the Hungarian sculptor Fadrusz. Population (1890), 32,756; (1900), 49,295.

Kolpino, one of the chief iron-works of the Crown in Russia, government and 16 miles south-east of St Petersburg, on the railway to Moscow, and on the Izhora river. Over 5000 tons of iron, as also steel and copper goods, are turned out every year. Population (1897), 8076.

Kolyvañ.—1. A town of Russia, West Siberia, government and district of Tomsk, on the Chaus river, 5 miles from the Ob. It is a wealthy town, the merchants carrying on a considerable export trade in cattle, hides, tallow, corn, and fish. It was founded in 1713 under the name of Chaussky Ostrog, and has rapidly grown. Population (1897), 11,703. 2. KOLYVAÑSKIY ZAVOD, another town of the same government, district of Biysk, Altai region, on the Byelaya river, 192 miles south-east of Barnaul; altitude, 1290 feet. It is renowned for its stone-cutting factory, where marble, jasper, various porphyries and breccias are worked into vases, columns, &c. Population, 5000. 3. Old name of Reval, founded by Yaroslav Vsevolodovich in 1233.

Komárom (German, *Komorn*), a municipal town of Hungary, capital of the county of the same name, on the left bank of the Danube, 48 miles west-north-west of Budapest. Since 1896 it has been united with Uj-Szöny. In 1896 a statue of General George Klapka (1820–1892) was erected, in memory of his brilliant defence of the town against the Austrians in the Hungarian revolution. It is the birthplace of the novelist Maurus Jókai. Population (1891), 13,076; (1900), 20,264.

Komotau (Czech, *Chomutov*), the chief town of a government district of the same name in Bohemia, at the foot of the Erzgebirge, 30 miles south-west of Aussig. Among the additions to its industry are the central workshops of the Buschtiehrad railway, the making of watches, chemicals, tin toys, silk kerchiefs, &c. Population (1890), 13,050; (1900), 15,925, almost exclusively German and Catholic.

Kongsberg, a mining town of Norway, county Buskerud, 56 miles by rail south-west of Christiania. The annual value of the output of the silver-mines averages £35,000 to £50,000. Population (1875), 4357; (1900), 5585.

Konia.—1. A viláyet in Asia Minor which includes the whole, or parts of, Pamphylia, Pisidia, Phrygia, Lycaonia, Cilicia, and Cappadocia. It is divided into five sanjaks—Adalia, Buldur, Hamid-abad, Konia, and Nigdeh. The population (900,000 Moslems and 80,000 Christians) is for the most part agricultural and pastoral. The only industries are carpet-weaving and the manufacture of cotton and silk stuffs. There are chrome mines and mines of argentiferous lead and rock salt. The principal exports are salt, opium, cotton, cereals, wool, and live stock; and the imports cloth goods, coffee, rice, and petroleum. 2. The chief town of the above, the ancient *Iconium*, altitude 3320 feet, situated at the south-west edge of the vast central plain of Asia Minor, amidst luxuriant orchards watered by streams from the hills. There are interesting remains of Seljúk buildings, all showing strong traces of Persian influence in their decorative details. The most important mosque is the great Türbe, which contains the tombs of Mevlana Jelal ed-dín, founder of the order of Mevlevi (whirling) dervishes, and of his successors. The climate is good—hot in summer and cold, with snow, in winter. The population of 45,000 includes 5000 Christians. Konia is connected by railway with Smyrna, and *viâ* Eski-shehr with Constantinople. After the capture of Nicæa by the Crusaders (1097), Konia became the capital of the Seljúk Sultans of Rúm. It was temporarily occupied by Godfrey, and again by Frederick Barbarossa, but this scarcely affected its prosperity. During the reign of Ala ed-dín I. (1219–36) the city was thronged with artists, poets, historians, jurists, and dervishes, driven westwards from Persia and Bokhara by the advance of the Mongols, and there was a brief period of great splendour. In 1472 it was annexed, with Karamania, to the Osmanli Empire by Muhammad II. In 1832 it was occupied by Ibrahim Pasha.

See RAMSAY. *Historical Geography of Asia Minor; St Paul the Traveller.*—MURRAY. *Handbook to Asia Minor.*

König, Karl Rudolph (1832–1901), physicist, was born at Königsberg (Prussia) on 26th November 1832, and studied at the university of his native town, taking the degree of Ph.D. About 1852 he went to Paris, and became apprentice to the famous violin-maker, J. B. Vuillaume, and some six years later he started business on his own account. He called himself a "maker of musical instruments," but the instruments for which his name is best known are tuning-forks, which speedily gained a high reputation among physicists for their accuracy and general excellence. From this business König derived his livelihood for the rest of his life. He was, however, very far from being a mere tradesman, and even as a manufacturer he regarded the quality of the articles that left his workshop as a matter of greater solicitude than the profits they yielded. Acoustical research was his real interest, and to that he devoted all the time and money he could spare from his business. An exhibit which he sent to the London Exhibition of 1862 gained a gold medal, and at the Philadelphia Exposition of 1876 great admiration was expressed for a tonometric apparatus of his manufacture. This consisted of about 670 tuning-forks, of as many different pitches, which extended over four octaves, and it afforded a perfect means for testing, by enumeration of the beats, the number of vibrations producing any given note and for accurately tuning any musical instrument. An attempt was made to secure this apparatus for the University of Pennsylvania, and König was induced to leave it behind him in America on the assurance that it would be purchased; but ultimately, the money not being forthcoming, the arrangement fell through, to his great disappointment and pecuniary loss. Some of the forks he disposed of to the University of Toronto, where they now are. The remainder he used as a nucleus for the construction of a still more elaborate tonometer. While the range of the old apparatus was only between 128 and 4096 vibrations a second, the lowest fork of the new one only made 16 vibrations a second, while the highest gave a sound too shrill to be perceptible by the human ear. König will also be remembered as the inventor and constructor of many other beautiful pieces of apparatus for the investigation of acoustical problems, among which may be mentioned his wave-sirens, the first of which was shown at Philadelphia in 1876. His original work dealt, among other things, with Wheatstone's sound-figures, the characteristic notes of the different vowels, manometric flames, &c.; but perhaps the most important of his researches are those devoted to the phenomena produced by the interference of two tones, in which he controverted the views of Helmholtz as to the existence of summation and difference tones. He died in Paris on 2nd October 1901.

Königgrätz, a royal circuit town and episcopal seat in Bohemia, Austria, 12 miles north of Pardubitz, which was fortified up to 1884. Population (1890), 7816; (1900), 9773, chiefly Czech. A garrison numbering 2256, composed of three battalions of infantry and a regiment of artillery, is stationed here. There are four Czech high schools, and the industry includes the manufacture of machinery, colours, and *carton-pierre*, as well as gloves and wax candles. Numerous monuments (Austrian, Saxon, and Prussian) have been erected in various parts of the battlefield of 3rd July 1866, still frequently referred to as the battle of Sadowa.

Königinhof (Czech, *Králové Dvůr*), the chief town of a government district in north-east Bohemia, Austria, 21 miles east of Gitschin. Population (1890), 8635; (1900), 10,601, Czech. The chief industries are cotton-weaving, yarn-spinning, brewing, sugar-refining, tanning, corn-milling, and the sawing of timber.

The controversy concerning the genuineness of the "Königinhof MSS.," containing specimens of old Czech epic and lyric poetry, dating from the 13th century (see *Ency. Brit.* xi. 440), would now appear to have been finally decided in the negative by a consensus of Czech and German philologists. The former include the Czech university professors Masaryk, Gebauer, and Goll, and the latter, Wattenbach, Büdinger, and Feifalik. (See articles by Gebauer in the *Archiv für Slaw. Philologie*, x.-xi., and his *Poučení o padělaných rukopisích Královédvorském a Zelenohorském* (Prague, 1889); Knieschek, *Die Streit über die Königinhofer und Grüneberger Handschrift* (Prague, 1888), and the *Deutsche Zeitschrift für Geschichtswissenschaft*, 1889–90.) In December 1899 there was an alleged discovery, in the 62nd line of the "Judgment of Libussa," of a cryptical confession of the authorship by Wenceslaus Hanka himself. This particular line of the poem contains only two words, the remainder consisting of a number of single coloured letters, of which every second is reversed. These were described as "strange characters" by Palacky, the celebrated Bohemian historian, who regarded them as a kind of trifling on the part of the transcriber. It is now reported that they have been deciphered by Professor Ladislaus Dolansky as "V. H. A. N. K. A. F. E. C. I. T.," that is to say, "V. Hanka fecit." (Æ. O'N.)

Königsberg, a town of Prussia, capital of the province of East Prussia, the second capital of the kingdom of Prussia, a first-class fortress, and headquarters of the 1st German Army Corps, on hilly ground on both banks of the river Pregel, 4½ miles above its entrance into the Frisches Haff. Königsberg owes its position as capital to the fact that the first king of Prussia, Frederick I., in 1701 crowned himself in this city, because it stood outside the empire, and thus gave him the standing of a fully independent sovereign. The defensive works consist principally of a dozen outer forts, which in both plan and equipment answer to the rigorous requirements of modern warfare. The city possesses two ornamental sheets of water—the Schloss Teich and the Ober Teich—the former within and the latter without the old ring of fortifications. The suburb of Hufan, outside the western Steindammer, is a favourite pleasure resort, amongst its attractions being the zoological gardens. The conspicuous new buildings embrace the administrative offices (1882) in the Italian Renaissance style, the synagogue, the imposing Palæstra Albertina (a species of gymnasium, 1898), the gift of Dr Lange of New York, and various offices (railway, &c.). In addition to the older monuments to Frederick I. and Kant, there have been added a bronze statue of Duke Albert (1891) and another of the Emperor William I. (1894), both by Reusch. Königsberg is well equipped with museums and similar institutions, the most noteworthy being the Prussia Museum of Antiquities (specially rich in East Prussian finds from the Stone Age to the Viking period) and the archives (both these in the castle), the industrial art and technical museum, the collection of the sculptor Siemering's works in the Altstadt town hall, the astronomical observatory, botanical gardens, zoological museum, physical institute, mineralogical-geological institute, the collections of the physical-economical society, the chemical laboratory, the architectural school, and several medical institutes. In 1900–01 the university was attended by 874 students, and had about 120 professors. The tomb of Kant is in the cathedral. Industries have made a great advance; besides those previously mentioned, there are printing works and manufactories of chemicals and artificial manure, toys, sugar, cellulose, and wood-pulp, tobacco, pianos, and amber wares. A new channel has been made (1901), at the cost of £615,000, between Königsberg and Pillau, its port, 29 miles distant, on the outer side of the Frisches Haff, so as to admit vessels drawing 20 feet right up to Königsberg, and the result has been greatly to quicken the trade of the city. It is protected for a long distance by moles, in which a break has been left in the Fischhauser Wiek, to permit of freer circulation of the water and for the prevention of damage to the mainland. The following are the principal exports of the port:—Cereals and flour (average annual value, £1,250,000), hemp (£600,000), flax (£600,000), timber (£420,000), sugar (£152,000), hemp tow (£152,000), oil-cakes (£240,000), and rags (£60,000). The total trade amounted in 1899 to £10,000,000, of which £4,100,000 was the value of the exports, and £5,900,000 the value of the imports; as compared with £7,525,000 for exports, and £8,950,000 for imports in 1886, or £16,475,000 altogether. Since 1894, when 2173 vessels of 910,825 tons cleared, there has been a decline in the overseas shipping, namely, to 1520 vessels of 367,150 tons in 1899. There is in addition a river traffic of between 300,000 and 350,000 tons annually. Population (1885), 151,151; (1890), 161,666; (1900), 187,897.

Königshütte, a town of Prussia, province of Silesia, 3 miles south of Beuthen and 122 miles by rail south-east of Breslau. It lies in the centre of coal mines, ironworks, and zinc works, and has also manufactures of bricks, roofing paper, and turnery, flour-mills and saw-mills. Population (1885), 32,072; (1900) 57,875.

Königswinter, a town and summer resort of Prussia, in the Rhine province, on the right bank of the Rhine, 24 miles south-south-east of Cologne by rail, at the foot of the Siebengebirge and the romantic Drachenfels (ascended by a toothed railway). Many of the inhabitants are stone-dressers, the stone (trachyte) being quarried close by. Population (1900), 3804.

Konotop, a district town of Russia, government and 83 miles east-south-east of Chernigov, on the Kieff-Kursk railway. It has trade in grain and other agricultural produce. Population (1897), 23,083.

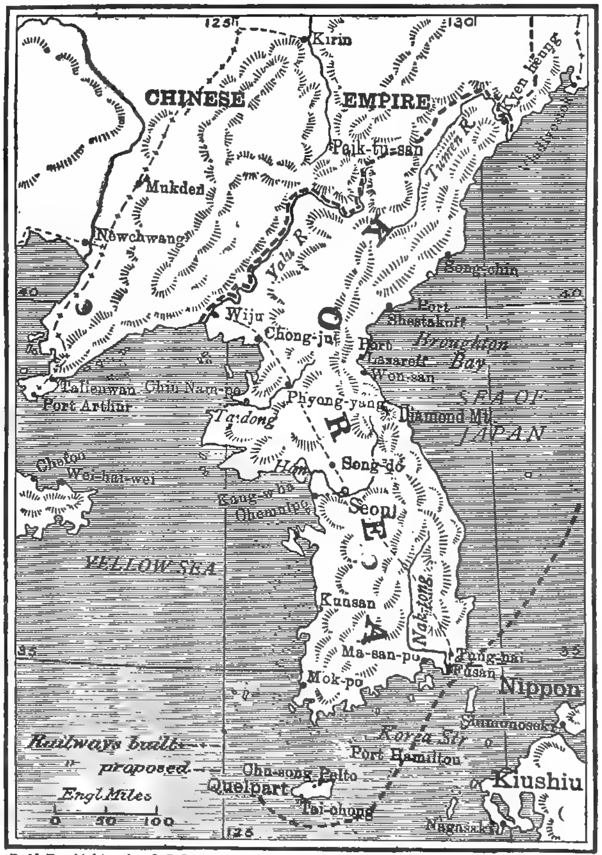
Konstantinovskaya, a Cossack village, Russia, province of Don Cossacks, on the right bank of the Don, 48 miles east of Novocherkask. It is the seat of district administration of the first Don district, and has an important cattle fair. Population (1897), 10,700.

Kooringa, or BURRA, a town of South Australia, in a mining and agricultural district, in the county of Burra, on Burra Creek, 101 miles by rail north by east of Adelaide. The Burra Burra copper-mine is in the immediate neighbourhood. Two iron bridges across the creek connect the town with Baldina and the eastern plains. Large areas in the district are devoted to wheat-growing. Population (1901), 1994.

Kopp, Hermann Franz Moritz (1817–1892), German chemist, was born on 30th October 1817 at Hanau, where his father practised as a physician. After attending the gymnasium of his native town, he studied at Marburg and Heidelberg, and then, attracted by the fame of Liebig, went in 1839 to Giessen, where he became a *privat-docent* in 1841, and professor of chemistry twelve years later. In 1864 he was called to Heidelberg in the same capacity, and he remained there till his death on 20th February 1892. Kopp devoted himself especially to physico-chemical inquiries, and in the history of chemical theory his name is associated with several of the most important correlations of the physical properties of substances with their chemical constitution. Much of his work was concerned with specific volumes, the conception of which he set forth in a paper published when he was only twenty-two years of age; and the principles he established have formed the basis of subsequent investigations in that subject, although his results have in some cases undergone modification. Another question to which he gave much attention was the connexion of the boiling-point of compounds, organic ones in particular, with their composition. In addition to these and other laborious researches, Kopp was a prolific writer. In 1843–47 he published a comprehensive *History of Chemistry* in four volumes, to which three supplements were added in 1869–75. The *Development of Chemistry in Recent Times* appeared in 1873, and in 1886 he published a work in two volumes on *Alchemy in Ancient and Modern Times.* In addition he wrote on theoretical and physical chemistry for the Graham-Otto *Lehrbuch der Chemie*, and for many years from 1851 he was acting editor of the *Annalen der Chemie.*

Korat, known officially as NAKAWN RAJA SEMA, a walled town in the Siamese province of the same name, 170 miles north-east of Bangkok, situated in 14° 59′ N. and 102° 5′ E. It is the administrative centre of a munton or "circle." Its position makes it the great distributing centre for the whole of the plateau lying between the Me Kong on the north and east, the forested hill ranges of Muang Lom Sâk on the west, and the Dawng Praya Yen and Dawng Rek on the south-west and south. A railway from Bangkok was opened in 1900. There are a few hundred Chinese traders in and about Korat, and the total import and export trade of the whole district is calculated to amount only to £130,000. A French consular official now resides in the town by virtue of Article VIII. of the Franco-Siamese treaty. Population, about 6000.

Korea (CH'AO HSIEN, DAI HAN).—Korea is an empire of Eastern Asia, the mainland portion of which consists of a peninsula stretching southwards from the maritime province of Siberia and Chinese Manchuria, with an estimated length of about 600 miles, an extreme breadth of 135 miles, and a coast-line of 1740 miles. It extends from 34° 18′ to 43° N., and from 124° 36′ to 130° 47′ E. Its northern boundary, on which it is conterminous with Russia for 11 miles, is marked by the Tumen and Yalu rivers; the eastern by the Sea of Japan; the southern by the Strait of Korea; and the western by the Yalu and the Yellow Sea, down to which, from Krasnoye Celo, where three empires meet, it has China on its frontier. The south and west coasts are fringed by about 200 islands (exclusive of islets), two-thirds of which are inhabited; 100 of them are from 100



B. V. Darbishire & O. J. R. Howarth, Oxford, 1901.

SKETCH MAP OF KOREA.

to 2000 feet in height, and many consist of bold bare masses of volcanic rock. The most important are Quelpart (*q.v.*) and the Nan Hau group. The latter, 36 miles from the eastern end of Quelpart, possesses the deep, well-sheltered, and roomy harbour of Port Hamilton, which lies between the north points of the large and well-cultivated islands of Sun-ho-dan and So-dan, which have a population of 2000. Aitan, between their south-east points, completes this noble harbour. The east coast of Korea is steep and rock-bound, with deep water and a tidal rise and fall of from 1 to 2 feet. The west coast is often low and shelving, and abounds in mud-banks, and the tidal rise and fall is from 20 to 36 feet. Korean harbours, except two or three which are closed by drift ice for some weeks in winter, are ice-free. Among them are Port Shestakoff, Port Lazareff, and Won-san in Broughton Bay; Fusan, Ma-san-po, at the mouth of the Nak-tong, on the south coast; Mok-po, Chin Nam-po, near the mouth of the Tai-dong; and Chemulpo, near the mouth of the Han, the port of the capital and the sea terminus of the first Korean railway on the west coast.

Mountains.—Korea is distinctly mountainous, and has no plains deserving the name. In the north there are mountain groups with definite centres, the most notable being Paik-tu San (8700 feet), which contains the sources of the Yalu and Tumen. From these groups a lofty range runs southwards, dividing the empire into two unequal parts. On its east, between it and the coast, which it follows at a moderate distance, is a fertile strip difficult of access, and on the west it throws off so many lateral ranges and spurs as to break up the country into a chaos of corrugated and precipitous hills and steep-sided valleys, each with a rapid, perennial stream. Farther south this axial range, which includes the Diamond Mountain group, falls away towards the sea in treeless spurs and small and often infertile levels. The northern groups and the Diamond Mountain are heavily timbered, but the hills are covered mainly with coarse, sour grass, and oak and chestnut scrub.

Rivers.—These are shallow and rocky, and are usually only navigable for a few miles from the sea. Among the exceptions are the Yalu (Amnok), Tumen, Tai-dong, Nak-tong, Mok-po, and Han. The last, rising in Kang-wön-Do, 30 miles from the east coast, cuts Korea nearly in half, reaching the sea on the west coast near Chemulpo; and, in spite of many serious rapids, is a valuable highway for commerce for over 150 miles.

Geological Formation.—The geology is little known as yet. The formations are chiefly volcanic. Extinct craters and lava fields frequently occur. Igneous rock abounds. The best soil is finely disintegrated lava. Sedimentary and organic rock is found in the west. Limestone formation occurs largely on the Han and Tai-dong rivers, and the latter is often skirted by high cliffs of coarse conglomerate, presenting a striking vertical cleavage, alternating with red sandstone. In central Korea white quartz and pink and gray granite abound.

Climate.—The climate is superb for nine months of the year, and the three months of rain, heat, and damp are not injurious to health. Koreans suffer from malaria, but Europeans and their children are fairly free from climatic maladies, and enjoy robust health. The summer mean temperature of Seoul is about 75° F., that of winter about 33°; the average rainfall, 36·3 inches in the year, and of the rainy season 21·86 inches. The rains come in July and August on the west and north-east coasts, and from April to July on the south coast, the approximate mean annual rainfall of these localities being 30, 35, and 42 inches respectively. These averages are based on the observations of seven years only.

Flora.—The plants and animals await study and classification. Among the indigenous trees are the *Abies excelsa*, *Abies microsperma*, *Pinus sinensis*, *Pinus pinea*, three species of oak, five of maple, lime, birch, juniper, mountain ash, walnut, Spanish chestnut, hazel, willow, hornbeam, hawthorn, plum, pear, peach, *Rhus vernicifera*, (?) *Rhus semipinnata*, *Acanthopanax ricinifolia*, *Zelkawa*, *Thuja orientalis*, *Elæagnus*, *Sophora Japonica*, &c. Azaleas and rhododendrons are widely distributed, as well as other flowering shrubs and creepers, *Ampelopsis Veitchii* being universal. Liliaceous plants and cruciferæ are numerous. The native fruits, except walnuts and chestnuts, are worthless. The persimmon attains perfection, and experiment has proved the suitability of the climate to many foreign fruits. The indigenous economic plants are few, and are of no commercial value, excepting wild *ginseng*, a good root of which is worth $15 per ounce, bamboo applied to countless uses, and "tak-pul" (*Hibiscus Manihot*), used in the manufacture of paper.

Fauna.—The tiger takes the first place among wild animals. He is of great size, his skin is magnificent, and he is so widely distributed as to be a peril to man and beast. Tiger-hunting is a profession with special privileges. Leopards are numerous, and are occasionally shot within the walls of Seoul. There are deer (at least five species), boars, bears, antelopes, beavers, otters, badgers, tiger-cats, marten, an inferior sable, striped squirrels, &c. Among birds there are black eagles, peregrines (largely used in hawking), and, specially protected by law, turkey bustards, three varieties of pheasants, swans, geese, common and spectacled teal, mallards, mandarin ducks, white and pink ibis, cranes, storks, egrets, herons, curlews, pigeons, doves, nightjars, common and blue magpies, rooks, crows, orioles, halcyon and blue kingfishers, jays, nuthatches, redstarts, snipe, gray shrikes, hawks, kites, &c. But, pending further observations, it is not possible to say which of the smaller birds actually breed in Korea and which only make it a halting-place in their annual migrations.

Area and Population.—The estimated area is 82,000 square miles, somewhat under that of Great Britain. The first complete census was taken in 1897, and returned the population in round numbers at 17,000,000, females being in the majority. It is estimated that little more than half the arable land is under cultivation, and that the soil could support an additional 7 millions. The native population is absolutely homogeneous. In 1898 the foreign population consisted of 15,000 Japanese, 2000 Chinese, and about 400 of other nationalities, of whom 200 were Americans and nearly 100 British. This population has increased considerably since 1897, owing to the expansion of trade and the opening of new ports. Northern Korea, with its severe climate, is thinly peopled, and the rich and warm provinces of the south and west are populous. A large majority of the people are engaged in agriculture. There is no emigration, except into Russian and Chinese territory.

SEOUL (*Han-yang*), the capital, is situated in 37° 34′ N. and 127° 6′ E., at an altitude of 120 feet, and is distant 25 miles from Chemulpo, its seaport, and 4 from Mapu, its river-port. It lies in a basin among granite hills nowhere exceeding 2627 feet, remarkable for their denudation and their abrupt black crags and pinnacles. A well-built, crenelated stone wall from 20 to 30 feet high, about 11 miles in circuit, and pierced by 8 gateways with double-roofed gate towers, surrounds it. Its population in 1897 was 219,825, with an excess of 11,079 males. The native houses are built of stone or mud, deeply eaved, and either tiled or thatched. Above these rise the towers of the Roman Catholic cathedral, the high curved roofs of the royal audience halls, the palace gateways, and the showy buildings of the Russian and French Legations. Its antiquities are the Bell Tower, with a huge bronze bell dated 1468, a marble pagoda elaborately carved, but not of Korean workmanship, seven centuries old, and a "Turtle-Stone" of about the same date. Seoul has some wide streets of shops, hundreds of narrow alleys, and is very fairly clean. Its supply of water is bad and very limited. It has an electric tramway 4 miles long, and the Seoul and Chemulpo railway was opened in July 1900 to a station within the city. Besides being the seat of government, Seoul is the centre of education, business, and pleasure for the empire, and the residence of a large number of absentee proprietors and officials.

SONGDO (*Kaisöng*), the capital from about 910 to 1392, is a walled city of the first rank, 25 miles north of Seoul, with a population of 60,000. It possesses the stately remains of the palace of the Korean kings of the Wang dynasty, is a great centre of the grain trade and the sole centre of the *ginseng* manufacture, makes wooden shoes, coarse pottery, and fine matting, and manufactures with sesamum oil the stout oiled paper for which Korea is famous.

Phyong-yang, a city on the Tai-dong, had a population of 60,000 before the war of 1894, in which it was nearly destroyed. It is fast regaining its population. It lies on rocky heights above a region of stoneless alluvium on the east, and with the largest and richest plain in Korea on the west. It has five coal mines within ten miles, and the district is rich in iron, silk, cotton, and grain. It has easy communication with the sea (its port being Chin-nampo), and is important historically and commercially. Auriferous quartz is worked by a foreign company in its neighbourhood. Near the city is the illustrated standard of land measurement cut by Ki-tze in 1124 B.C.

With the exceptions of Kang-wha, Chong-ju, Tung-nai, Fusan, Won-san, it is very doubtful if any other Korean towns reach a population of 15,000. The provincial capitals and many other cities are walled. Most of the larger towns are in the warm and fertile southern provinces. One is very much like another, and nearly all their streets are replicas of the better alleys of Seoul. The actual antiquities of Korea are dolmens, sepulchral pottery, and Korean and Japanese fortifications.

Race.—The origin of the Korean people is unknown. They are of the Mongol family; their language belongs to the so-called Turanian group, is polysyllabic, possesses an alphabet of 11 vowels and 14 consonants, and a script named *En-mun.* Literature of the higher class and official and upper class correspondence are exclusively in Chinese characters, but since 1895 official documents have contained an admixture of *En-mun.* The Koreans are distinct from both Chinese and Japanese in physiognomy, though dark straight hair, dark oblique eyes, and a tinge of bronze in the skin are always present. The cheek-bones are high; the nose inclined to flatness; the mouth thin-lipped and refined among patricians, and wide and full-lipped among plebeians; the ears are small, and the brow fairly well developed. The expression indicates quick intelligence rather than force and mental calibre. The male height averages 5 ft. 4½ in. The hands and feet are small and well-formed. The physique is good, and porters carry on journeys from 100 to 200 ℔. Men marry at from 18 to 20 years, girls at 16, and have large families, in which a strumous taint is nearly universal. Women are secluded and occupy a very inferior position. The Koreans are rigid monogamists, but concubinage has a recognized status.

Government.—Up to July 1894 the system of administration was modelled on that of China, except that government was in the hands of a hereditary aristocracy, privileged and corrupt. The king was absolute, and law consisted practically of royal edicts, published in the *Gazette.* During the war between Japan and China, Japan, then in the ascendant, devised special machinery for the reform of Korean abuses, and during the following months the administration was reorganized and greatly assimilated to that of Japan. Between the close of 1895 and 1900 there were ceaseless administrative fluctuations; valuable reforms quietly lapsed; the general movement was retrograde, and the old order now exists in the spirit if not in the letter. The emperor is an independent and practically an absolute sovereign, the modifying influence of the cabinet having become insignificant. The central Government consists of a Council of State formed of a president premier, and the heads of nine departments—Home Office, Foreign Office, Treasury, War Office, Education, Justice, and the Ministry of Agriculture, Trade, and Industry, with their subordinate bureaus. This body frames laws and passes resolutions which require the imperial seal for their validity. There is a Privy Council (consisting of a president, vice-president, not more than 50 councillors appointed by the throne, and two secretaries), which is empowered, when consulted by the cabinet, to inquire into questions referred to it. On paper the new constitution, which was very elaborate, modified the royal absolutism considerably; but a decree passed towards the end of 1896, after the king's escape from Japanese control, marked a distinct reversion to the absolutism renounced by his oath in January 1895. One by one the checks devised by the Japanese "advisers" became inoperative, and by 1898 the imperial will, working under partially new conditions, produced a continual chaos, and by 1900 succeeded practically in overriding all constitutional restraints.

Local Administration.—Korea for administrative purposes is divided into 13 provinces and 339 prefectures or magistracies, while the capital has a separate government, and each of the eight treaty ports and the Russo-Korean trading mart, Kyen-heung, is under a superintendent, ranking with a consul. The village is the administrative unit, and under the new system its headman and officials are annually elected. The headman and a man from each family form a village council, which deals by resolution with educational matters, registration of houses and lands, sanitation, roads and bridges, agricultural improvements, common dykes, payment of taxes, relief in famine, adjustment of the *corvée*, and bye-laws. All resolutions must be sent up to the Home Office through the prefect and the provincial governor twice a year. Above the village and below the prefecture are cantons and districts, but it is on the efficient working of the village system that much of Korean wellbeing depends.

Education.—The "Royal Examinations" in Chinese literature held in Seoul up to 1894, which were the entrance to official position, being abolished, the desire for a purely Chinese education has diminished. In Seoul there are now an imperial English school with two foreign teachers, a reorganized Confucian college, a normal college under a very efficient foreign principal, Japanese, Chinese, Russian, and French schools, chiefly linguistic, several Korean primary schools, mission boarding-schools, and the *Pai Chai* College, connected with the American Methodist Episcopal Church, under imperial patronage, and subsidized by Government, in which a liberal education of a high class is given and *En-mun* receives much attention. The Koreans are expert linguists, and the Government wisely makes liberal grants to the linguistic schools. About 1100 young men are receiving a liberal education under foreign teachers; and in the primary schools about 1200 boys are learning arithmetic, geography, and Korean history, with the outlines of the governmental systems of other civilized countries. The Education Department is tolerably efficient, and aims at the general extension of primary and intermediate schools, and a uniform series of text-books in the vernacular.

Law.—A criminal code, scarcely equalled for barbarity, though twice mitigated by royal edict since 1785, remained in force in its main provisions till 1895. Since then a mixed commission of revision has done some good work, but a body of law and the judges to administer it righteously have still to be created. The Ministry of Justice has charge of all judicial matters, and as a high court of justice hears appeals from certain district courts. Five classes of law courts have been established, and provision has been made for appeals in both civil and criminal cases. Elaborate legal machinery was devised, but it exists chiefly on paper, and its provisions are daily violated by the imperial will and the gross corruption of officials.

Kyei.—Abuses in legal administration and in tax-collecting are the chief grievances which lead to local insurrections. Oppression by the throne and the official and noble classes prevails extensively; but the weak protect themselves by the use of the *Kyei*, or principle of association, which develops among Koreans into powerful trading guilds, trades-unions, mutual benefit associations, money-lending guilds, &c. Nearly all traders, porters, and artisans are members of guilds, powerfully bound together and strong by combined action and mutual helpfulness in time of need.

Revenue and Finance.—The chief sources of revenue are the land tax, paid since 1896 in money; the customs duties; the house tax, from which Seoul is exempt; the *ginseng* duty, and the tax on gold dust. These yield roughly as follows:—Land tax, £277,364; house tax, £46,564; *ginseng* duty, £15,000; duty on gold dust, £4000; customs duties, £100,000; miscellaneous taxes, £30,000. The budget for 1899 showed an estimated expenditure of £647,113, with a small surplus; but the revenue for 1900 was only estimated at £520,000, with an expenditure of £690,000, in consequence of which deficit all new works were dropped and relief from financial straits was rendered necessary by a foreign loan. In 18 months of 1896-97, with an Englishman in control of the Treasury, two-thirds of the Japanese loan of 3,000,000 *yen* of 1895 was paid off. The emperor's privy purse stands at £50,000.

Religion.—Buddhism, which swayed Korea from the 10th to the 14th century, has been discredited for three centuries, and its priests are ignorant, immoral, and despised. Confucianism is the official cult, and all officials offer sacrifices and homage at stated seasons in the Confucian temples. Confucian ethics are the basis of morality and social order. Ancestor-worship is universal. The popular cult is, however, the propitiation of demons, a modification of the Shamanism of Northern Asia. The belief in demons, mostly malignant, keeps the Koreans in constant terror, and much of their substance is spent on propitiations. Sorceresses and blind sorcerers are the intermediaries. The fees annually paid to these persons are estimated at 3,000,000 dollars. In January 1897 there were in Seoul 1000 sorceresses, earning on an average 15 dollars per month each, an annual expenditure on dealings with spirits by the most enlightened city in Korea of 180,000 dollars, exclusive of very large sums paid to the male sorcerers and geomancers.

Christianity.—Putting aside the temporary Christian work of a Jesuit chaplain to the Japanese Christian General Konishe, in 1594 during the Japanese invasion, as well as that on a larger scale by students who received the evangel in the Roman form from Peking in 1792, and had made 4000 converts by the end of 1793, the first serious attempt at the conversion of Korea was made by the French *Société des Missions Étrangères* in 1835. In spite of frequent persecutions, there were 16,500 converts in 1857 and 20,000 in 1866, in which year the French bishops and priests were martyred by order of the emperor's father, and several thousand native Christians were beheaded, banished, or imprisoned. This mission in 1900 had about 30 missionaries and 40,000 converts. In 1884 and 1885, toleration being established, Protestant missionaries of the American Presbyterian and Methodist Episcopal churches entered Korea, and have been followed by a large number of agents of other denominations. An English bishop, clergy, doctors, and nursing sisters arrived in 1890. Hospitals, orphanages, schools, and an admirable college in Seoul have been founded, along with tri-lingual (Chinese, Korean, and English) printing-presses; religious, historical, and scientific works and much of the Bible have been translated into *En-mun*, and periodicals of an enlightened nature in the Korean script are also circulated. The progress of Protestant missions was very slow for some years, but since 1895 converts have multiplied. In 1900 these missions had about 13,000 members and adherents, and 110 missionaries.

Defence.—The standing army, which (on paper) consists of cavalry, artillery, infantry, and engineers, numbers 4000 men in Seoul, 800 of whom constitute the imperial body-guard, 1200 in the provinces, and a cadet corps. Its uniform and equipments are European and modern; Berdon rifles chiefly and Gatling guns. Between 1893 and 1898 its drill instructors were successively American, Japanese, and Russian. Korea has no fortified places, the ancient "Five Fortresses" for the defence of Seoul being practically unarmed and in the hands of the priests. There is a naval school at Kong-wha, but no navy. Seoul has 1200 highly-paid military police.

Production and Industries.—(i.) *Minerals.*—Extensive coalfields, producing coal of fair quality, as yet undeveloped, occur in Hwang-hai Do and elsewhere. Iron is abundant, especially in Phyöng-an Do, and rich copper ore, silver, and galena are found. Experts believe that reefs of rich auriferous quartz exist. In 1885 the rudest process of "placer" washing produced an export of gold dust amounting to £120,000, and in 1897 to £205,529. These are the amounts declared as passing through the customs, but it is estimated that more than double these values leaves Korea clandestinely. The reefs were left untouched till 1897, when an American company, which had obtained a concession in Phyöng-an Do in 1895, introduced the latest mining appliances, and raised the declared export of 1898 to £240,047, believed to represent a yield for that year of £600,000. Russian, German, and English applicants have since obtained concessions. The *concessionnaires* regard Korean labour as docile and intelligent.

(ii.) *Agriculture.*—Korean soil consists largely of light sandy loam, disintegrated lava, and rich, stoneless alluvium, from 3 to 10 feet deep. The rainfall is abundant during the necessitous months of the year, facilities for the irrigation of the rice crop are ample, and drought and floods are seldom known. Land is held from the proprietors on the terms of receiving seed from them and returning half the produce, the landlord paying the taxes. Any Korean can become a landowner by reclaiming and cultivating unoccupied crown land for three years free of taxation, after which he pays taxes annually. Good land produces two crops a year. The implements used are two makes of iron-shod wooden ploughs; a large shovel, worked by three or five men, one working the handle, the others jerking the blade by ropes attached to it; a short sharp-pointed hoe, a bamboo rake, and a wooden barrow, all of rude construction. Rice is threshed by beating the ears on a log; other grains, with flails on mud threshing-floors. Winnowing is performed by throwing up the grain on windy days. Rice is hulled and grain coarsely ground in stone querns or by water pestles. There are provincial horse-breeding stations, where pony stallions, from 10 to 12 hands high, are bred for carrying burdens. Magnificent red bulls are bred by the farmers for ploughing and other farming operations, and for the transport of goods. Sheep and goats are bred on the imperial farms, but only for sacrifice. Small, hairy, black pigs and fowls are universal. The cultivation does not compare in neatness and thoroughness with that of China and Japan. There are no trustworthy estimates of the yield of any given measurement of land. The farmers put the average yield of rice at thirtyfold, and of other grain at twentyfold. Korea produces all cereals and root crops except the tropical, along with cotton, tobacco, a species of the Rhea plant used for making grass-cloth, and the *Brousonettia papyrifera.* The articles chiefly cultivated are rice, millet, beans, *ginseng* (at Songdo), cotton, hemp, oil-seeds, bearded wheat, oats, barley, sorghum, and sweet and Irish potatoes. Korean agriculture suffers from infamous roads, the want of the exchange of seed, and the insecurity of the gains of labour. It occupies about three-fourths of the population.

(iii.) *Other Industries.*—The industries of Korea, apart from supplying the actual necessaries of a poor population, are few and rarely collective. They consist chiefly in the manufacture of sea-salt, of varied and admirable paper, thin and poor silk, horse-hair crinoline for hats, fine split bamboo blinds, hats, and mats, coarse pottery, hemp cloth for mourners, brass bowls, and grass-cloth. Won-san and Fusan are large fishing centres, and salt fish and fish manure are important exports; but the prolific fishing grounds are worked chiefly by Japanese labour and capital, 6836 Japanese licensed boats having worked from Fusan in 1898. Paper and *ginseng* are the only manufactured articles on the list of Korean exports. The arts are *nil.*

Commerce.—Since certain Korean ports were opened by treaty to foreign trade the customs have been under the management of European commissioners nominated by Sir Robert Hart of Peking. The dues collected in 1885 were about £25,000, and in 1898 over £100,000. The following returns from 1884 to 1898 apply solely to the direct foreign trade of the open ports:—

(i.) *Foreign Trade*—

	Imports.	Exports.
1884	£170,113	£95,377
1885	290,727	91,759
1886	466,250	104,753
1887	541,761	187,164
1888	597,005	137,283
1889	603,729	185,076
1890	790,261	591,746
1891	876,078	561,057
1892	689,772	366,560
1893	437,598	316,072
1894	584,318	345,614
1895	875,820	396,715
1896	708,461	512,275
1897	1,017,238	906,737
1898	1,194,843	576,896

Gold dust is not included in the foregoing figures for exports. In order of value in 1898 the chief exports (including gold) stood thus: Rice, £278,272; gold, £240,047; beans, £112,469; *ginseng*, £95,446; hides, £23,874. Of the total import trade of 1898 cotton goods represented one-half, the British share averaging about £300,000. The other chief imports were silk piece-goods, £77,676; grass-cloth, £49,417; kerosene oil, £41,309; railway plant and machinery, £32,750; Japanese matches, £14,204. The imports of Japanese cotton yarn, which is woven into a strong cloth on Korean handlooms during the winter, rose from £33,467 in 1895 to £99,749 in 1898.

(ii.) *Shipping.*—In 1885 the shipping entered at three open ports was 321 sailing vessels and 138 steamers. In 1898 the shipping entered inwards and outwards at five open ports was as follows:—

Flag.	Total for Korea.			
	Sailing.		Steam.	
	Number of Vessels.	Tons.	Number of Vessels.	Tons.
British . .	...	...	1	1,908
Chinese . .	463	9,257	...	...
Korean . .	377	9,034	344	81,059
German .	...	...	27	23,526
Japanese . .	1359	53,669	758	448,476
Russian .	2	160	32	29,613
Norwegian .	...	...	2	2,310
Hawaiian .	1	958	...	...
Total . .	2202	73,078	1164	586,892

There is a noteworthy increase of vessels under the Korean flag. Korea has regular steam communication with ports in Japan, the Gulf of Pe-chi-li, Shanghai, and Vladivostok by Japanese and Russian steamers, and her own steamers call at most of her own ports.

Roads, Posts, Telegraphs.—The main roads centring in Seoul are seldom fit even for the passage of ox-carts, and the secondary roads are bad bridle-tracks, frequently degenerating into "rock ladders." The inland transit of goods is almost entirely on the backs of bulls carrying from 450 to 600 ℔, on ponies carrying 200 ℔, and on men carrying from 100 to 150 ℔, bringing the average cost up to a fraction over 8d. per mile per ton. The *corvée* exists, with its usual hardships. Bridges are made of posts, carrying a framework either covered with timber or with pine branches and earth. They are removed at the beginning of the rainy season, and are not replaced for three months. The larger rivers are unbridged, but there are numerous Government ferries. The infamous roads and the risks during the bridgeless season greatly hamper trade. Under Japanese auspices a railway from Chemulpo was completed to the capital in 1900. The Japanese have secured a concession for a line from Seoul to Fusan, and the French one for a Seoul-Wiju railway, which, however, lapsed in 1899. Japanese steamers ply on the Han between Chemulpo and Seoul. A postal system, established in 1894–1895, has been gradually extended. There is a central office in Seoul, with about thirty provincial branches. There are postage stamps of four values. The Japanese have efficient post offices in Seoul and the treaty ports. Korea is connected with the Chinese and Japanese telegraph systems by a Japanese line from Chemulpo *viâ* Seoul to Fusan, and by a line lately acquired by the empire between Seoul and Wiju. The state has also lines from Seoul to Chemulpo, Fusan, and Won-san.

Banks and Money.—Banking facilities consist of the Russo-Korean Bank in Seoul, a branch of the Hong-Kong and Shanghai Bank at Chemulpo, and branches of two Japanese banks of high repute in Seoul and several of the open ports.

Currency.—Though Korea since the treaties has been constantly engaged in constructing mints, she can hardly be said to possess a currency. In 1894, on a silver basis, she issued a coinage of brass *cash*, 500 to the dollar, 1-cent copper pieces, 5-cent nickel pieces, and 20- and 100-cent silver. It was soon found that the larger silver coins were minted at a loss, and but few were issued. Korea practically depends on Japan for her currency, but Japanese silver and notes scarcely pass in the interior, and the medium of exchange remains the old and still legal debased copper *cash*, strung in strings of 100 on twisted straw, about 9 ℔ weight being the equivalent of a shilling. The adoption of a gold standard by Japan has caused much confusion. In 1898 the available coinage in Korea diminished by 2,000,000 *yen*, leaving only about 1,600,000 in silver and paper, a scarcity which affected trade injuriously.

History.—By both Korean and Chinese tradition Ki-tze—a councillor of the last sovereign of the 3rd Chinese dynasty, a sage, and the reputed author of parts of the famous Chinese classic, the *Shu-King*—is represented as entering Korea in 1122 B.C. with several thousand Chinese emigrants, who made him their king. The peninsula was then peopled by savages living in caves and subterranean holes. By both learned and popular belief in Korea Ki-tze is recognized as the founder of Korean social order, and is greatly reverenced. He called the new kingdom *Ch'ao-Hsien*, pacified and policed its borders, and introduced laws and Chinese etiquette and polity. Korean ancient history is far from satisfying the rigid demands of modern criticism, but it appears that Ki-tze's dynasty ruled the peninsula until the 4th century B.C., from which period until the 10th century A.D. civil wars and foreign aggressions are prominent. Nevertheless, Hiaksai, which with Korai and Shinra then constituted Korea, was a centre of literary culture in the 4th century, through which the Chinese classics and the art of writing reached the other two kingdoms. Buddhism, a forceful civilizing element, reached Hiaksai in A.D. 384, and from it the sutras and images of northern Buddhism were carried to Japan, as well as Chinese letters and ethics. Internecine wars were terminated about 913 by Wang the Founder, who unified the peninsula under the name Korai, made Song-do its capital, and endowed Buddhism as the state religion. In the 11th century Korea was stripped of her territory west of the Yalu by a warlike horde of Tungus stock, since which time her frontiers have been stationary. The Wang dynasty perished in 1392, an important epoch in the peninsula, when Ni Taijo, or Litan, the founder of the present dynasty, ascended the throne, after his country had suffered severely from Genghis and Khublai Khan. He tendered his homage to the first Ming emperor of China, received from him his investiture as sovereign, and accepted from him the Chinese calendar and chronology, in itself a declaration of fealty. He revived the name *Ch'ao-Hsien*, changed the capital from Song-do to Seoul, organized an administrative system, which with some modifications continued till 1895, and exists partially still, carried out vigorous reforms, disestablished Buddhism, made merit in Chinese literary examinations the basis of appointment to office, made Confucianism the state religion, abolished human sacrifices and the burying of old men alive, and introduced that Confucian system of education, polity, and social order which has dominated Korea for five centuries. Either this king or an immediate successor introduced the present national costume, the dress worn by the Chinese before the Manchu conquest. The early heirs of this vigorous and capable monarch used their power, like him, for the good of the people; but later decay set in, and Japanese buccaneers ravaged the coasts, though for two centuries under Chinese protection Korea was free from actual foreign invasion. In 1592 occurred the epoch-making invasion of Korea by a Japanese army of 150,000 men, by order of the great regent Hideyoshi. China came to the rescue with 60,000 men, and six years of a gigantic and bloody war followed, in which Japan used firearms for the first time against a foreign foe. Seoul and several of the oldest cities were captured, and in some instances destroyed, the country was desolated, and the art treasures and the artists were carried to Japan. The Japanese troops were recalled in 1598 at Hideyoshi's death. The port and fishing privileges of Fusan remained in Japanese possession, a heavy tribute was exacted, and until 1790 the Korean king stood in humiliating relations towards Japan. Korea never recovered from the effects of this invasion, which bequeathed to all Koreans an intense hatred of the Japanese, which has not been greatly modified in the three following centuries. In 1866, 1867, and 1870 French and American punitive expeditions attacked parts of Korea in which French missionaries and American adventurers had been put to death, and inflicted much loss of life, but retired without securing any diplomatic successes, and Korea continued to preserve her complete isolation. The first indirect step towards breaking it down had been taken in 1860, when Russia obtained from China the cession of the Usuri province, thus bringing a European power down to the Tumen. A large emigration of famine-stricken Koreans and persecuted Christians into Russian territory followed. The emigrants were very kindly received, and many of them became thrifty and prosperous farmers. In 1876 Japan, with the consent of China, wrung a treaty from Korea by which Fusan was fully opened to Japanese settlement and trade, and Won-san (Gensan) and Inchiun (Chemulpo) were opened to her in 1880. In 1882 China promulgated her "Trade and Frontier Regulations," and America negotiated a commercial treaty, followed by Germany and Great Britain in 1883, Italy and Russia in 1884, France in 1886, and Austria in 1892. A "Trade Convention" was also concluded with Russia. Seoul was opened in 1884 to foreign residence, and the provinces to foreign travel, and the diplomatic agents of the contracting Powers obtained a recognized status at the capital. These treaties terminated the absolute isolation which Korea had effectually preserved. During the negotiations, although under Chinese suzerainty, she was treated with as an independent state. Between 1897 and 1899, under diplomatic pressure, Song-chin, on the north-east coast; Ma-san-po, near the mouth of the Nak-tong, 40 miles west of Fusan on the south coast; and Kun-san, Mok-po, and Chin-nam-po, on the west coast, were opened to foreign trade and residence. From 1882 to 1894 the chief event in the newly-opened kingdom was a plot by the Tai-won-Kun, the present emperor's father, to seize on power, which led to an attack on the Japanese Legation, the members of which were compelled to fight their way, and that not bloodlessly, to the sea. Japan secured ample compensation; and the Chinese Resident, aided by Chinese troops, deported the Tai-won-Kun to Tientsin. In 1884 at an official banquet the leaders of the progressive party assassinated six leading Korean statesmen, and the intrigues in Korea of the banished or escaped conspirators have created difficulties which have not yet subsided. In spite of a constant struggle for ascendancy between the queen and the returned Tai-won-Kun, the next decade was one of quiet. China, always esteemed in Korea, consolidated her influence under the new conditions through a powerful Resident; prosperity advanced, and certain reforms were projected by foreign "advisers." In May 1894 a more important insurrectionary rising than usual led the king to ask armed aid from China. She landed 2000 troops on 10th June, having previously, in accordance with treaty provisions, notified Japan of her intention. Soon after this Japan had 12,000 troops in Korea, and occupied the capital and the treaty ports. Then Japan made three sensible proposals for Korean reform, to be undertaken jointly by herself and China. China replied that Korea must be left to reform herself, and that the withdrawal of the Japanese troops must precede negotiations. Japan rejected this suggestion, and on 23rd July attacked and occupied the royal palace. After some further negotiations and fights by land and sea between Japan and China war was declared formally by Japan, and Korea was for some time the battle-ground of the belligerents. The Japanese victories resulted for Korea in the solemn renunciation of Chinese suzerainty by the Korean king, the substitution of Japanese for Chinese influence, the introduction of many important reforms under Japanese advisers, and of checks on the absolutism of the throne. Everything promised well. The finances flourished under the capable control of Mr M'Leavy Brown, C.M.G. Large and judicious retrenchments were carried out in most of the Government departments. A measure of judicial and prison reform was granted. Taxation was placed on an equable basis. The pressure of the trade guilds was relaxed. Postal and educational systems were introduced. An approach to a constitution was made. The distinction between patrician and plebeian, domestic slavery, and beating and slicing to death were abolished. The age for marriage of both sexes was raised. Chinese literary examinations ceased to be a passport to office. Classes previously degraded were enfranchised, and the alliance between two essentially corrupt systems of government was severed. For about eighteen months all the departments were practically under Japanese control. On 8th October 1895 the Tai-won-Kun, with Korean troops, aided by Japanese troops under the orders of Viscount Miura, the Japanese minister, captured the palace, assassinated the queen, and made a prisoner of the king, who, however, four months later, escaped to the Russian Legation, where he remained till the spring of 1897. Japanese influence waned. The engagements of the advisers were not renewed. A strong retrograde movement set in. Reforms were dropped. The king, with the checks upon his absolutism removed, reverted to the worst traditions of his dynasty, and the control and arrangements of finance were upset by Russia. Korea, incapable of standing alone, now leans upon Russia or Japan, according to the pressure applied at the time. At the close of 1897 the king assumed the title of emperor, and changed the official designation of the empire to *Dai Han*—Great Han. Early in 1902 the independence of Korea was guaranteed by a clause in the treaty of alliance signed in that year between Great Britain and Japan. (See also China, Japan.)

Authorities.—The first Asiatic notice of Korea is by Khordadbeh, an Arab geographer of the 9th century A.D., in his *Book of Roads and Provinces*, quoted by Baron Richthofen in his great work on *China*, p. 575. The earliest European source of information is a narrative by H. Hamel, a Dutchman, who was shipwrecked on the coast of Quelpart and held in captivity in Korea for thirteen years. The amount of papers on Korea scattered through English, German, French, and Russian magazines, and the proceedings of geographical societies, is very great, and for the last three centuries Japanese writers have contributed largely to the sum of general knowledge of the peninsula. The list which follows includes some of the more recent works which illustrate the history, manners and customs, and awakening of Korea:—*British Foreign Office Reports on Korean Trade, Annual Series.* London.—*Bibliographie Koréanne*, 3 vols. Paris, 1897.—Bishop, Mrs I. L. *Korea and Her Neighbours*, 2 vols. London, 1897.—Brandt, M. von. *Ostasiatische Fragen.* Leipzig, 1897.—Cavendish, A. E. J., and Goold Adams, H. E. *Korea, and the Sacred White Mountain.* London, 1894.—Culin, Stewart. *Korean Games.* Philadelphia, 1895.—Curzon. *Problems of the Far East.* London, 1896.—Dallet. *Histoire de l'église de Korée*, 2 vols. Paris, 1874.—Gale, J. S. *Korean Sketches.* Edinburgh, 1898.—Griffis, W. E. *The Hermit Nation*, 3rd and revised edition. New York, 1889.—Hamel, H. *Relation du Naufrage d'un Vaisseau Halindois, &c., traduite du Flamond par M. Minutoli.* Paris, 1670.—Hîdemoto, Okoji. *Der Feldzug der Japanir gegen Korea im Jahre 1597: translated from Japanese by Professor von Pfizmaier*, 2 vols. Vienna, 1875.—Jametel, M. "La Korée: Ses resources, son avenir commercial," *L'Économiste Française.* Paris, July 1881.—Lowell, Percival. *Chosön: The Land of the Morning Calm.* London, Boston, 1886.—Miln, L. J. *Quaint Korea.* Harper, New York, 1895.—Laguerie, V. de. *La Korée Independante, Russe ou Japonaise?* Paris, 1898.—Ross, J. *Korea: Its History, Manners, and Customs.* Paisley, 1880.—Wilkinson, W. H. *The Korean Government: Constitutional Changes in Korea during the period 23rd July 1894–30th June 1896.* Shanghai, 1896. Dictionaries and vocabularies by Mr Meyers, the French missionaries, and others, were superseded in 1898 by a large and learned volume by the Rev. J. S. Gale, a Presbyterian missionary, who devoted some years to the work. (I. L. B.)

Korets, a town of south-west Russia, government of Volhynia, 73 miles north-west of Zhitomir. It is one of the oldest Russian towns, being mentioned first in the annals in 1150. It was often plundered by the Lithuanians, the Poles, and the Cossacks in the 15th, 16th, and 17th centuries. It has now woollen-cloth mills, distilleries, and tanneries. Population (1897), 9600.

Korneuburg, the chief town of a government district in Lower Austria, on the left bank of the Danube, opposite Klosterneuburg, 8 miles north by west of Vienna. It is a steamship station and an important emporium of the salt and corn trade. The industry comprises the manufacture of coarse textiles, pasteboard, &c. Its charter as a town dates from 1298, and it was a much-frequented market in the preceding century. At the beginning of the 15th century it was surrounded by walls, and in 1450 a fortress was erected. It was frequently involved in the conflict between the Hungarian king Matthias Corvinus and the Emperor Frederick III., and also during the Thirty Years' War. Population (1890), 7271; (1900), 8298, German.

Korostyshev, a town of south-west Russia, government of Kieff. It lies 13 miles east of Zhitomir, of which it has become a summer resort, on account of its picturesque situation on the Teterev and easy access. It has iron mineral springs, a seminary for teachers, several woollen-cloth mills, two paper mills, saw-mills, tanneries, distilleries, and granite quarries. Population (1897), 13,000.

Korsör, a seaport town of Denmark, county Sorö, on the island of Zealand, 71 miles by rail west-south-west of Copenhagen, on the east shore of the Great Belt. The harbour, which is formed by a bay of the Baltic, has a depth throughout of 20 feet. It is the point of departure and arrival of the steam ferry to Nyborg on Fünen. The port was entered by 1689 vessels of 295,213 tons, and cleared by 1683 of 297,199 tons in 1899. The chief exports were fish, cereals, bacon; the chief imports, petroleum and coal. A market town since the 14th century, Korsör has ruins of an old fortified castle, on the south side of the channel, dating from the 14th and 17th centuries. Population (1880), 3954; (1890), 4685; (1900), 6054.

Kosel, a town of Prussia, province of Silesia, on the Oder, 29 miles south-east of Oppeln by rail. It was a fortified town from the 13th century until 1874, when the fortifications were razed and their site laid out as promenades. There is a lively river trade and manufacture of sugar, cheese, and leather; the royal stud farm for the province is situated here. Population (1885), 5461; (1900), 7085.

Kösen, a village and summer resort of Prussia, province of Saxony, 33 miles by rail south by west of Halle, on the Saale. On the adjacent Rudelsburg the German students have erected monuments to their comrades who fell in the Franco-German war of 1870–71, to Bismarck (1896), and to the Emperor William I. Here is also a saline mineral spring used for bathing. Kösen is famous as the central meeting-place of the German students' corps, which holds an annual congress every Whitsuntide. Population (1900), 2901.

Köslin, a town of Prussia, province of Pomerania, 105 miles by rail north-east of Stettin. There are a cadet academy and a deaf and dumb asylum. Population (1885), 17,277; (1895), 18,935; (1900), 20,418.

Kossuth, Lajos [Louis] (1802–1894), Hungarian patriot, was born at Monok, a small town in the county of Zemplin. His father, who was descended from an old untitled noble family and possessed a small estate, was by profession an advocate. Louis, who was the eldest of four children, received from his mother a strict religious training. His education was completed at the Calvinist college of Scharashottak and at the University of Budapest. At the age of nineteen he returned home and began practice with his father. His talents and amiability soon won him great popularity, especially among the peasants. He was also appointed steward to the Countess Szapary, a widow with large estates, and, as her representative, had a seat in the County Assembly. This position he lost owing to a quarrel with his patroness, and he was accused of appropriating money to pay a gambling debt. His fault cannot have been very serious, for he was shortly afterwards (he had in the meantime settled in Pesth) appointed by Count Hunyady to be his deputy at the National Diet in Pressburg. At the age of twenty he therefore was introduced to political life. It was a time when, under able leaders, a great national party was beginning the struggle for reform against the stagnant Austrian Government. As deputy he had no vote, and he naturally took little share in the debates, but it was part of his duty to send written reports of the proceedings to his patron, since the Government, with a well-grounded fear of all that might stir popular feeling, refused to allow any published reports. Kossuth's letters were so excellent that they were circulated in MS. among the Liberal magnates, and soon developed into an organized parliamentary Gazette (*Orszagyulesi tudositasok*), of which he was editor. At once his name and influence spread. In order to increase the circulation, he ventured on lithographing the letters. This brought them under the official censure, and was forbidden. He continued the paper in MS., and when the Government refused to allow it to be circulated through the post, sent it out by hand. In 1836 the Diet was dissolved. Kossuth continued the agitation by reporting in letter form the debates of the county assemblies, to which he thereby gave a political importance which they had not had when each was ignorant of the proceedings of the others. The fact that he embellished with his own great literary ability the speeches of the Liberals and Reformers only added to the influence of his news-letters. The Government in vain attempted to suppress the letters, and, other means having failed, he was in 1837, with Weszelenyi and several others, arrested on a charge of high treason. After spending a year in prison at Ofen, he was tried and condemned to four more years' imprisonment. His confinement was strict and injured his health, but he was allowed the use of books. He greatly increased his political information, and also acquired, from the study of the Bible and Shakespeare, a wonderful knowledge of English. His arrest had caused great indignation. The Diet which met in 1839 supported the agitation for the release of the prisoners, and refused to pass any Government measures. Metternich long remained obdurate, but the danger of war in 1840 obliged him to give way. Immediately after his release Kossuth married a lady who during his prison days had shown great interest in him. Henceforward she strongly urged him on in his political career. He had now become a popular leader. As soon as his health was restored he was appointed editor of the *Pesti Hirlap*, the newly-founded organ of the party. Strangely enough, the Government did not refuse its consent. The success of the paper was unprecedented. The circulation soon reached what was then the immense figure of 7000. The attempts of the Government to counteract his influence by founding a rival paper, the *Vilag*, only increased his importance and added to the political excitement. The warning of the great reformer Szechenyi that by his appeal to the passions of the people he was leading the nation to revolution was neglected. Kossuth, indeed, was not content with advocating those reforms—the abolition of entail, the abolition of feudal burdens, taxation of the nobles—which were demanded by all the Liberals. By insisting on the superiority of the Magyars to the Slavonic inhabitants of Hungary, by his violent attacks on Austria (he already discussed the possibility of a breach with Austria), he raised the national pride to a dangerous pitch. At last, in 1844, the Government succeeded in breaking his connexion with the paper. The proprietor, in obedience to orders from Vienna (this seems the most probable account), took advantage of a dispute about salary to dismiss him. He then applied for permission to start a paper of his own. In a personal interview Metternich offered to take him into the Government service. The offer was refused, and for three years he was without a regular position. He continued the agitation with the object of attaining both the political and commercial independence of Hungary. He adopted the economic principles of List, and founded a society, the "Vedegylet," the members of which were to consume none but home produce. He advocated the creation of a Hungarian port at Fiume. With the autumn of 1847 the great opportunity of his life came. Supported by the influence of Louis Batthyany, after a keenly fought struggle he was elected member for Budapest in the new Diet. "Now that I am a deputy, I will cease to be an agitator," he said. He at once became chief leader of the Liberals. Deak was absent. Batthyany, Szechenyi, Szemere, Eotvos, his rivals, saw how his intense personal ambition and egoism led him always to assume the chief place, and to use his parliamentary position to establish himself as leader of the nation, but before his eloquence and energy all apprehensions were useless. His eloquence was of that nature, in its impassioned appeals to the strongest emotions, that it required for its full effect the highest themes and the most dramatic situations. In a time of rest, though he could never have been obscure, he would never have attained the highest power. It was therefore a necessity of his nature, perhaps unconsciously, always to drive things to a crisis. The crisis came, and he used it to the full.

On 3rd March 1848, as soon as the news of the Revolution in Paris had arrived, in a speech of surpassing power he demanded parliamentary government for Hungary and constitutional government for the rest of Austria. He at once became the leader of the European revolution; his speech was read aloud in the streets of Vienna to the mob by which Metternich was overthrown, and when a deputation from the Diet visited Vienna to receive the assent of the Emperor to their petition, it was Kossuth who received the chief ovation. Batthyany, who formed the first responsible ministry, could not refuse to admit Kossuth, but he gave him the ministry of finance, probably because that seemed to open to him fewest prospects of engrossing popularity. If that was the object, it was in vain. With wonderful energy he began developing the internal resources of the country: he established a separate Hungarian coinage—as always, using every means to increase the national self-consciousness; and it was characteristic that on the new Hungarian notes which he issued his own name was the most prominent inscription; hence the name of *Kossuth notes*, which was long celebrated. A new paper was started, to which was given the name of *Kossuth Hirlapia*, so that from the first it was Kossuth rather than the Palatine or the president of the ministry whose name was in the minds of the people associated with the new Government. Much more was this the case when, in the summer, the dangers from the Croats, Serbs, and the reaction at Vienna increased. In a great speech of 11th July he asked that the nation should arm in self-defence, and demanded 200,000 men; amid a scene of wild enthusiasm this was granted by acclamation. When Jellachich was marching on Pesth he went from town to town rousing the people to the defence of the country, and the popular force of the *Honved* was his creation. When Batthyany resigned he was appointed with Szemere to carry on the Government provisionally, and at the end of September he was made President of the Committee of National Defence. From this time he was in fact, if not in name, the dictator. With marvellous energy he kept in his own hands the direction of the whole Government. Not a soldier himself, he had to control and direct the movements of armies; can we be surprised if he failed, or if he was unable to keep control over the generals or to establish that military co-operation so essential to success? Especially it was Görgei (*q.v.*), whose great abilities he was the first to recognize, who refused obedience; the two men were in truth the very opposite to one another; the one all feeling, enthusiasm, sensibility; the other cold, stoical, reckless of life. Twice Kossuth deposed him from the command; twice he had to restore him. It would have been well if Kossuth had had something more of Görgei's calculated ruthlessness, for, as has been truly said, the revolutionary power he had seized could only be held by revolutionary means; but he was by nature soft-hearted and always merciful; though often audacious, he lacked decision in dealing with men. It has been said that he showed a want of personal courage: this is not improbable; the excess of feeling which made him so great an orator could hardly be combined with the coolness in danger required of a soldier; but no one was able, as he could, to infuse courage into others. During all the terrible winter which followed, his energy and spirit never failed him. It was he who overcame the reluctance of the army to march to the relief of Vienna; after the defeat of Schwechat, at which he was present, he sent Bem to carry on the war in Transylvania. At the end of the year, when the Austrians were approaching Pesth, he asked for the mediation of Mr Stiles, the American envoy. Windischgratz, however, refused all terms, and the Diet and Government fled to Debreczin, Kossuth taking with him the regalia of St Stephen, the sacred Palladium of the Hungarian nation. Immediately after the accession of the Emperor Francis Joseph all the concessions of March had been revoked and Kossuth with his colleagues outlawed. In April, when the Hungarians had won many successes, after sounding the army, he issued the celebrated declaration of Hungarian independence, in which he declared that "the house of Hapsburg-Lorraine, perjured in the sight of God and man, had forfeited the Hungarian throne." It was a step characteristic of his love for extreme and dramatic action, but it added to the dissensions between him and those who wished only for autonomy under the old dynasty, and his enemies did not scruple to accuse him of aiming at the crown himself. For the time the future form of government was left undecided, but Kossuth was appointed responsible Governor. The hopes of ultimate success were frustrated by the intervention of Russia; all appeals to the Western Powers were vain, and on 11th August Kossuth abdicated in favour of Görgei, on the ground that in the last extremity the general alone could save the nation. How Görgei used his authority to surrender is well known; the capitulation was indeed inevitable, but a greater man than Kossuth would not have avoided the last duty of conducting the negotiations so as to get the best terms.

With the capitulation of Villagos Kossuth's career was at an end. A solitary fugitive, he crossed the Turkish frontier. He was hospitably received by the Turkish authorities, who, supported by Great Britain, refused, notwithstanding the threats of the allied emperors, to surrender him and the other fugitives to the merciless vengeance of the Austrians. In January 1849 he was removed from Widdin, where he had been kept in honourable confinement, to Shumla, and thence to Katahia in Asia Minor. Here he was joined by his children, who had been confined at Pressburg; his wife (a price had been set on her head) had joined him earlier, having escaped in disguise. In September 1851 he was liberated and embarked on an American man-of-war. He first landed at Marseilles, where he received an enthusiastic welcome from the people, but the prince-president refused to allow him to cross France. On 23rd October he landed at Southampton and spent three weeks in England, where he was the object of extraordinary enthusiasm, equalled only by that with which Garibaldi was received ten years later. Addresses were presented to him at Southampton, Birmingham, and other towns; he was officially entertained by the Lord Mayor of London; at each place he pleaded the cause of his unhappy country. Speaking in English, he displayed an eloquence and command of the language scarcely excelled by the greatest orators in their own tongue; and if we recollect that he had never before been outside the Austrian Empire, these speeches must be recognized as being among the most marvellous products of human genius. The agitation had no immediate effect, but the indignation which he aroused against Russian policy had much to do with the strong anti-Russian feeling which made the Crimean war possible.

From England he went to the United States of America: there his reception was equally enthusiastic, if less dignified; an element of charlatanism appeared in his words and acts which soon destroyed his real influence. Other Hungarian exiles protested against the claim he appeared to make that he was the one national hero of the Revolution. Count Casimir Batthyany attacked him in *The Times*, and Szemere, who had been prime minister under him, published a bitter criticism of his acts and character, accusing him of arrogance, cowardice, and duplicity. He soon returned to England, where he lived in close connexion with Mazzini, by whom, with some misgiving, he was persuaded to join the Revolutionary Committee. Quarrels of a kind only too common among exiles followed; the Hungarians were especially offended by his claim still to be called Governor. He watched with anxiety every opportunity of once more freeing his country from Austria. An attempt to organize a Hungarian legion during the Crimean war was stopped, but in 1859 he entered into negotiations with Napoleon, left England for Italy, and began the organization of a

Hungarian legion, which was to make a descent on the coast of Dalmatia. The Peace of Villafranca made this impossible. From that time he resided in Italy; he refused to follow the other Hungarian patriots, who, under the lead of Deak, accepted the compromise of 1866; for him there could be no reconciliation with the house of Hapsburg, nor would he accept less than full independence and a republic. He would not avail himself of the amnesty, and though elected to the Diet of 1867, never took his seat. He never lost the affections of his countrymen, but he refrained from an attempt to give practical effect to his opinions, nor did he allow his name to become a new cause of dissension. A law of 1879, which deprived of citizenship all Hungarians who had voluntarily been absent ten years, was a bitter blow to him.

He died in Turin on 23rd March 1894, at the age of ninety-two; his body was taken to Pesth, where he was buried amid the mourning of the whole nation.

There is no full biography of Kossuth, and many points in his career and character will probably always remain the subject of controversy. The fullest account of the Revolution is given in HELFERT, *Geschichte Oesterreichs*, Leipzig, 1869, &c., representing the Austrian view.

See also *Hungary and its Revolutions, with a Memoir of Louis Kossuth.* By E. O. S. Bohn, 1854.—HORVATH. *25 Jahre aus der Geschichte Ungarns, 1823–48.* Leipzig, 1867.—MAURICE. *Revolutions of 1848–49.*—STILES. *Austria in 1848–49.* New York, 1852.—SZEMERE. *Politische Charakterskizzen: III. Kossuth.* Hamburg, 1853.—LOUIS KOSSUTH. *Memoirs of my Exile.*—PULSZKY. *Meine Zeit, mein Leben.* 1880. (J. W. HE.)

Kostroma, a government of middle Russia. Area, 32,702 square miles. Nearly three-quarters of the surface is covered with woods. Population (1897), 1,429,228, thoroughly Russian, with a small admixture of other aborigines. Agriculture remains relatively poor. Out of 20,001,000 acres, 7,861,500 acres belong to private owners, 6,379,500 to the peasant communities, 3,660,800 to the crown, and 1,243,000 to the imperial family. Only 2,300,000 acres are under grain crops, the average crop being about 3,300,000 quarters. Flax crops are on the increase, also hops. There were in 1897, 258,207 horses, 435,000 cattle, and 439,000 sheep. Domestic industries are widely spread. Factories are growing—chiefly cotton, flax, and linen mills, chemical works, tanneries, paper mills, &c.—and show an aggregate yearly return of about £3,000,000. There is only one school for 3296 inhabitants. It is divided into twelve districts, the chief towns of which are Kostroma (41,268), Bui (2626), Chukhloma (2200), Galich (6182), Kineshma (7564), Kologriv (2566), Makariev (6068), Nerekhta (3000), Soligalich (3420), Varnavin (1140), Vetluga (5200), and Yurievets (4778).

Kotah, a native state of India, in the Rajputana Agency, with an area of 3803 square miles. The population in 1881 was 417,275; in 1891, 526,267, showing an apparent increase of 26 per cent.; average density, 138 persons per square mile. In 1901, on an enlarged area of about 5700 square miles, the population was 544,349, showing an average density of only 96 persons per square mile. The gross revenue in 1896–97 was Rs.27,83,072; tribute, Rs.3,84,720; expenditure on public works, Rs.3,31,390; on army Rs.4,20,000; number of schools, 26, attended by 1490 pupils, of whom 85 were girls. In 1897 a considerable portion of the area added to Jhalawar in 1838 was restored to Kotah. The present Maharao, Umad Singh, was born in 1873, and succeeded in 1889. He was educated at the Mayo College, Ajmere. A continuation of the branch line of the Indian Midland railway from Goona to Bara passes through Kotah for 29 miles. It was opened in 1889 at a cost to the state of Rs.19,00,000. It was proposed to construct a light railway from Bara to Kotah town. The state suffered from drought in 1896–97, and again more severely in 1899–1900. In 1896–97 the coinage at the mint was Rs.24,130, the rupee being of the same weight and fineness as the British rupee. The inscription on the reverse, in Persian characters, was "Her Majesty of England, the victorious monarch." The town of KOTAH is on the right bank of the Chambal. Population (1881), 40,270; (1891), 38,793; (1901), 33,679, showing a continuous decrease. A handsome new palace has been constructed, and a water-supply for the town and suburbs is under consideration by the municipal committee. The high school had 378 pupils in 1897–98, of whom 158 were learning English. The school for the sons of nobles had 56 pupils, in addition to 9 boys at the Mayo College educated at the expense of the state. There are also two girls' schools, for Hindu and Mahommedan girls. The Victoria Hospital is under a native Christian lady. The public library called the Crosthwaite Institute was founded in 1899.

Kotelna, a town of Russia, government of Kharkov, district Akhtyrka, on the frontier of Poltava. It has a variety of domestic trades, forges, and oil works. Population, 13,960.

Köthen, or CÖTHEN, a town of Germany, duchy of Anhalt, 22 miles by rail north of Halle. It has a technical institute, a school of gardening, and a school of forestry. A new town hall was finished in 1899. Among others, there is a monument to J. S. Bach, who was music director here from 1717 to 1723. Population (1885), 17,473; (1900), 22,092.

Kotka, a seaport of Russia, Finland, government of Viborg, 35 miles by rail from Kuivola junction of the Helsingfors railway, on an island of same name at the mouth of the Kymmene river. Timber is shipped down this river from all the lakes of the Päjäne basin to the sawmills of Kotka, employing 1400 workers. Over 200,000 cubic metres of timber are exported. It is also the chief port for exports from and imports to East Finland. It is the military station of the Russian navy, and has three gymnasia and technical schools. Population (1897), 4801.

Kovalevsky, Sophie (1850–1891), Russian mathematician, daughter of General Corvin-Krukovsky, was born at Moscow, 15th January 1850. From her earliest childhood she showed a remarkable love of study and the keenest interest in mathematical forms, even before she had any conception of their meaning. As a young girl she was fired by the aspiration after intellectual liberty that animated so many young Russian women at that period, and drove them to study at foreign universities, since their own were closed to them. This led her, in 1868, to contract one of those conventional marriages in vogue at the time, with a young student, Waldemar Kovalevsky, and the two went together to Germany to continue their studies. She first went to Heidelberg, where she studied under Helmholtz, Kirchhoff, Königsberger, and du Bois-Reymond, and from 1871–74 read privately with Weierstrass at Berlin, as the public lectures were not then open to women. In 1874 the University of Göttingen granted her a degree *in absentiâ* excusing her from the oral examination on account of the remarkable excellence of the three dissertations sent in, one of which, on the theory of partial differential equations, is one of her most remarkable works. Another was an elucidation of Laplace's mathematical theory of the form of Saturn's rings. Soon after this she returned to Russia with her husband, who was appointed professor of palæontology at Moscow, where he died in 1883. At this time Madame Kovalevsky was at Stockholm, where Mittag Leffler, also a pupil of Weierstrass, who had been recently appointed to the chair of mathematics at the newly-founded university, had procured for her a post as lecturer. She discharged her duties so successfully that in 1884 she was appointed full professor. This post she held till her death on 10th February 1891. In 1888 she achieved the greatest of her successes, gaining the Prix Bordin offered by the Paris Academy. The problem set was "to perfect in one important point the theory of the movement of a solid body round an immovable point," and her solution added a result of the highest interest to those transmitted to us by Euler and Lagrange. So remarkable was this work that the value of the prize was doubled as a recognition of unusual merit. Unfortunately Madame Kovalevsky did not live to reap the full reward of her labours, for she died just as she had attained the height of her fame and had won recognition even in her own country by election to membership of the St Petersburg Academy of Science.

Kovel, a district town of Russia, government of Volhynia, 117 miles by rail south-east of Brest Litovsk, on the marshy banks of the Turiya. Population (1897), 17,300, more than one-third of whom are Jews.

Kovno, a Lithuanian government of north-west Russia. It touches the Baltic Sea by a narrow strip at Memel. Population (1857), 969,369; (1897), 1,549,444, of whom 788,102 are women, and 147,878 live in towns. Average births 54,000, deaths 36,000; average increase about 1 per cent. The ethnographical composition of the population was estimated by Rittich as: Zhmudes, 40 per cent., chiefly in the west; Lithuanians, 30 per cent., chiefly in the east; Jews, 18 per cent.; Germans, about 16,000; Russians only 5280, and Poles only 3130 families. These figures remain approximately correct, only Jews (313,417 in 1892) having grown to be more than 25 per cent. of the population. Agriculture is in a good condition, but the peasants' allotments are small, and a considerable number of the peasants are agricultural labourers. The average acreage under crops is 3,369,400 under various grains, and 202,500 under potatoes, so that in an average year the province has an available surplus of 2,200,000 quarters of grain and about 840,000 quarters of potatoes. Nearly 285,000 cwts. of flax are obtained every year. Dairying is in a good condition, and horse and cattle breeding are attracting attention. Fishing, too, is important, and the navigation on the rivers is brisk. A variety of small and domestic industries is carried on in the towns by the Jewish population (23,769 artisans in 1893), but only to a slight extent in the villages. As many as from 18,000 to 24,000 men are compelled every year to migrate in search of work. The yearly returns of the factories (1360) attain about £650,000 (distilleries, tobacco, steam flour-mills, hardware). Schools are insufficient (only 13,827 pupils in the elementary schools), but well organized. All village schools have small libraries and land (1 to 3 acres) for model school gardens. The chief towns of the seven districts into which the government is divided are Kovno, Novoalexandrovsk (6370), Povenyezh (13,044), Rossieny (7455), Shavli (15,914), Telshi (6215), and Vilkomir (13,509).

Kovno (Polish *Kowno*, Russian *Kovna*, Lithuanian *Kaune*), capital of the above government, at the confluence of the Niemen with the Viliya, 503 miles south-west of St Petersburg by rail, and 54 miles from Wierzbołowo (Prussian frontier). It is a first-class fortress. It is an important entrepôt for goods passing from and to Prussia, but the yearly returns of sea-borne goods brought by rail only attain 75,000 tons. Population (1863), 23,937; (1897), 73,543.

Kovroff, a district town of Russia, government and 40 miles by rail north-east of Vladimir, on the line to Nijni-Novgorod. It has large railway carriage works, cotton mills (1700 workers), steam flour-mills, tallow houses, &c., and quarries of limestone. Population (1890), 6600; (1897), 14,570.

Kozlov, a district town of Russia, government and 45 miles west of Tambov, on the Lyesnoi Voronezh river, amidst a fertile agricultural region. It is a railway junction, and consequently its importance for the export of cattle (65,000 head), grain, meat, eggs (22,000,000), tallow, hides, &c., is steadily growing, as are also its factories, flour-mills, tallow-houses, distilleries, tanneries, glue-works, &c. Population (1897), 40,347.

Kragerö, a town of Norway, Bratsberg county, on the south coast, 67 miles north-east of Christiansand. The total trade is valued at about £127,000 a year. The chief exports are timber, ice, wood-pulp, and apatite and felspar. Coal is the principal import. The town possesses a mercantile fleet of some 46,000 tons burden. Population (1875), 4669; (1900), 5223.

Kraguyevatz, the principal town of central Servia (so-called "Thoomadiya," the forest land), 59 miles south-south-east of Belgrade. It is situated on the small river Lepenitza, in a very fertile country. In the first years of Servia's autonomy under Prince Milosh, it was the residence of the prince and the seat of government (1818–39). Even later, between 1868 and 1880, the National Assembly (*Nardona Skupshtina*) usually met there. In 1857 the first cannon-foundry in Servia was established there, and since that time it has developed into the principal arsenal and military store of the country. It is the seat of the district prefecture, of a tribunal, and of a large garrison. It boasts the finest college building and the finest cathedral (in Byzantine style) in Servia. In 1885 it was connected by a branch line (Kraguyevatz–Lapovo) with the principal railway (Belgrade–Nish), and since then the prosperity of the town has steadily increased. Population, 14,160.

Krakatoa. See Geology (III.).

Kraszewski, Joseph Ignatius (1812–1887), Polish novelist and miscellaneous writer, was born at Warsaw, 27th July 1812, of an aristocratic family. He showed a precocious talent for authorship, beginning his literary career with a volume of sketches from society as early as 1829, and for more than half a century scarcely ever intermitting his literary production, except during a period of imprisonment upon a charge of complicity in the insurrection of 1831. He narrowly escaped being sent to Siberia, but, rescued by the intercession of powerful friends, he settled upon his landed property near Grodno, and devoted himself to literature with such industry that a mere selection from his fiction alone, published at Lemberg from 1871 to 1875, occupies 102 volumes. He was thus the most conspicuous literary figure of his day in Poland. His extreme fertility was suggestive of haste and carelessness, but he declared that the contrivance of his plot gave him three times as much trouble as the composition of his novel. Apart from his gifts as a story-teller, he did not possess extraordinary mental powers; the "profound thoughts" culled from his writings by his admiring biographer Bohdanowicz are for the most part mere truisms. His copious invention is nevertheless combined with real truth to nature, especially evinced in the beautiful little story of *Jermola the Potter* (1857), from which George Eliot appears to have derived the idea of *Silas Marner*, though she can only have known it at second hand. Compared with the exquisite art of *Silas Marner*, *Jermola* appears rude and unskilful, but it is not on this account the less touching in its fidelity to the tenderest elements of human nature. Kraszewski's literary activity falls into two well-marked epochs, the earlier when, residing upon his estate, he produced romances like *Jermola*, *Ulana*, *Kordecki*, devoid of any special tendency, and that after 1863, when the suspicions of the Russian Government compelled him to settle in Dresden. To this period belong several political novels published under the name of *Boleslawita*, historical fictions such as *Countess Cosel*, and the "culture" romances *Morituri* and *Resurrection*, by which he is perhaps best known out of his own country. In 1884 he was accused of plotting against the German Government, and sentenced to seven years' imprisonment in a fortress, but was released in 1886, and withdrew to Geneva, where he died on 19th March 1887. His remains were brought to Poland and interred at Cracow. Kraszewski was also a poet and dramatist; his most celebrated poem is his epic "Anafielas" (1840–43). He was indefatigable as literary critic, editor, and translator, wrote several historical works, and was conspicuous as a restorer of the study of national archæology in Poland. (R. G.)

Kremenets (Polish, *Kremeniec*), a district town of south-west Russia, government of Volhynia, 128 miles west of Zhitomir, and 25 miles east of Brody railway station, in Austrian Galicia. It is situated in a gorge of the Kremenets Hills, where an old Polish fortress, now in ruins, was erected. It has trade in tobacco and grain for export. Population (1897), 17,618.

Kremenskaya, a growing Cossack village of south-east Russia, province of Don Cossacks, 70 miles north-west of Tsaritzyn. Population (1892), 9900; (1895), 15,727.

Krementchug, a district town of south-west Russia, government and 75 miles by rail south-west of Poltava, on the left bank of the Dnieper. It is an important entrepôt for commerce, chiefly in grain and timber, and is also a considerable river port and a growing industrial centre (steam flour-mills, steam saw-mills, forges, tobacco factories, &c.). Population (1887), 31,000; (1897), with Kryukov suburb, on the opposite side of the Dnieper, 58,648.

Krems, or KREMS AN DER DONAU, chief town of a district in Lower Austria, at the confluence of the Krems with the Danube. The manufactures comprise steel goods, mustard and vinegar, and a special kind of white lead (*Kremser Weiss*) is prepared from deposits in the neighbourhood. The trade is mainly in these products and in wine and saffron. The Danube harbour of Krems is at the adjoining town of Stein (4299). Population, with suburbs (1890), 10,584; (1900), 12,657, including a garrison of 1755.

Kremsier (Czech, *Kroměříž*), a town in Moravia, Austria, with a special charter, 37 miles east by north of Brünn. Its industries include the manufacture of machinery and iron-founding, brewing and corn-milling, and there is a considerable trade in corn, cattle, fruit, and manufactures. Population (1890), 12,480; (1900), 13,991, including a garrison of 1065.

Kreuzburg, a town of Prussia, province of Silesia, 24 miles north-north-east of Oppeln. It was the birthplace of Gustav Freytag (1816–1895). Here are flour-mills, distilleries, iron-works, breweries, &c.; also a provincial lunatic asylum and a teachers' seminary. Population (1885), 6578; (1900), 10,236.

Kreuznach, a town and watering-place of Prussia, in the Rhine province, on the river Nahe, and 9 miles by rail south of Bingen. In the school of the old town is preserved a collection of Roman and mediæval antiquities. Here was discovered in 1893 a finely-preserved Roman mosaic. A statue of Bismarck (1897) adorns the old town. Its saline waters attract some 6000 persons annually. Population (1885), 16,414; (1900), 21,334.

Kriegspiel, or the "WAR GAME," is of German origin, as its name indicates. The positions of troops are marked on maps, movements are made under regulations, and the whole or portions of past campaigns can be reproduced in outline of fair accuracy, or hypothetical manœuvres may be formulated for study and instruction. The materials required are at least three copies of the same map, drawn to such scale as may be suitable to the magnitude of the operations to be represented. If the scheme is one for small numbers of troops, maps of large scale are essential, as small features of the ground largely influence the action of small bodies, and it is only on large-scale maps that the real influence of small features can readily be appreciated. Conversely, with large bodies, maps on a diminished scale are convenient. A great amount of detail is necessary in all maps drawn for military purposes; heights as represented by contours, roads, buildings, water-courses, fences, and the nature of the ground, all enter into the question of the feasibility or the reverse of military operations; and where the map is the actual field of manœuvre, the features of the natural field must be adequately supplied. Blocks, cut or moulded to scale, represent the different units of the combatants; and colours, generally red and blue, distinguish friend from foe. Some pairs of dividers and a few measures of the same scale as the maps employed complete the material outfit. Printed regulations for the conduct of kriegspiel are of small value; and although rules have been drafted at various times and in many languages, they have generally been allowed to lapse, practice having proved that the decision of a competent umpire is of more value, as to the soundness or unsoundness of a military manœuvre, than a code of regulations which inevitably lack elasticity.

The usual course of procedure varies but little in the different countries in which the system has been employed. The central map screened from the view of the combatants is used by the umpire, who places on it the forces of both sides; copies are on either hand behind screens or in adjoining rooms, and on them representative blocks are placed in positions which agree with the information possessed by each respective commander. A scheme is formulated such as may occur in war, and a "General Idea" or "Narrative" is the common property of both sides. This contains those items of common knowledge which would be in the possession of either commander in the field. The General Idea is supplemented by "special ideas," issued one to each of the combatants, supplying the information which a commander might reasonably be expected to have of the details of his own force. A third series of instructions is issued, entitled "Orders," which define to each commander the object to be attained; and on receipt of these he is required to draft specific orders, such as, in manœuvre or in war, would be considered necessary for issue to field units in the assumed circumstances. Up to this point the instruction is strictly parallel to service conditions, but from the moment the umpire or an assistant moves a unit, falsity may supervene; armies on the map move without hitch or breakdown, but it is the exception, not the rule, for movements of real bodies to be carried on without unforeseen delay. The units of artillery, cavalry, infantry, or train-waggons, advance or retreat at a rate approximately regulated to their normal pace. Information gained by advancing patrols is brought at realistic speed to its destination; and no alteration in the ordered movements of a unit is allowed, till expiration of the calculated time for the transmission of the intelligence and for the issue of fresh orders. So the exercise progresses, each movement is marked, and periodically the blocks on the three maps are placed as they would be at a simultaneous moment. Smaller units yield to larger ones of the enemy; equal forces, if unassisted by superiority of position, "contain" one another, and are practically neutralized till reinforcements arrive and equilibrium is overthrown.

The decisions of the umpire are all-important, and it is he who makes or mars the value of the instruction. Some axioms must be universally accepted for the guidance both of himself and of the players. A force arrayed within effective range on the flank of an equal and hostile force has the better position of the two. Artillery in position with an unimpeded glacis is a terrible task for a frontal attack. Cavalry, as such, is ineffective in woodlands, marshes, or a country broken up by cross hedges or wire fencing. Infantry in masses is an ideal target for efficient artillery, and in scattered bodies affords opportunities for attack by well-handled cavalry. The just application of the ideas contained in these few sentences to the varying stages of a combat is no mean task for a cultured student.

One of many difficulties encountered in war is the lack of accurate information. Any one man's view of details spread over large areas of country is extremely limited; and even with the greatest precautions against unreality, a commander's information is vastly more accurate over the extended units of his mimic force at kriegspiel, than when the forces so represented are men, horses, and machines, wrapped in dust or in smoke, and partially obscured by accidents of the ground too insignificant for reproduction on the map. Yet whilst accepting a certain unreality in kriegspiel, and to a less degree in field manœuvres, both by one and the other military training and education are furthered. The framing of orders follows identical lines at kriegspiel, at manœuvres, or in war. The movement of troops in mimic warfare should be brought to harmonize as far as possible with reality. The study of past campaigns, laboriously traced through maps and records, matured the prowess of commanders of such various calibres as Frederick, Napoleon, Wellington, and von Moltke. The reproduction on the kriegspiel map of the strategy of Napoleon's campaigns in 1796 and in 1815 shows a similarity of design. In either case he commanded a central force acting against the inner flanks of allies, whose base-communications were divergent. In 1796 the Piedmontese and the Austrians conformed to Napoleon's preconceived idea and retired eccentrically. In the Waterloo campaign, Blucher, with loyal heroism, abandoned his own communication and rallied to his ally. War here differentiated the efficiency gained or lost by good or bad moral force, but it is difficult on paper to reproduce similar conditions. The paralysing effect caused by a flanking assault on an attacking force may be indicated at kriegspiel, yet it is impossible to gauge theoretically the amount of its efficacy. A force in position to threaten communications may be placed on the map, but Osman at Plevna delayed the Russian advance to an extent altogether unforeseen. Von Moltke supervised kriegspiel exercises for the general staff of the German army, and printed records exist of various problems he suggested, orders issued by the selected commanders, and finally the searching criticisms by the field-marshal himself. The concentrating march of the armies on Paris was probably analysed in detail between 1866 and 1870, and treated as a strategical problem on the map, but no seer could have prophesied tactical incidents such as the capture and recapture of Le Bourget or the combats on the plateau of Châtillon. It may be stated with confidence that the measured movements of troops over a kriegspiel map, and the necessary drafting of orders, are aids to the acquisition of military proficiency; but directly the contact of important bodies of troops is represented on paper, imagination, not realism, governs the results. (J. B. S.)

Krishnagar, a town of British India, headquarters of Nadia district in Bengal, situated on the left bank of the river Jalangi, connected with Ranaghat, on the Eastern Bengal railway, by a light railway, 20 miles in length, which was opened in 1899. Population (1881), 27,477; (1891), 25,500. It is the residence of the rajah of Nadia. Coloured clay figures are manufactured. The Government college had 83 pupils in 1896–97; there is a collegiate high school, with 194 pupils.

Kristo Das Pal (1838–1884), Indian publicist, was born in Calcutta in 1838, and after receiving an English education at the Oriental Seminary, was appointed assistant secretary to the British Indian Association in 1885. It was an association of Bengal landlords founded about the middle of the 19th century, and numbered among its members some of the most cultured men of the day, such as Raja Radha Kanta Dev, a patron of Sanskrit learning and head of the Orthodox community; Prosonno Kumar Tagore, the most successful lawyer of his time; Ram Gopal Ghosh, the most gifted speaker and most patriotic representative of his countrymen; Debendra Natu Tagore, head of the Brahmo Somaj; Joy Kishen Mukerjea, an able, far-sighted, practical landlord; Digambar Mitra, another clear-headed and influential landlord; Rajendra lal Mitra, the distinguished antiquary and scholar; Mahendra lal Sarkar, favourably known in India for his scientific researches. Three years after his appointment as assistant-secretary, Kristo Das Pal became editor of the *Hindu Patriot*, originally started in 1853 and conducted with ability and zeal by Harish Chandra Mukerji until his death in 1861. When Kristo Das Pal became editor, the journal was transferred by a trust deed in 1862 to some members of the British Indian Association, and henceforth became to some extent an organ of that body. Thus from 1862 Kristo Das Pal had rare opportunities for distinction, and proved his abilities and independence during an eventful career of twenty-two years until his death. Among the publicists who helped and co-operated with him were Maharaja Sir Jotendra Mohan Tagore and Maharaja Sir Narendra Krishna Dev, scions of the two most distinguished houses of Calcutta. In 1863 Kristo Das Pal was appointed justice of the peace and municipal commissioner of Calcutta. In 1872 he was made a member of the Bengal Legislative Council, where his practical good sense and moderation were much appreciated by successive Lieutenant-Governors of Bengal. His opposition, however, to the Calcutta Municipal Bill of 1876, which first recognized the elective system, was attributed to his prejudice in favour of the "classes" against the "masses." In 1883 he was appointed member of the Viceroy's Legislative Council. In the discussions on the Rent Bill, which came up for consideration before the Council, Kristo Das Pal, as secretary to the landlords' association, necessarily took the side of the landlords. He died on 24th July 1884. (R. C. D.)

Krivoi Rog, a town of Russia, government of Kherson, on Ingulets river, near to the station of the same name on the Ekaterinoslav railway, 133 miles north-east of Nikolayev. It is the centre of a district, very rich in metals and various minerals obtained from a narrow stretch of crystalline schists underlying the Tertiary deposits. Iron ores (60 to 70 per cent. of iron), copper ores, colours, brown coal, graphite, slate, and lithographic stone are obtained. Population (1895), 9811.

Krivoscie, a small stretch of barren mountainous country, forming part of the Dinaric alpine region, bounded on the S. by the Bocche di Cattaro, in the Austrian crownland of Dalmatia, and on the N.W., N., and E. by Herzegovina and Montenegro. The district, which is inhabited by Servians, has been in the possession of Austria since 1814. It was the scene of two revolts (in 1869 and from December 1881 to March 1882), consequent upon the efforts of the Austrian Government to enforce military service upon the inhabitants. A number of forts have now been erected in the district. Population (1890), 27,947; (1900), 29,979, including a garrison of 2079.

Kronstadt (Hungarian, *Brassó*), a corporate town of Hungary and capital of a county, in the extreme south-east of Transylvania, just below the Tömös Pass in the Carpathians. Population (1891), 30,739; (1900), 36,646, of whom about 12,000 were Hungarians, the others in about equal proportion Germans and Wallachians. It is an important industrial and commercial town; its trade, chiefly with Rumania and the Balkan states, is very considerable, and it has manufactures of clothes and sausages, besides distilleries and petroleum refineries. On the top of the Romantic Mount Cenk (3000 feet), near the town, stands one of the monuments, erected (in 1896) at several parts of the country, to commemorate the millennium of the Hungarian state.

Kruger, Stephanus Johannes Paulus (1825-——), formerly President of the Transvaal Republic, was born in Colesberg, Cape Colony, on 10th October 1825. The founder of the Kruger family appears to have been a German named Jacob Kruger, who in 1713 was sent with others by the Dutch East India Company to the Cape. Mr Kruger's father was Caspar Jan Hendrick Kruger, who was born in 1796, and whose wife bore the name of Steyn. At the age of ten Paul Kruger—as he afterwards came to be known—accompanied his parents in the migration, known as the Great Trek, from the Cape Colony to the territories north of the Orange in the years 1835–40 (see South Africa). From boyhood his life was one of adventure. Brought up on the borderland between civilization and barbarism, constantly trekking, fighting, and hunting, his education was necessarily of the most primitive character. He learnt to read and to write, and was taught the narrowest form of Dutch Presbyterianism. His literature was almost confined to the Bible, and the Old Testament was preferred to the New. It is related of Mr Kruger, as indeed it has been said of Piet Retief and others of the early Boer leaders, that he believed himself the object of special Divine guidance. At about the age of twenty-five he is said to have disappeared into the veldt, where he remained alone for several days, under the influence of deep religious fervour. During this sojourn in the wilderness Mr Kruger stated that he had been especially favoured by God, who had communed with and inspired him. Throughout his life he professed this faith in God's will and guidance, and much of his influence over his followers is attributable to their belief in his sincerity and in his enjoyment of Divine favour. The Dutch Reformed Church in the Transvaal, pervaded by a spirit and faith not unlike those which distinguished the Covenanters, was divided in the early days into three sects. Of these the narrowest, most puritanical, and most bigoted was the Dopper sect to which Mr Kruger belonged. His Dopper following was always unswerving in its support, and at all critical times in the internal quarrels of the state rallied round him. The charge of hypocrisy, frequently made against Mr Kruger—if by this charge is meant the mere juggling with religion for purely political ends—does not appear entirely just. The subordination of reason to a sense of superstitious fanaticism is the keynote of his character, and largely the explanation of his life. Where faith is so profound as to believe the Divine guidance all, and the individual intelligence *nil*, a man is able to persuade himself that any course he chooses to take is the one he is directed to take. Where bigotry is so blind, reason is but dust in the balance. At the same time there have been incidents in Mr Kruger's life which but ill conform with any Biblical standard he might choose to adopt or feel imposed upon him. Even van Oordt, his eloquent historian and apologist, is cognizant of this fact.

At the age of seventeen Paul found himself an Assistant Field Cornet, at twenty he was Field Cornet, and at twenty-seven Commandant in an expedition against a native chief Sechele. In 1853 he took part in another expedition against Montsioa. When not fighting natives in those early days Mr Kruger was engaged in distant hunting excursions which took him as far north as the Zambezi. In 1852 the Transvaal secured the recognition of its independence from Great Britain in the Sand River Convention. For twenty years after this date the condition of the country was one bordering upon anarchy, and into the faction strife which was continually going on Mr Kruger freely entered (see Transvaal). In 1857 he joined Pretorius in a conspiracy for abolishing the district governments in the Transvaal and substituting one central government. What was styled a Representative Assembly was summoned at Potchefstroom in order to arrange a new constitution. At the same time Pretorius, accompanied by Commandant Paul Kruger, led an expedition into the Free State, where, with the help of a malcontent faction within its borders, they hoped to overthrow the Free State Government and compel a federation between the two countries. The invading commando was met on the Rhenoster river by President Boshof, in command of the Free State forces. Finding that even in the Transvaal his action against the Free State had excited the strongest resentment, and that General Schoeman was coming down from Zoutpansberg to assist President Boshof, Pretorius decided to withdraw. Commandant Kruger then bore a flag of truce to President Boshof and arranged terms of peace, which included an apology from the Pretorius party for the invasion. The blackest incident in connexion with this invasion is the fact that the Pretorius and Kruger party had actually sent emissaries to Basutoland to induce the Basutos to rise and harass the Free State forces behind, while they were attacking them in front.

From this time forward Mr Kruger's life is so intimately bound up with the history of his country, and even in later years of South Africa, that a study of that history is essential to an understanding of it (see Transvaal and South Africa). The years which followed the abortive invasion of the Free State in 1857 were years of continual unrest and faction strife in the Transvaal. In this strife Mr Kruger played a leading part, and showed very little scruple or broad patriotism so long as his party might prevail. In 1864, when Pretorius was president, Kruger was elected commandant-general of the forces of the Transvaal. In 1871 a boundary dispute arose with the British Government, which was settled by the Keate award. The decision caused so much discontent in the Transvaal that it brought about the downfall of President Pretorius and his party; and Burgers, an educated Dutch minister, resident in Cape Colony, was elected to succeed him. During the term of Burgers's Presidency, which terminated with the British annexation in 1877, Kruger appeared to great disadvantage. Instead of loyally supporting the President in the difficult task of reducing chaos to order and establishing some sort of civilized government in the Transvaal, he did everything in his power to undermine his authority, even going so far as to urge the Boers to pay no taxes while Burgers was in office. In fact, there is no question that the faction of which he was a prominent member was chiefly responsible for bringing about that *impasse* in the government of the country which drew such bitter protest from Burgers and terminated in the annexation by the British in 1877. At this period of Transvaal history it is impossible to trace any true patriotism in the action of the majority of the inhabitants. The one idea of Kruger and his faction was to oust Burgers from office on any pretext, and, if possible, to put Kruger in his place. When the downfall of Burgers was assured and annexation offered itself as the alternative resulting from his downfall, it is true that Mr Kruger opposed it. But matters had gone too far. Annexation became an accomplished fact, and Mr Kruger accepted paid office under the British Government. He continued, however, so openly to agitate for the retrocession of the country, accompanying two deputations to England, that Sir Theophilus Shepstone, the British administrator, dismissed him from his service. In 1881 the Boer rebellion occurred, and Kruger was one of the famous triumvirate, of which General Joubert and Pretorius were the other members, who, after Majuba, negotiated the terms of peace on which the Pretoria Convention of 1881 was subsequently drafted. In 1883 he was elected President of the Transvaal, receiving 3431 votes as against 1171 recorded for Joubert.

Paul Kruger.
(From a photograph by Elliott and Fry, London.)

In November 1883 President Kruger again visited England, this time for the purpose of getting another Convention. The visit was successful, the London Convention, which for years was a subject of subsequent controversy, being granted by Lord Derby in 1884 on behalf of Her Majesty's Government. The government of the Transvaal being once more in the hands of the Boers, the country rapidly drifted towards that state of national bankruptcy from which it had only been saved by annexation in 1877. In 1886, the year in which the Rand mines were discovered, President Kruger was by no means a popular man even among his own followers; as an administrator of internal affairs he had shown himself grossly incompetent, and it was only the specious success of his negotiations with the British Government which had retained him any measure of support. In 1888 he was elected President for a second term of office. In 1889 Dr Leyds, a young Hollander, was appointed state secretary, and the system of state monopolies around which so much corruption grew up was soon in full course of development. The principle of government monopoly in trade being thus established, President Kruger now turned his attention to the further securing of Boer political monopoly. The Uitlanders were increasing in numbers, as well as providing the state with a revenue. In 1890, 1891–92, and 1894 the franchise law (which at the time of the Convention was on a liberal basis) was so modified that all Uitlanders were practically excluded altogether. In 1893 Mr Kruger had to face a third Presidential election, and on this occasion the feeling in the country was so strong that it was fully anticipated that his more liberal opponent, General Joubert, would be elected. The votes actually returned were 7911 for Kruger and 7246 for Joubert. Before the Presidential election Mr Kruger had taken care to conciliate the Volksraad members, as well as to see that at all the Volksraad elections, which occurred shortly before the Presidential election, his supporters were returned, or if not returned, that his opponents were objected to on some trivial pretext, and by this means prevented from actually sitting in the Volksraad until the Presidential election was over. At this time the Hollander and *concessionnaire* influence had become a strong power in the state, and was all in favour of President Kruger. In spite of these facts, the election was nominally a close one, and there was a general belief that Joubert was elected. General Joubert accused the Government of tampering with the returns, and appealed to the Volksraad. The appeal, however, was fruitless. The action taken by President Kruger at this election, and his previous actions in ousting President Burgers and in absolutely excluding all Uitlanders from the franchise, all show that at any cost, in his opinion, the Government must remain a close corporation, and that while he lived he must remain at the head of it. It was a blind, reckless, and unscrupulous policy, which inevitably led to disaster.

After the Jameson Raid in December 1895 President Kruger put off Sir Hercules Robinson, as well as the reformers in Johannesburg, with promises that the Uitlander grievances should be seriously considered and dealt with. But no sign of keeping this promise was given.

In 1898 Mr Kruger was elected President of the Transvaal for the fourth and last time. In 1899 relations between the Transvaal and Great Britain had become so strained that a conference was arranged at Bloemfontein between Sir Alfred Milner, the High Commissioner, and President Kruger. Mr Kruger was true to his principles. At every juncture in his life his object had been to gain for himself and his own narrow policy everything that he could, while conceding nothing in return. It was for this reason that he invariably failed to come to any arrangement with Brand while the latter was President of the Free State. In all his negotiations with Great Britain after 1881 Mr Kruger had invariably gained something. All the energies of the Boer President were centred on his intrigues for obtaining complete independence of Great Britain, and for ignoring the whole spirit, if not the letter, of the Conventions. In 1889, the very year following President Brand's death, he was able to make a treaty with President Reitz, his successor, which bound each of the Boer Republics to assist the other in case its independence was menaced, unless the quarrel could be shown to be an unjust one on the part of the state so menaced. In effect it bound the Free State to share all the hazardous risk of the reckless anti-British Transvaal policy, without the Free State itself receiving anything in return. Mr Kruger thus achieved one of the objects of his life. With such a history of apparent success, it is not to be wondered at that the Transvaal President came to

Bloemfontein to meet Sir Alfred Milner in no mood for concession. After hearing the very moderate franchise proposal of Sir Alfred Milner, he made his counter proposals. These included a treaty of arbitration, and the incorporation of Swaziland and Zambaansland (which would have included a piece of the coast-line) with the Transvaal. The negotiations fell through, as in the temper in which President Kruger entered upon them they were bound to do. It is true that he made an ostensible offer of concession on the franchise question, but even that proposal was made dependent on so many conditions that it was a palpable sham. Every proposition which Sir Alfred Milner made was met by the objection that it threatened the independence of the Transvaal. This retort was President Kruger's rallying cry whenever he found himself in the least degree pressed, either from within or without the state. To admit Uitlanders to the franchise, to no matter how moderate a degree, would destroy the independence of the state; and the same argument had been used in 1897 to rouse the extreme section of his followers into opposition to the report of the Industrial Commission (a commission of Mr Kruger's own nominees), who reported in a sense adverse to his exclusive and monopolist policy. In October 1899, after a long and fruitless correspondence with the British Government, war with Great Britain was ushered in by an ultimatum from the Transvaal. Immediately after the ultimatum Natal and the Cape Colony were invaded by the Boers both of the Transvaal and the Free State. Yet one of the most memorable utterances made by Mr Kruger at the Bloemfontein Conference was couched in the following terms: "We follow out what God says, 'Accursed be he that removeth his neighbour's landmark.' As long as your Excellency lives you will see that we shall never be the attacking party on another man's land." The course of the war that followed is described under TRANSVAAL. In 1900, Bloemfontein and Pretoria having been occupied by British troops, Mr Kruger fled the country and proceeded to Europe, where he endeavoured to induce the European Powers to intervene on his behalf, but without success. Mr Kruger was thrice married, and had a large family; his second wife died in 1891, his third wife in 1901. When he fled to Europe he left his wife in Lord Roberts's custody at Pretoria, but she gradually failed, and died there. It is recorded that when the statue to President Kruger at Pretoria was erected, it was by Mrs Kruger's wish that the hat was left open at the top, in order that the rainwater might collect there for the birds to drink.

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Krumau, or KRUMMAU, an old town in Bohemia, on the Moldau, 14 miles south-west by south of Budweis, marking the northern limit of the German border of Bohemia at this point. A château of Prince Schwarzenberg, with interesting archives, occupies a prominent position on a rock overlooking the river. The town has a considerable inland trade and an important textile industry (linen yarn, cloth, and cashmeres), steam sawmills and cornmills, limekilns and breweries, and manufactures paper, cellulose, &c. Population (1890), 8331; (1900), 8673, chiefly Germans.

Krupp, Alfred (1812–1887), German inventor, and founder of the celebrated steel works and gun factory at Essen, was born on 26th April 1812, at that town, where his father, Friedrich Karl Krupp, had set up a small foundry, which, after his death in 1826, was carried on by his widow. Alfred, as the eldest son, found himself compelled, at the age of fourteen, to leave school and take the direction of the works. The prospect was a cheerless one. His father had spent a considerable fortune in the vain attempt to cast steel in large blocks; and, in order to keep the works going at all, the family had to live with the utmost frugality, while the youthful director worked side by side with his workmen by day, and spent great part of the night carrying on the experiments begun by his father. Even so, for the next fifteen years the returns were never more than sufficient to cover the workmen's wages. In spite of all, Krupp never lost confidence in the practicability of his father's schemes. In 1841 his invention of the spoon-roller brought in sufficient money to enable him to enlarge his factory and spend money on casting steel blocks. In 1847 he made his first cannon of cast steel. At the Great Exhibition of 1851 in London he exhibited a 6-pounder cannon made entirely of cast steel, and a solid flawless ingot of steel weighing 2000 ℔, more than twice as much as any previously cast. Krupp's exhibit caused a sensation in the engineering world, and the Essen works at once sprang into fame. In 1851 another successful invention, this time in the making of railway tyres, supplied a profit, which was devoted partly to the enlargement and equipment of the factory, and partly to the execution of his long-cherished scheme—the construction of a breech-loading cannon of cast steel. Krupp himself was strongly convinced of the superiority of breech-loaders to muzzle-loaders, on account of the greater accuracy of firing and the saving of time; but his view did not win general acceptance in Germany till after the Franco-German war, when the army was supplied throughout with Krupp's perfected field-piece. When once the excellence of its work was recognized, the factory developed with amazing rapidity. At the time of Alfred Krupp's death (on 14th July 1887) he employed 45,000 men, and, including those in works outside Essen, his rule extended over no less than 75,000 persons. To all these he performed the part of a father. Special "colonies" were built for the employés and their families, with parks, libraries, schools, and recreation grounds, while the widows' and orphans' fund and other philanthropic and benefit schemes ensured the men and their families against anxiety in case of illness or death. After a time the fame of the Essen works attracted large numbers of visitors, and princes vied with one another in conferring distinctions on the "Cannon King," the informal title which alone their owner cared to bear. He declined to be ennobled, for he gloried in the name his own work had made celebrated; thirty-five Orders had been bestowed upon him, but he never wore one. After his death the works were carried on by his only son, Friedrich Alfred, who continued his father's beneficent rule and the inherited tradition of conscientious work and flawless material. (A. Z.)

Kuba, Old (*Kudial-kaleh*), a district town of Russia, Transcaucasia, government and 95 miles north-west of Baku, on the route to Derbent, on Kudial-chai river; altitude, 1990 feet. It was founded in the 17th century, and annexed to Russia in 1806. The chief occupation of the inhabitants is the silk-worm culture and the fabrication of plain silk stuffs and carpets. Population (1897), 15,346.

Kubañ (*Kubanskaya Oblast*), a province of Russia, North Caucasia, having the Sea of Azov on the W., the province of Don Cossacks on the N., Stavropol and Terek on the E., and Kutais and Tchernomorsk on the S. and S.W. It thus contains the low and marshy lowlands on the Sea of Azov, the western portion of the fertile plains of northern Caucasia, and the northern slopes of the Caucasus range from its north-west extremity to the Elbruz. The main range, which reaches a height of 9200 feet in the group of peaks of Oshten, and gradually rises to 18,572 feet in the Elbruz, is thickly snow-clad between these two peaks, and very few passes lead from the province of Kubañ to the Black Sea littoral. (See CAUCASUS.) In its southern parts the province includes the parallel ranges known as the Black Mountains, from 3000 to 6000 feet high, intersected by gorges growing deeper and wilder as one approaches the main range. Owing to a relatively wet climate and a profusion of rivers, these mountains are thickly clothed with woods, under the shadow of which a thick underwood of rhododendrons, "Caucasian palms" (*Buxus sempervirens*), ivy, clematis, &c., develops, so as to render the forests almost impassable. They cover altogether nearly 20 per cent. of the aggregate area. Wide treeless plains, from 1000 to 2000 feet high, spread farther north, and are profusely watered by the many tributaries and sub-tributaries of the Kubañ—Little and Great Zelenchuk, Urup, Laba, Pshish—rushing through narrow gorges from the Caucasus range, and spreading fertility in the plains. In its lower course the Kubañ, which is a river nearly 500 miles long, as it approaches the Sea of Azov subdivides into a labyrinth of branches, and enters both the Sea of Azov (main branch in the 15th century) and the Black Sea, forming a wide delta, low, covered with rushes, peopled by boars, and very unhealthy. The same character is maintained by the low plains in the east of the Azov Sea, covered with numerous semi-stagnant lakes. Fishing is the chief wealth of this part of the province, the Achueff fisheries on the Kubañ being famous. Malaria is the enemy of these regions, and is specially deadly on the Tamañ peninsula, as also along the left bank of the lower and middle Kubañ.

There is considerable mineral wealth in the province. Coal is found on the Kubañ and its tributaries, but its extraction is still insignificant (less than 10,000 tons per annum). Naphtha wells exist in the district of Maikop, but the best are in the Tamañ peninsula, where they cover an area of 570 square miles. The yearly extraction of naphtha (begun in 1866) reaches now about 50,000 tons. Iron ores, silver, and zinc are found; alabaster is extracted, as also some salt, soda, and "Epsom" salt. The best mineral waters are at Psekup and Tamañ, where there are also numbers of mud volcanoes, which appear of all sizes, ranging from small hillocks to hills 175 feet and 365 feet high (Aktaniz, or Kukuoba), and even higher. They all throw out mud, stones, roots of plants, &c. The soil is very fertile in the plains, parts of which are covered with black earth and are being rapidly populated.

The population reached 1,926,323 in 1897, of whom 1,788,622 are Russians, 8000 Poles, 13,095 Armenians, and 11,410 Germans. There were 945,873 women, and only 156,486 lived in towns. The aborigines were represented by 103,516 Cherkesses and 5000 Nogai Tatars. The Cherkesses or Adyghe (Kabardians, Besleneis, Abadzekhs, &c.), who formerly occupied the mountain valleys, were compelled, after the conquest in 1861, either to settle in the flat land or to emigrate, those who refused to move being driven across the mountains to the Black Sea coast. Most of them (nearly 200,000) emigrated to Turkey, where they formed the Bashi-bazouks. Peasants from the interior provinces of Russia occupied the plains of the Kubañ, and now they number over 1,000,000, while the Kubañ Cossacks number 804,372 (405,428 women).

The area under crops has rapidly extended of late, the cereal crop of 1897 being 6,729,000 quarters (8,000,000 in 1894). Wheat is by far the chief crop (nearly three-quarters of the total area under crops are under wheat); rye, oats, barley, millet, Indian corn, some flax and potatoes, as also tobacco (133,000 cwts.), are also grown. Agricultural machinery is largely resorted to, and the province becomes a reserve granary for Russia. There were in 1894, 188,700 horses, 983,600 horned cattle, 1,213,000 sheep, and 25,600 goats. Bee-keeping is general, and gardening and vine-growing are rapidly spreading. Fishing in the Black Sea and Azov Sea, as also in the Kubañ, is important. Industrial pursuits give occupation to a little over 21,000 people (yearly returns about £1,200,000 only).

Two main lines of railway intersect the province, one running north-west to south-east, from Rostoff to Vladikavkaz, and another starting from the former south-westwards to Novorossiysk.

Schools have been introduced since 1863, and there were in 1897, besides the gymnasia in the chief towns, 364 primary schools (many having model gardens or farms), with 31,244 pupils, and 435 church schools (15,600 pupils). The province is divided into 7 districts (*otdyels*), the chief towns of which are Ekaterinodar, capital of the province (65,697), Anapa (6676), Armavir, chief town of Labinsk (6388), Batalpashinsk (5866), Maikop (34,191), Temryuk (14,476), and Yeisk (35,446). The territory of the Kubañ Cossacks (see COSSACKS) is divided into 11 military districts. (P. A. K.)

Kuchinoerabujima, an island belonging to Japan, measuring 8 miles in length by 2½ in breadth, and lying to the south of Kiushiu, in 30° 3′ N. and 130° 10′ E. Its highest peak, Shindake, measures 2313 feet.

Kuenen, Abraham (1828–1891), Dutch theologian, the son of an apothecary, was born on 14th September 1828, at Haarlem, where he was educated at the primary school and gymnasium. On his father's death, which took place before the boy was fifteen, it became necessary for him to leave school and take a humble place in the business. Happily old friends, who recognized the lad's ability, arranged to pay for his education first at the gymnasium and afterwards at the University of Leyden, where he was destined to spend the rest of his life. He studied theology, and won his doctor's degree by an edition of thirty-four chapters of Genesis from the Arabic version of the Samaritan Pentateuch. In 1853 he became "extraordinary" professor of theology at Leyden, and in 1855, when he became full professor, he married a daughter of Muurling, one of the founders of the Groningen school, which made the first pronounced breach with Calvinistic theology in the Reformed Church of Holland. Kuenen himself soon became one of the main supports of the modern theology, of which Scholten and Opzoomen were the chief founders, and of which Leyden became the headquarters. His first great work, a *Historico-Critical Introduction to the Old Testament*, followed the lines of the dominant school of Ewald. But before long he came under the influence of Colenso, and learned to regard the prophetic narrative of Genesis, Exodus, and Numbers as older than what was by the Germans denominated "Grundschrift" (*Book of Origins*). In 1869–70 he published *The Religion of Israel*. This was followed in 1875 by *A Study of Hebrew Prophecy*, largely polemical in its scope, and specially directed against those who rest theological dogmas on the fulfilment of prophecy. In 1882 Kuenen came to England to deliver a course of Hibbert lectures on Natural and Universal Religion; in the following year he presided at the Congress of Orientalists held at Leyden. In 1886 his volume on the Hexateuch was published in England. He died at Leyden on 10th December 1891. Kuenen was also the author of numerous articles, papers, and reviews; a series on the Hexateuch, which appeared in the *Theologisch Tijdschrift*, of which he was joint-editor, is one of the finest products of modern criticism. A distinguishing characteristic of the man was his great courtesy, which never failed him even in the most animated controversy, and which set the tone in Holland, where the polemical acrimony so common in many countries is little known. Kuenen was a great admirer of England, which he visited three times, once to meet Colenso, another time as a delegate to the British and Foreign Unitarian Association, and the last time in 1882, when he lectured at London and Oxford. Several of his works have been translated into English by Mr Philip Wicksteed. (A. Z.)

Kuen-lun, a geographical term which was used at a time when the geography of Central Asia was almost totally unknown, and which is still partly retained. The ancients used to imagine an immense range of mountains crossing Asia from west to east, on the parallel of the island of Rhodos, and separating the rivers which flow towards the Arctic Ocean from those which flow southwards. Humboldt, influenced by his own and Klaproth's studies of Chinese sources, represented Asia as covered with a network of mountain ranges running along the parallels and the meridians; and among the former he represented the Kuen-lun as a sort of backbone of Asia, "the highest and longest mountain range on the earth," crossing Asia from west to east in its middle parts. Ritter, guided by his keen geographical genius, saw in the Kuen-lun a northern border-ridge of the Tibetan plateau which, together with the Tian-shan mountains, nearly parallel to it, encloses the "high valley" (*Hochthal*) or plateau of the Western Gobi or Chinese Turkestan (*Asien*, ii. 409); farther east, he added, following Klaproth, it penetrates as a high snow-clad range between the upper Hoang-ho and the sources of the Yang-tse-kiang. This was the right conception. However—following Humboldt—the geographers in the middle of the 19th century, such as Berghaus in his *Physikalischer Atlas* (edition of 1852: "Bergketten von Asien und Europa"), traced a succession of mountain ranges running west to east, from the Bosphorus to the 100th degree of longitude. This line passed along the south coast of the Black Sea through Asia Minor, the Anti-Caucasus, and the Kopet-dagh, which were connected farther east, by hypothetical ranges traced across Afghanistan and the Pamirs (*q.v.*), with the northern border ranges of the Tibetan plateau (Russian range, Altyn-tagh, and Nan-shan highlands of modern maps); and still farther east Berghaus continued it, though not without some hesitation (see Text, *Geologie*, p. 4), in the region of the sources of the Blue river. The "Kuen-lun Oneüta or Kulkun" was thus a high range running from the Pamir to the sources of the Ya-long river, as a sort of continuation of a similar range running from the Pamir to the Bosphorus. Richthofen, in his *China*, vol. i., 1876, made a notable change in this representation of the Kuen-lun. The northern border range of the Tibetan plateau (which exists in reality, as is now known, as Russkiy Range and Altyn-tagh) did not appear on his map, and the Kuen-lun was represented as a complex system of numerous parallel ranges, all running along slightly curved lines almost west to east (crossing the 35th parallel under an angle of about 15°), from the Pamir plateau to the 115th meridian. Richthofen thus gave an orographic picture far more remote from reality—such as we now know it—than even the picture given in 1852 by Berghaus.

Humboldt's broad generalizations, notwithstanding their hypothetical character, and Ritter's far more correct inductions, based on a careful description, greatly stimulated research in Central Asia; and owing to the investigations of the Pundits, Carey, Dalgleish, Rockhill, Littledale, the prince of Orleans, and Bonvalot, Dutreuil-de-Rhins in Central Asia, Richthofen and Szecheny in the Far East, Bower and Thorold, and especially the series of Russian expeditions inaugurated by Prjevalsky and continued by Pyevtsoff, Roborovsky, and Kozloff, Potanin, the brothers Grum-Grzimailo, Grombchevskiy, Bogdanovich, Obrucheff, and Skassi, we are now able to construct a more or less correct map of the region over which the Kuen-lun used to be traced. It appears that ranges of mountains of very different geographical aspect and origin have been huddled together by early geographers under the general name of Kuen-lun, which name is now restricted on modern maps (" Asien," in Stieler's Atlas, the maps of the Russian general staff) to the northern border ranges of the Tibetan plateau—thus including the Keriya range in the meridian of Khotan, the Russkiy Khrebet, and the Altyn-tagh (or Astyn-tagh).

As to the partially explored highlands around the sources of the Hoang-ho, the region which extends farther east to the 110th meridian, the short ranges Min-shan, Hsi-king-shan, and Tsin-ling-shan, represented by Wegener as continuing the Kuen-lun beyond the 104th meridian, in accordance with Richthofen's views—the whole region has assumed a quite different aspect since the surveys of the Russian explorers of this region have become known. Instead of these ranges we see the escarpments of the south Mongolian plateau facing the plains of China, and running in a north-westerly direction to meet the escarpments of In-shan and the Great Khingan (*q.v.*); while in the upper courses of the Hoang-ho, the Yang-tse-kiang, and the Mekong we find three vast ranges—Burkhan Budha, and two as yet unnamed—which run distinctly from the north-west to the south-east, between and parallel to these three rivers, as appears from the last expedition of Kozloff.

It may also be added that modern exploration has given a quite different aspect to the mountains of Western Asia as well. Thus we see the mighty Hindu Kush running south-west to north-east to join the Pamirs, and (instead of Berghaus's Manish Koh and Korgan) we have the plateau of Afghanistan fringed and intersected by ranges having the same south-west to north-east direction; the Kopet-dagh appears as the border range of the Iran plateau running north-west to south-east, and the Elburz and the Anti-Caucasus escarpments have the same direction; while the Pontic range at the south-east corner of the Black Sea runs south-west to north-east to join the main Caucasus range (see CAUCASUS). Thus instead of a supposed west-to-east direction for all these mountains, we find two distinct directions, south-west to north-east, and north-west to south-east, or west-north-west to east-south-east, of which—if a suggestion by analogy be permitted—the latter would be of a much younger (Secondary and Tertiary) origin than the former, as they have been shown to be in the Tian-shan by Mushketoff.

The mountain ranges which are found in Central Asia in about the 36th degree of latitude, between the Pamir plateau and the 95th degree of longitude, and which were formerly described under the vague name of Kuen-lun, belong to several quite distinct systems of mountains. It is now known that the mountains which limit the Pamirs on the east—Kashgar mountains, Sary-kol—have the character of a formidable border range, which goes down on the one side to the high plains (3900 to 4500 feet) of Eastern Turkestan, but on the other, or south-western side, has its foot on the high Pamir swelling 10,500 to 13,000 feet above sea-level. These mountain ranges have a definite direction from north-west to south-east. They rise far above the snow-line, which lies at a level of from 18,000 to 20,000 feet, and reach their highest point in the Muztagh-ata massive, which consists of gneisses and granites, and they give origin to several glaciers, which descend to the 13,000 feet level. One, and south of the Muztagh-ata two, parallel snow-clad ranges run in the same direction from 39° 20′ to 36° 30′ N., meeting there the north-eastern end of the Hindu Kush, and giving origin to the Kyzyl-su, the Yarkand-daria, and the Raskem-daria. The upper parts of these rivers are now known to flow in longitudinal valleys at the south-west foot of the above ranges until they pierce them, to escape into Kashgaria. The few passes across these mountains lie at heights of from 14,800 to 16,340 feet (Kara-tash). Under the name of Chung-kyr, these mountains, retaining still their south-easterly direction, reach 78° 30′ long. The *Muz-tagh* range (between the Shimshal and the upper Raskem), beginning in 37° N., runs in the same direction, parallel to them, but nearer to the Himalaya (see map of Kanjut, the Raskem, and the Sary-kol by the Russian general staff). On the eastern slopes of the Kashgar mountains the Russian geologist, Bogdanovich found the same red rocks with marine fossils which Stoliczka considered in 1874 as belonging to the Triassic age, though they proved to be Upper Devonian (corals, *Stromatoporæ*, *Bryozoæ*, *Atrypa reticularis*, *A. latilinguis*, and *A. aspera*, *Spirifer Verneuli*, &c.). This important discovery settles also the age of the fossiliferous rocks which Stoliczka found farther south in the Kilian mountains at the issue from the Sanju pass. They also must be Devonian.

From 78° 30′ E. to 51° E. a range of mountains—the Kilian, or the Khotan, or Keriya mountains—runs in a west-north-west to east-south-east direction, representing a mighty snow-clad border ridge, of which the northern foot rests on the high plains of East Turkestan, 4300 to 4500 feet, while its southern, or rather south-south-west foot, lies on the shoulder of the north-west Tibetan plateau, 15,000 to 16,500 feet. It is in this range that Stoliczka found, at an altitude of nearly 6000 feet, the *Gryphea* fossils which he considered Triassic, and upon which such wide speculations about a Central Asian Mediterranean were based later. They belonged, however, to the Upper Devonian age (Bogdanovich). The passes through these mountains rise but a few hundred feet above the high plains of Tibet, and the range has more the character of an escarpment than of a true mountain-chain. The Muz-tagh continues to run nearly parallel to it from north-west to south-east, 100 miles farther to the south-west, raising its peaks to heights of 24,350 to 28,870 feet, and ending on the Tibetan plateau about the 79th meridian. It is to this part of the old Kuen-lun (the Kilian, Khotan, and Keriya mountains) that the name of Kuen-lun is now restricted on many modern maps.

The next division of the North Tibetan border range, which faces East Turkestan, has a quite different direction, namely, from south-west to north-east, which direction becomes west-south-west to east-north-east beyond the 89th meridian. Prjevalsky has named these mountains *Russian Range* (Russkiy Khrebet; Ak-kar-chekyl-taghom), while the eastern portion of the same border range is known as the *Altyn-tagh*, or, more properly, Astyn-tagh, according to Bogdanovich; however, the former name is more widely used by cartographers. The Russian range consists mostly of two parallel ranges, one of which is covered with snow. Its north-western foot is in East Turkestan, at an altitude of from 4700 (Keriya) to 4100 feet (Cherchen oasis), while its other foot stands on the inconceivably dreary, stony deserts of the Tibetan plateau, which have an altitude equal to that of high European mountains, *i.e.*, about 16,000 feet. In 86° E. a range named Akka-tagh, and, farther east, Prjevalsky's range, runs nearly due east until it strikes the Jin-ri Peak, or Monomakh's Crown (20,000 feet), in the Columbus ridge, which crosses the Tibetan plateau from north-west to south-east.

A longitudinal valley separates the Russian range from the western end of the Altyn or Astyn-tagh, which decreases in altitude (11,000 to 9300 feet) beyond 92° E. It fringes the Tsaidam plateau, which is only 8000 to 9500 feet high, and consequently lower than the preceding portion of the Tibetan plateau. From this latter the Tsaidam plain is separated by the Tsaidam, Columbus, Marco-Polo, Garynga, and Torai mountains, all running north-west to south-east.

The *Tibetan plateau* is intersected in fact by several ranges of mountains, which run either south-west to north-east or north-west to south-east, and thus divide it into rhomboidal divisions, having something of the shape of Bohemia, though on a much larger scale, and representing, so far as our present knowledge goes, terraces, at various altitudes, of these high and massive swellings of the earth's crust. The Tsaidam (or Chaidam) has also that rhomboidal shape. To a great extent it is the bottom of an immense interior lake, now covered with clayey and salty deposit.

The *Nan-shan Highlands* limit the Tsaidam on the north-east. They embrace a territory 380 miles long and 260 miles wide (about 99,000 square miles), entirely filled with parallel mountain ranges all running from the north-west to the south-east. Plains and plain-like longitudinal valleys, having their flat bottoms at altitudes of 12,000 to 14,000 feet (occasionally 11,150 feet, and 9200 to 9900 at the south-western border) and interspersed with lakes (Kuku-nor, 10,500 feet; Khara-nor, 13,280 feet, and several small ones), fill up the space between these mountain ranges. In the south-east the Nan-shan highlands reach the highlands of the Chinese province of Kan-su, and near the sharp bend of the Hoang-ho at Si-ang-fu (province Shen-si) they meet the escarpments by which the great Khingan and the Su-Shan are continued, and by which the Mongolian plateau sinks down to the lowlands of China. On the north-east the Nan-shan highlands have their foot on the level—about 4000 feet on the average—of the Mongolian plateau, *i.e.*, in the Ala-shan. On the north-west they are fringed by a border range, the Da-sue-shan, which is a continuation of the Altyn-tagh, from 12,200 to 13,000 feet high in its passes, and pierced by several rivers flowing to Lake Khalachi. This border range, which continues on to the 97th meridian, separates the Nan-shan from the plains of the Bei-shan (see MONGOLIA), 4100 to 5000 feet high.

The results of the Russian Tibetan expeditions, combined with those of Szecheny, Michaelis, Loczy, and Rockhill, have revealed the true structure of the Nan-shan highlands. Their south-western borders—that is, the mountains which rise along the north-eastern border of the Tsaidam—consist of short irregular chains, interrupted by large plains, which are sprinkled with lakes, and differ but slightly in altitude from the Tsaidam itself. Next comes a succession of narrow mountain ranges which separate this lower border terrace from the higher one (12,000–13,500 feet). The first mountain range on this higher terrace is Ritter's range, covered in 38° 20′ N. and 96° E. with formidable snow-fields. The passes at both ends of this snow-clad massive lie at altitudes of 15,990 feet and 14,680 feet respectively. The next range is Humboldt's or Ama-surgu range, which runs north-west to south-east from the Altyn-tagh to about 38° N., and is perhaps continued by the southern Kuku-nor range, which reaches the Hoang-ho (7440 feet on the banks of the river) at Gui-de-tin. It includes, in fact, several other parallel ranges—Mushketoff's, Semenoff's, Suess's, Alexander III.'s, Bain-sarlyk, &c.—the mutual relations of which are, however, not yet definitively settled, and consequently Grum-Grzimailo (in his article "Nan-shan" in the Russian *Encyclopædic Dictionary*) is perhaps right in describing this portion of the highlands singly as *Central Nan-shan.*

Small lateral chains of mountains, rising some 2000 feet above the general level of that plateau, and owing their origin to erosion, connect the central Nan-shan with the next parallel ranges, which may be described as *Eastern Nan-shan.* The mutual relations of the latter, as well as the names of its different chains, are equally unsettled. Thus, one of them is named indiscriminately Nan-shan, Richthofen's range, or Momo-shan; while another, which runs parallel to the north-eastern slope of the preceding, is named T'holo-shan, or T'holo-Nan-shan, or northern Tetung. In fact, the region is filled by three different ranges of nearly equal height, all rising above the snow-line in many of their peaks. Finally, there is a range of mountains, about 10,000 feet high, named Lung-shan by Obrucheff, which fringes the north-eastern side of the Hang-chu-fu valley, and belongs also to the Nan-shan system. But the string of oases in the Kan-su province, which stretches between the Lung-shan and the preceding range, lies, however, on the lower level of the Mongolian plateau (4000 to 5000 feet).

Generally speaking, the Nan-shan highlands are a wide region raised to from 12,000 to 14,000 feet above the sea, and intersected by a succession of wild, stony, and partly snow-clad mountains, towering another 4000 to 7000 feet above its surface, and arranged in a system of narrow parallel chains all running north-west to south-east. The chains of mountains are from 8 to 17 miles wide, seldom as much as 35, while the broad, flat valleys between them attain widths of from 20 to 27 miles. As a rule the passes are at an altitude of from 12,000 to 14,000 feet, and the peaks reach from 18,000 to 20,000 feet in the western portion of the highlands, while in the eastern portion they may be about 2000 feet lower. The glaciers also attain a greater development in the western portion of the Nan-shan, but the valleys are dry, and the slopes of both the mountains and the valleys, furrowed by deep ravines, are devoid of vegetation. Good pasture grounds are only found near the streams. The soil is a dry gravel and clay, upon which bushes of *Ephedra*, *Nitraria*, and various *Salsolaceæ* grow wide apart. In the north-eastern Nan-shan, on the contrary, a stream runs in each gorge, and both the mountain slopes and the bottoms of the valleys are clothed with vegetation. Woods of conifers (*Picea obovata*) and deciduous trees—Prjevalsky's poplar, birch, mountain ash, &c., and a variety of bushes—appear everywhere. Higher up, in the picturesque gorges, one finds rhododendrons, willows, *Potentilla fruticosa*, *Spiræœ*, *Loniceeræ*, &c., and the rains must evidently be more copious and better distributed. In the central Nan-shan only the north-eastern slopes are covered with forests. In the south, where the Nan-shan enters the Kan-su province, wide accumulations of loess make their appearance, and it is only the northern slopes of the hills that are clothed with trees.

The largest water basin of the Nan-shan is *Lake Kuku-nor* (altitude about 18,500 feet), which is about 65 miles long and 40 miles wide, and attains in the south a depth of 59 feet. Its water is salt (0·0111 per cent. of salts). It receives the Bukhain-gol and about 25 other streams, but has no outflow. It is closely surrounded by mountains, but good alpine meadows reach its shores and cover a neighbouring hilly plateau. Rain seems to fall upon its shores in much greater abundance than upon the mountains. Numerous animals, especially the wild donkey (*Asinus kiang*) and the antelope (*Antilope Cuvieri*), breed on these meadows, and Tanguts, perhaps also Mongols, graze them with their numerous herds. Two species of fish, belonging to the *Schizopygopsis* and *Diplophysa* genera, are found in its waters. Numbers of eagles (*Haliætus Macei*), gulls (*Larus ichthyætus*, *L. brunneicephalus*), and Indian geese, *Casarca rutila*, and *Podiceps cristatus*, are attracted to its shores; but, probably owing to the lake being frozen from November till the end of March, and to the absence of reeds, few birds visit it during their migrations.

The region situated between 95° and 99° E., as far as lat. 29°, was explored by Kozloff in 1900 and 1901. It appears that south of the Tsaidam the country forms a high plateau, the average level of which lies at 12,000 to 13,000 feet (lower levels are only found in the deeply trenched valley of the Blue River and its tributaries), while four vast snow-clad ridges cross the surface of the plateau from north-west to south-east, reaching in their passes altitudes of 15,500 to 16,000 feet, and lifting their peaks 500 to 600 feet above the passes. The north-western border ridge of this plateau is formed by the Burkhan-budha and the Amne-machin, which confront the Tsaidam, with snow-clad, deeply furrowed peaks, that rise 8000 to 9000 feet above its surface. The other three ridges run due north-west to south-east between the upper courses of the Hoang-ho, the Yang-tse-kiang, the Mekong, and the upper Salween. Farther south-westwards, approaching lat. 29°, we enter a region where the monsoons begin to make their influence felt, and the country assumes more and more the character of an alpine region, with all the differentiations which are characteristic of such regions—this being due to the more pronounced erosion. The valleys are deeply sunk into the plateau, as much as 9000 feet at the confluence of the Blue river and the Sy-chu; and the climate grows much milder down in the valleys, and the vegetation becomes accordingly more varied. In all probability this plateau, with its parallel ranges of mountains, joins some huge but as yet unexplored escarpment which connects the Himalaya with the Great Khingan.

In the case of the so-called Eastern Kuen-lun, it is sufficient to look at the modern maps of the Russian general staff which embody Skassi's surveys and the recent materials (map of the Kan-su expedition, corrected in 1891 in Potanin's work), to see that Richthofen's and Wegener's representations of that region hardly give a correct idea of its real structure. There are no mountains in this region which could be in any way connected with the Kuen-lun proper, *i.e.*, with the *northern* border ridge of the Tibetan plateau. On the contrary, we have from Kalgan to the 104th meridian a succession of terrace escarpments by which the South Mongolian plateau (4000 to 5000 feet of altitude) drops down to the high plains of China, 1000 to 2000 feet, and in these terraces it is impossible not to see a direct continuation of the Great Khingan. Only these terraces, edged by relatively low border ranges along their escarpments, cover here a zone over 200 miles wide (as against 100 miles, or less, in the Great Khingan, north of Peking), and assume more and more a direction east-north-east to west-south-west (east to west in the Tsun-ling escarpment?). However, neither orographically nor geologically can they be connected in any way with the border range which separates Eastern Turkestan from the North Tibetan plateau, and which is the only portion of the old "Kuen-lun" which can now retain that time-honoured name.

Authorities.—Owing to the vagueness of the conceptions attached to the term "Kuen-lun," to give its literature would mean to enumerate all the explorations carried on in Central Asia, Mongolia, and Western China for the last thirty years of the 19th century. A good enumeration of the works published before 1890, and a map of itineraries, will be found in Wegener's *Versuch einer Orographie des Kuen-lun*, Marburg, 1891, but his map is already out of date. The quarto publications of the Russian Geographical Society, describing the expeditions of Prjevalsky, Pyevtsoff, Roborovsky, and Kozloff, the brothers Grum-Grzimailo, Bogdanovich, Obrucheff, Potanin, and Skassi, for the so-called Eastern Kuen-lun, and of Grombchevskiy and Ivanoff for the Pamirs—in fact, all the series of *Izvestia* of the Russian Geographical Society, and of *Petermann's Mittheilungen*, since 1887—must be consulted for the itineraries of the Russian and German travellers and the maps based on their surveys, unaltered by subsequent modifications; and the *Geographical Journal* for the same years, for the same purpose as regards the English travellers. The original reports of the explorations of Sven Hedin, Bonvalot, and the prince of Orleans must be consulted for the travellers of other nationalities. Short indexes of literature will be found also in the articles "Kuen-lun," by Bogdanovich; "Nan-shan," by Grum-Grzimailo, and many others in the Russian *Encyclopædic Dictionary*. (P. A. K.)

Kühne, Willy (1837–1900), German physiologist, was born at Hamburg on 28th March 1837. After attending the gymnasium at Lüneburg, he went to Göttingen, where his master in chemistry was Wöhler and in physiology R. Wagner. Having graduated in 1856, he studied under various famous physiologists, including du Bois-Reymond at Berlin, Claude Bernard in Paris, and Ludwig and Brücke in Vienna. At the end of 1863 he was put in charge of the chemical department of the pathological laboratory at Berlin under Virchow; in 1868 he was appointed professor of physiology at Amsterdam; and in 1871 he was chosen to succeed Helmholtz in the same capacity at Heidelberg, where he died on 10th June 1900. His original work falls into two main groups—the physiology of muscle and nerve, which occupied the earlier years of his life, and the chemistry of digestion, which he began to investigate while at Berlin with Virchow. He was also known for his researches on vision and the chemical changes occurring in the retina under the influence of light. The visual purple, described by Boll in 1876, he attempted to make the basis of a photochemical theory of vision, but though he was able to establish its importance in connexion with vision in light of low intensity, its absence from the retinal area of most distinct vision detracted from the completeness of the theory and precluded its general acceptance.

Kulja (Chinese, *Ili-ho*), a territory in north-west Mongolia, belonging to the Chinese Empire; bounded, according to the treaty of St Petersburg of 1881, on the W. by the Semiryechensk province of Russian Turkestan, on the N. by the Boro-khoro mountains, and on the S. by the mountains Khan-tengri, Muz-art, Terskei, Eshik-bashi, and Narat. It comprises the valleys of the Tekes (middle and lower portion), Kunghes, the Ili as far as the Russian frontier and its tributary, the Kash, with the slopes of the mountains turned towards these rivers. Its area occupies about 19,000 square miles (Grum-Grzimailo).

Physical Features.—The valley of the Kash is about 160 miles long, and is cultivated in its lower parts, while the Boro-khoro mountains are snow-clad in their eastern portion, and fall with very steep slopes to the valley. The Arshan mountains, which separate the Kash from the Kunghes, are lower, but rocky, naked, and difficult of access. The valley of the Kunghes is about 120 miles long; the river flows first in a gorge, then amidst thickets of rushes, and very small portions of its valley are fit for cultivation. The Narat mountains in the south are also very wild, but are covered with forests of deciduous trees (apple-tree, apricot-tree, birch, poplar, &c.), and pine trees. The Tekes flows in the mountains, and pierces narrow gorges. The mountains which separate it from the Kunghes are also snow-clad, while those to the south of it reach 24,000 feet of altitude in Khan-tengri, and are covered with snow and glaciers—the only pass through them being the Muzart. Forests and alpine meadows cover their northern slopes. Agriculture was formerly developed on the Tekes, as is testified by old irrigation canals. The Ili is formed by the junction of the Kunghes with the Tekes, and for 120 miles it flows through Kulja, its valley reaching a width of 50 miles at Horgos-koljat. This valley is famed for its fertility, and is admirably irrigated by canals, part of which, however, fell into decay after 55,000 of the inhabitants migrated to Russian territory in 1881. The climate of this part of the valley is, of course, continental—frosts of −22° F. and heats of 107° F. being experienced—but snow lasts only for one and a half months, and the summer heat is tempered by the proximity of the high mountains. Apricots, peaches, pears, and some vines are grown, as also some cotton-trees near the town of Kulja, where the average yearly temperature is 48·5° F. (January 15°, July 77°). Barley is grown up to an altitude of 6500 feet.

The *population* may number about 125,000, of whom 75,000 are settled and about 50,000 nomads (Grum-Grzimailo). The Taranchis from East Turkestan represent about 40 per cent. of the population; about 40,000 of them left Kulja when the Russian troops evacuated the territory, and the Chinese Government sent some 8000 families from different towns of Kashgaria to take their place. There are, besides, about 20,000 Sibos and Solons, 3500 Kara-kidans, a few Dungans, and more than 10,000 Chinese. The nomads are represented by about 18,000 Kalmyks, and the remainder by Kirghiz. Agriculture is insufficient to satisfy the needs of the population, and food is imported from Semiryechensk. Excellent beds of coal are found in different places, especially about Kulja, but the fairly rich copper ores and silver ores have ceased to be worked.

The *chief towns* are Suidun, capital of the province, and Kulja. The latter (Old Kulja) is on the Ili river, and has about 10,000 inhabitants, chiefly Taranchis. It is one of the chief cities of the region, owing to the importance of its bazaars, and is the seat of the Russian consul and a telegraph station.

History.—Two centuries B.C. the region was occupied by the fair and blue-eyed Ussuns, who were driven away in the 6th century of our era by the northern Huns. Later the Kulja territory became a dependency of Dzungaria. The Uigurs, and in the 12th century the Kara-Kidañs, took possession of it in turn. Tchinghiz Khan conquered Kulja in the 13th century, and the Mongol Khans resided in the valley of the Ili. It is supposed (Grum-Grzimailo) that the Oirats conquered it at the end of the 16th or the beginning of the 17th century; they kept it till 1755, when the Chinese annexed it. During the insurrection of 1864 the Dungans and the Taranchis formed here the Taranchi sultanate, and this led to the occupation of Kulja by the Russians in 1871. Ten years later the territory was restored to China. (P. A. K.)

Kulm, a town of Prussia, province of West Prussia, 33 miles by rail north-north-west of Thorn, on the bank of the Vistula. The existing town walls date from the 13th century. There are large oil-mills, also iron-foundries and machine shops, and manufacture of horse-shoes, as well as an important trade in agricultural produce, including fruit and vegetables. Population (1885), 9975; (1900), 11,079.

Kulmsee, a town in the province of West Prussia, Prussia, 14 miles by rail north of Thorn. It has a fine Roman Catholic cathedral (1251, restored 1422), having been down to 1823 the seat of the see of Kulm. Sugar, butter, and cheese are manufactured. Population (1900), 8987.

Kulp, a village of Transcaucasia, Russia, in the government of Erivan, district Surmalinsk, 2 miles from the Arax river. Close by is the Kulp salt mountain, about 1000 feet high, consisting of beds of clay intermingled with thick layers of rock salt, which has been worked from time immemorial. Regular galleries are cut now in the transparent, horizontal salt layers, from which cubes of about 70 lb weight are extracted to the amount of about 170,000 cwts. every year.

Kum, a small province of Persia, bounded on the N. by the province of Tehran, and on the S. by that of Kashan. It is divided into seven districts, has a population of 45,000 to 50,000, and pays a yearly revenue of about £8000. KUM, the capital, in 34° 39′ N. and 50° 55′ E., has an elevation of 3100 feet. It owes much of its importance to the fact that it contains the tomb of Imam Reza's sister, Fâtmeh, who died there in A.D. 816, and large numbers of pilgrims visit the city during six or seven months of the year. The fixed population is about 20,000. A carriage road 92 miles in length, constructed in 1890–93, connects the city with Tehran. A very fine quality of cotton with a long staple is grown in the surrounding districts.

For full description of province and city, see *Eastern Persian Irak*, London, 1896.

Kumaon, an administrative division of British India, in the North-West Provinces. It consists of a large Himalayan tract, together with a submontane strip called the Tarai or Bhabar. Area, 13,743 square miles; population (1881), 1,046,263; (1891), 1,181,567, showing an increase of nearly 10 per cent.; average density, 85 persons per square mile, ranging from 72 in the mountains to 219 in the Tarai. In 1901 the population was 1,202,130, showing an increase of less than 2 per cent. At the time of the census of 1891 the division was composed of the three districts of Kumaon, Garhwal, and the Tarai; but the two districts of Kumaon and Tarai have since been redistributed and renamed after their headquarters, Naini Tal and Almora. The former district of Kumaon had an area of 7151 square miles; population (1881), 493,641; (1891), 563,181, showing an increase of 14 per cent.; average density, 79 persons per square mile. Kumaon proper, with the Tarai, constituted an old Rajput principality, which became extinct at the beginning of the 19th century. The inhabitants are known as Khasias. The country was annexed after the Gurkha war of 1815, and was governed for seventy years on the non-regulation system by three most successful administrators—Mr Traill, Mr J. H. Batten, and Sir Henry Ramsay. Tea gardens cover an area of about 3000 acres.

Kumta, or COOMPTA, a town of British India, in the South Kanara district of Bombay, on the sea-coast, 40 miles south of Karwar. It has an open roadstead, with a lighthouse and considerable trade. Carving in sandalwood is a speciality. The commercial importance of Kumta has declined since the opening of the Southern Mahratta railway system. Population, 10,713.

Kumyks, a people of Turkish stem in Caucasia, occupying the Kumyk plateau (*Kumykskaya ploskost*) in North Daghestan and South Terek, and numbering (1897) about 92,400. It is supposed that Ptolemy knew them under the name of Kami and Kamaks. Various explorers see in them descendants of the Khazars. Vambéry supposes that they settled in their present quarters during the flourishing period of the Khazar kingdom, in the 8th century. It is certain that some Kabardians also settled later. The Russians built forts in their territory in 1559, and under Peter I. Having long been more civilized than the surrounding Caucasian mountaineers, the Kumyks have always enjoyed some respect among them. The upper terraces of the Kumyk plateau, which the Kumyks occupy, leaving its lower parts to the Nogai Tatars, are very fertile.

Kunar.—The Kunar valley (Khoaspes in the classics) is the southern section of that great river system which reaches from the Hindu Kush to the Kabul river near Jalalabad, and which, under the names of Tarkhun, Chitral, Kashkar, &c., is more extensive than the Kabul basin itself. The lower reaches of the Kunar are wide and comparatively shallow, the river meandering in a multitude of channels through a broad and fairly open valley, well cultivated and fertile, with large flourishing villages and a mixed population of Mohmand and other tribes of Afghan origin. Here the hills to the eastward are comparatively low, though they shut in the valley closely. Beyond them are the Bajaor uplands. To the west are the great mountains of Kafiristan called Kashmund, snow-capped, and running to 14,000 feet of altitude. Amongst them are many wild but beautiful valleys occupied by Kafirs, who are rapidly submitting to Afghan rule. From 20 to 30 miles up the river on its left bank, under the Bajaor hills, are thick clusters of villages, amongst which are the ancient towns of Kunar and Pashat. The latter was visited by the writer in 1895, and the old orange groves and cypress gardens of the days of Babar, with modern pavilions of the Kashmir type, were found still lingering in the beauty of decay. The chief tributary from the Kafiristan hills is the Pechdara, which joins the river close to Chagan Sarai. It is a fine, broad, swift-flowing stream, with an excellent bridge over it (part of the Amir's military road developments), and has been largely utilized for irrigation. The Pechdara finds its sources in the Kafir hills amongst forests of pine and deodar and thick tangles of wild vine and ivy, wild figs, pomegranates, olives and oaks, and dense masses of sweet-scented shrubs. Above Chagan Sarai, as far as Arnawai, where the Afghan boundary crosses the river, and above which the valley belongs to Chitral, the river narrows to a swift mountain stream beset with boulders and hedged in with steep cliffs and difficult "parris," or slopes of rocky hillside. Wild almond here sheds its blossoms into the stream, and in the dawn of summer much of the floral beauty of Kashmir is to be found in the Kunar valley. At Asmar there is a slight widening of the valley, and the opportunity for a large Afghan military encampment, spreading to both sides of the river and connected by a very creditable bridge built on the cantilever system. There are no apparent relics of Buddhism in the Kunar, such as are common about Jalalabad or Chitral, or throughout Swat and Dir. This is probably due to the late occupation of the valley by Kafirs, who spread eastwards into Bajaor within comparatively recent historical times, and who still adhere to their fastnesses in the Kashmund hills. The Kunar valley route to Chitral and to Kafiristan is being developed by Afghan engineering. It may possibly extend ultimately unto Badakshan, in which case it will form the most direct connexion between the Oxus and India, and become an important feature in the strategical geography of Asia. (T. H. H*.)

Kundt, August Adolph Eduard Eberhard (1839–1894), German physicist, was born at Schwerin in Mecklenburg on 18th November 1839. He began his scientific studies at Leipzig, but afterwards went to Berlin. At first he devoted himself to astronomy, but coming under the influence of Magnus, he turned his attention to physics, and graduated in 1864 with a thesis on the depolarization of light. In 1867 he became *privat-docent* in Berlin University, and in the following year was chosen professor of physics at the Zürich Polytechnic; then, after a year or two at Würzburg, he was called in 1872 to Strassburg, where he took a great part in the organization of the new university, and was largely concerned in the erection of the Physical Institute. Finally in 1888 he went to Berlin as successor to Helmholtz in the chair of experimental physics and directorship of the Berlin Physical Institute. He died after a protracted illness at Israelsdorf, near Lübeck, on 21st May 1894. As an original worker Kundt was especially successful in the domains of sound and light. In the former he developed a valuable method for the investigation of aerial waves within pipes, based on the fact that a finely-divided powder—lycopodium, for example—when dusted over the interior of a tube in which is established a vibrating column of air, tends to collect in heaps at the nodes, the distance between which can thus be ascertained. An extension of the method renders possible the determination of the velocity of sound in different gases. In light Kundt's name is widely known for his inquiries in anomalous dispersion, not only in liquids and vapours, but even in metals, which he obtained in very thin films by means of a laborious process of electrolytic deposition upon platinized glass. He also carried out many experiments in magneto-optics, and succeeded in showing, what Faraday had failed to detect, the rotation under the influence of magnetic force of the plane of polarization in certain gases and vapours.

Kunene, formerly known also as Nourse, a river of south-west Africa, with a length of about 700 miles, mainly within Portuguese territory, but in its lower course forming the boundary between Angola and German south-west Africa. The upper basin of the river lies on the inner versant of the high plateau region which runs southwards from Bihe parallel to the coast, forming in places ranges of mountains which give rise to many streams running south and south-west to swell the Kunene. The main head-stream rises just north of 13° S., running generally from north to south through four degrees of latitude, but finally flowing west to the sea through a break in the outer highlands. A little south of 16° S. it receives the Kalonga from the east, and in about 16° 50′ the Kakulovar from the west. The Kakulovar has its sources in the Serra da Chella and other ranges of the Humpata district, but, though the longest tributary of the Kunene, is but a small river in its lower course, which traverses the arid region comprised within the lower basin of the Kunene. In 16° it is less than 10 yards wide, and about 4½ feet deep in the dry season. Between the mouths of the Kalonga and Kakulovar the Kunene traverses a swampy plain, inundated during high water, and containing several small lakes at other parts of the year. Before assuming a decided westerly course the Kunene has been reported to send one or more divergent branches towards the Etosha salt pan in the south-east, but the truth of this is not established. The river now becomes smaller in volume, entering an almost desert region with little or no vegetation. The stream is sometimes shallow and fordable, at others confined to a narrow rocky channel. The country becomes exceedingly broken, and many rapids obstruct the stream, the rocks presenting the most varied hues; but near its mouth the Kunene traverses a region of sand-hills which completely block its mouth at low water. There are indications that a former branch of the river once entered a bay to the south which seems to afford anchorage for ships. The best harbour on the coast is, however, the great Fish Bay, a little north of the mouth of the Kunene.

See Costa Leal in *Petermann's Mitteilungen*, No. 10, 1858.—Mayo. "Journey . . . to the River Cunene," *Proceedings Royal Geographical Society*, August 1883.—Essen. "Meine Reise nach den Kunene," *Verhandl. Gesells. für Erdkunde zu Berlin*, No. 2, 1897; and works by Capello and Ivens. (E. He.)

Kungrad, an important trading town in Russian Central Asia, province of Amu-daria, in the delta of that river, 40 miles south of Lake Aral; altitude 260 feet. It is the centre of several caravan routes leading to the Caspian Sea and the Uralsk province.

Kungur, a district town of Russia, government and 58 miles south-south-east of Perm, on Sylva river and on the highway to Siberia. It has a technical school, two public libraries, and a high school for girls, besides the usual educational institutions. Tanneries and the manufacture of boots, plain gloves, leather, overcoats, &c., exported chiefly to Siberia, in which over 1000 families are engaged, are the chief industries. It has trade in tallow, and linseed is exported and tea imported direct from China. Population (1892), 12,400; (1897), 14,324.

Kun Lông, the name of a district and ferry on the Salween in the northern Shan States of Burma. Both are insignificant, but the place has gained notoriety from being the nominal terminus in British territory of the railway under construction across the northern Shan States to the borders of Yünnan. In point of fact, however, this terminus will be seven miles below the ferry and outside of Kun Lông circle. At present Kun Lông ferry is little used, and the village was burnt by Kachins in 1893. It is served by dugouts, three in number in 1899, and capable of carrying about fifteen men on a trip. Formerly the trade seems to have been more considerable, and the Burmese had a customs station on the island from which the place takes its name, but the rebellion in the great state of Theinni and the southward movement of the Kachins, as well as the Mahommedan rebellion in Yünnan, diverted the caravans to the northern route to Bhamo, which is still chiefly followed.

Kuopio, a government of Finland, Russia, which includes northern Karelia, bounded on the N.W. and N. by Uleåborg, on the E. by Olonets, on the S.E. by Viborg, on the S. by St Michel, and on the W. by Vasa. Its area covers 16,500 square miles. The surface is hilly, reaching from 600 to 800 feet of altitude in the north (Suomenselkä hills), and from 300 to 400 feet in the south. It is built up of gneisso-granites, which are covered, especially in the middle and east, with younger granites, and partly of gneisses, quartzite, and talc schists, and augitic rocks. The whole is covered with Glacial and later lacustrine deposits. The soil is of moderate fertility, but often full of boulders. Large lakes cover 16 per cent. of surface, marshes and peat bogs over 29 per cent. of the area, and forests occupy 2,672,240 hectares. Steamers ply along the lakes as far as Joensuu. The climate is severe, the average temperature being for the year 36° F., for January 13°, and for July 63°. The population, which was 305,166 in 1897 (226,130 in 1872), consists almost exclusively of Finns (less than 1600 Swedes). Only 2·3 per cent. of the whole surface is under cultivation. Rye, barley, oats, and potatoes are the chief crops, and in good years these meet the needs of the population. Nearly 38,800 tons of iron ore are extracted every year, and nearly 12,000 tons of pig iron and 6420 tons of iron and steel are obtained in ten iron-works. Engineering and chemical works, tanneries, saw-mills, paper mills, and distilleries are the chief industrial establishments. The preparation of carts, sledges, and other wooden goods is spreading as a domestic industry. There is considerable traffic on the railways which cross the government. Timber, iron, butter, furs, and game are exported. The chief towns of the government are Kuopio, Joensuu (3158), and Idensalmi (1300).

Kuopio, capital of the above government, situated on Lake Kalla-vesi, 180 miles by rail from the Kuivola junction of the St Petersburg to Helsingfors main line, and the terminus of the railway which runs south to north from Kotka (Gulf of Finland) across middle Finland. Population (1897), 9412. It is picturesquely situated, and has a cathedral, two lyceums, and two gymnasia (both for boys and girls), a commercial and several professional schools. An agricultural school is at Leväis, close by. Kuopio, in consequence of its steamer communication with middle Finland and the sea (*viâ* Saima Canal), is a centre for trade, steadily growing in importance.

Küprolü, or Kuprili (Bulgarian *Valésa,* Greek *Vélissa*), a town of Macedonia, European Turkey, in the sanjak of Prizren and viláyet of Salonica, situated 600 feet above sea-level, on the Vardar, and on the Salonica–Metrovitza railway, 25 miles south-east of Uskub. It has a considerable trade in cocoons. Population, 22,000.

Kúrdistán, the "country of the Kúrds," including that part of Mount Taurus which buttresses the Armenian tableland and is intersected by the Batman Su, the Bohtan Su, and other tributaries of the Tigris; and the wild mountain district, watered by the Greater and Lesser Zab, which marks the western termination of the great Iranian plateau.

Population.—The total Kúrd population probably exceeds two and a half millions, namely, Turkish Kúrds 1,650,000, Persian 800,000, Russian 50,000, but there are no trustworthy statistics. The great mass of the population has its home in Kúrdistán. But Kúrds are scattered irregularly over the country from the river Sakaría on the west to Lake Urmia on the east, and from Kars on the north to Jebel Sinjar on the south. There is also an isolated settlement in Khorassan. The tribes, *Ashiret,* into which the Kúrds are divided, resemble in some respects the Highland clans of Scotland. Very few of them number more than 10,000 souls, and the average is about 3000. The sedentary and pastoral Kúrds, *Yerli,* who live in villages in winter and encamp on their own pasture-grounds in summer, form an increasing majority of the population. The nomad Kúrds, *Kocher,* who always dwell in tents, are the wealthiest and most independent. They spend the summer on the mountains and high plateaux, which they enter in May and leave in October; and pass the winter on the banks of the Tigris and on the great plain north of the Jebel Sinjar, where they purchase right of pasturage from the Shammar Arabs. Each tribe has its own pasture-grounds, and trespass by other tribes is a fertile source of quarrel. During the periodical migrations Moslem and Christian alike suffer from the predatory instincts of the Kúrd, and disturbances are frequent in the districts traversed. In Turkey the sedentary Kúrds pay taxes; but the nomads only pay the sheep tax, which is collected as they cross the Tigris on their way to their summer pastures.

Character.—The Kúrd delights in the bracing air and unrestricted liberty of the mountains. He is rarely a muleteer or camel-man, and does not take kindly to handicrafts. Though ignorant and unsophisticated, he is not wanting in natural intelligence. In recent years educated Kúrds have held high office under the Sultan, including that of Grand Vizier, have assisted in translating the Bible into Turkish, and in editing a newspaper. The men are lithe, active, and strong, but rarely of unusual stature. The women do not veil, and are allowed great freedom. The Kúrds as a race are proud, faithful, and hospitable, and have rude but strict feelings of honour. They are, however, much under the influence of dervishes, and when their fanaticism is aroused their habitual lawlessness is apt to degenerate into savage barbarity. They are not deficient in martial spirit, but have an innate dislike to the restraints of military service. The written literature is small, but the country is rich in traditions and legends, and in lyric and in epic poems which have been handed down from earlier times and are recited in a weird melancholy tone.

History.—When Sultan Selim I., after defeating Shah Ismail, 1514, annexed Armenia and Kúrdistán, he entrusted the organization of the conquered territories to Idris, the historian, who was a Kúrd of Bitlis. Idris found Kúrdistán bristling with castles, held by hereditary tribal chiefs of Kúrd, Arab, and Armenian descent, who were practically independent, and passed their time in tribal warfare or in raiding the agricultural population. He divided the territory into sanjaks or districts, and, making no attempt to interfere with the principle of heredity, installed the local chiefs as governors. He also resettled the rich pastoral country between Erzerúm and Erivan, which had lain waste since the passage of Timúr, with Kúrds from the Hakkiari and Bohtan districts. The system of administration introduced by Idris remained unchanged until the close of the Russo-Turkish war of 1828–29. But the Kúrds, owing to the remoteness of their country from the capital and the decline of Turkey, had greatly increased in influence and power, and had spread westwards over the country as far as Angora. After the war the Kúrds attempted to free themselves from Turkish control, and in 1834 it became necessary to reduce them to subjection. This was done by Reshid Pasha. The principal towns were strongly garrisoned, and many of the Kúrd beys were replaced by Turkish governors. A rising under Bedr Khán Bey in 1843 was firmly repressed, and after the Crimean war the Turks strengthened their hold on the country. The Russo-Turkish war of 1877–78 was followed by the attempt of Sheikh Obeidullah, 1880–81, to found an independent Kúrd principality under the protection of Turkey. The attempt, at first encouraged by the Porte, as a reply to the projected creation of an Armenian state under the suzerainty of Russia (see ARMENIA), collapsed after Obeidullah's raid into Persia, when various circumstances led the central government to reassert its supreme authority. Until the Russo-Turkish war of 1828–29 there had been little hostile feeling between the Kúrds and the Armenians, and as late as 1877–78 the mountaineers of both races had got on fairly well together. Both suffered from Turkey, both dreaded Russia. But the national movement amongst the Armenians, and its encouragement by Russia after the last war, gradually aroused race hatred and fanaticism. In 1891 the activity of the Armenian Committees induced the Porte to strengthen the position of the Kúrds by raising a body of Kúrdish irregular cavalry, which was well armed and called Hamidieh after the Sultan. The opportunities thus offered for plunder and the gratification of race hatred brought out the worst qualities of the Kúrds. Minor disturbances constantly occurred, and were soon followed by the massacre of Armenians at Sasún and other places, 1894–96, in which the Kúrds took an active part. The Hamidieh has tended to foster aspirations for the establishment of a Kúrd principality, and having fulfilled its object, is now regarded with distrust.

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Kúrdistán, in the narrower sense, a province of Persia, situated in the hilly districts between Azerbaïján and Kermánshah, and extending to the Turkish frontier on the W., and bounded on the E. by Garrús and Hamadán. In proportion to its size and population it pays a very small yearly revenue—only about £14,000—due to the fact that a great part of the population consists of wild and disorderly nomad Kúrds. Some of these nomads pass their winters in Turkish territory, and have their summer pasture-grounds in the highlands of Kúrdistán. This adds much to the difficulty of collecting taxation. The province is divided into sixteen districts, and its eastern part, in which the capital is situated, is known as Ardelán. The capital is SENENDIJ, usually known as SINNAH (not Sihna, or Sahna, as some writers have it), situated 60 miles northwest of Hamadán, in 35° 15′ N. and 47° 18′ E., at an elevation of 5300 feet. The city has a population of about 35,000, and manufactures great quantities of carpets and felts for the supply of the province and export. Some of the carpets are very fine and expensive, rugs 2 yards by 1½ costing £15 to £20. Post and telegraph offices have been established for a number of years.

Kurgan, a district town (founded 1553) of West Siberia, on the Siberian railway, 160 miles east of Czelyabrusk, situated in a wealthy agricultural district. Owing to its position at the terminus of steam navigation up the river Tobol, it has become second only to Tyumeñ as a commercial centre. It has a public library, a botanic garden, and a municipal bank. The returns of its three fairs exceed £300,000 a year. It has a large trade in cattle with Petropavlovsk, and considerable export of grain, tallow, meat, hides, butter, game, and fish. Population, 10,579.

Kuriles, a chain of small islands belonging to Japan, stretching in a north-easterly direction from Nemuro Bay, on the extreme east of the island of Ezo, to Chishima-kaikyo (Kurile Strait), which separates them from the southernmost point of Kamchatka. They lie between 44° 45′ to 50° 56′ N. and 145° 25′ to 156° 32′ E. Their coasts measure 1496 miles; their area is 6159 square miles; their total number is 32, and the names of the six principal islands, counting from the south, are Kunashiri, Shikotan, Etorofu (generally called Etorop, and known formerly to Europe as Staten Island), Onnekotan, Paramoshiri, and Shumshu. From Notsu-no-saki (Notsu Cape), the most easterly point of Nemuro province, to Tomari, the most westerly point in Kunashiri, the distance is 7⅓ miles, and the Kurile Strait separating Shumshu from Kamchatka is about the same width. The name "Kurile" is derived from the Russian *kurity* (smoke), in allusion to the active volcanic character of the group. The dense fogs that envelop these islands, and the violence of the currents in their vicinity, have greatly hindered exploration, so that little is known of their physiography. They lie entangled in a vast net of sea-weed; are the resort of innumerable birds, and used to be largely frequented by seals and sea-otters, which, however, have been almost completely driven away by unregulated hunting. Near the south-eastern coast of Kunashiri stands a mountain called Rausu-yama (3005 feet high), round whose base sulphur bubbles up in large quantities, and hot springs as well as a hot stream are found. On the west coast of the same island is a boiling lake, called Ponto, which deposits on its bed and round its shores black sand, consisting almost entirely of pure sulphur. This island has several lofty peaks: Ponnobori-yama near the east coast, and Chachanobori and Rurindake in the north. Chachanobori (about 7900 feet) is described by Messrs Chamberlain and Mason as "a cone within a cone, the inner and higher of the two being—so the natives say—surrounded by a lake." The island has extensive forests of conifers, with an undergrowth of ferns and flowering plants, and bears are numerous. The chief port of Kunashiri is Tomari, on the south coast. The island of Shikotan is remarkable for the growth of a species of bamboo (called Shikotan-chiku), having dark brown spots on the cane. Etorofu has a coast-line broken by deep bays, of which the principal are Naibo-wan, Rubetsu-wan, and Bettobu-wan on the northern shore, and Shikotap-wan on the southern. It is covered almost completely with dense forest, and has a number of streams abounding with salmon. Shana, the chief port, is in Rubetsu Bay. This island, the principal of the group, is divided into four provinces for administrative purposes, namely, Etorofu, Furubetsu, Shana, and Shibetomo. Its mountains are Atosa-nobori (4035 feet) in Etorofu; Chiripnupari (5009 feet) in Shana; and Moyoro-dake (3930 feet) and Atuiya-dake (3932 feet) in Shibetomo. Among the other islands three only call for notice on account of their altitudes, namely, Ketôi-jima, Rashua-jima, and Matua-jima, which rise to heights of 3944 feet, 3304 feet, and 5240 feet respectively.

Population.—Not much is known about the aborigines. By some authorities Ainu colonists are supposed to have been the first settlers, and to have arrived there *viâ* Yezo; by others, the earliest comers are believed to have been a hyperborean tribe travelling southwards by way of Kamchatka. The islands themselves have not been sufficiently explored to determine whether they furnish any ethnological evidences. The present population aggregates

4413, or 0·7 per square mile, of whom 555 are Ainu. There is little disposition to emigrate thither from Japan proper, the number of settlers being less than 100 annually.

History.—The three southern Kurile islands, Kunashiri, Etorofu, and Shikotan, are believed to have belonged to Japan from a remote date, but at the beginning of the 18th century the Russians, having conquered Kamchatka, found their way to the northern part of the Kuriles in pursuit of fur-bearing animals, with which the islands then abounded. Gradually these encroachments were pushed farther south, simultaneously with aggressions imperilling the Japanese settlements in the southern half of Saghalien. Japan's occupation was very far from being effective in either region, and in 1875 she was not unwilling to conclude a convention by which she agreed to withdraw altogether from Saghalien, provided that Russia withdrew from the Kuriles.

An officer of the Japanese navy, Lieutenant Gunji, left Tôkyô with about forty comrades in 1892, his intention being to form a settlement on Shumshu, the most northerly of the Kurile Islands. They embarked in open boats, and for that reason, as well as because they were going to constitute themselves their country's extreme outpost, the enterprise attracted public enthusiasm. After a long struggle, the immigrants became fairly prosperous. See *Notes on the Kurile Islands*, by Captain Snow, 1896. (F. BY.)

Kursk, a government of middle Russia, bounded on the N. by Orel, on the E. by Voronezh, on the S. by Kharkov, and on the W. by Chernigov. Area, 17,937 square miles. It belongs to the central plateau of middle Russia, of which it mostly occupies the southern slope, the highest parts being in Orel and Kaluga, to the north of Kursk. Its surface is from 700 to 1000 feet high, deeply ravined, and consequently assumes a hilly aspect in the valleys of the rivers. A regular layer of fertile loess of a yellowish colour covers the whole surface, and Kursk belongs almost entirely to the black-earth region of Russia. The flora offers a character quite distinct from that of the provinces situated to the north, not only on account of the black-earth flora which enters into its composition, but also of the plants of south-western Russia which belong to it, a characteristic which is accentuated in the southern portion of the province (V. Zinger, *Information about the Flora of Middle Russia*, in Russian). The climate is milder than that of middle Russia generally, and winds from the south-east and the south-west prevail in winter. The average temperatures are for the year 42° F., for January 14° F., and for July 67° F. The very interesting magnetic anomaly, known as the Byelgorod anomaly, covering an oval 20 miles long and 12 miles wide, near the town of this name, has been investigated by Smirnoff, Pilchikoff, Serghievskiy, and Tillo. The population (1,893,597 in 1862) was 2,396,577 in 1897, of whom 1,208,488 were women and 199,676 lived in towns. It is thoroughly Russian (76 per cent. Great Russians and 24 per cent. Little Russians), and 94 per cent. are peasants, who own about two-thirds of the land (6,808,700 acres), and live mostly in large villages. The yearly increase of population varies from 23,000 (bad crops) to 45,000 (good crops). Owing to the rapid increase of the peasantry and the small size of the allotments given at the emancipation, the holdings are now so small and the rents so high that emigration, chiefly to Siberia, is on the increase. Three-quarters of the available land is under crops, chiefly rye. Grain is exported in considerable quantities. Bees are commonly kept. There were, in 1897, 443,000 horses, 620,000 horned cattle, 1,030,000 sheep, and 300,000 swine. Factories (steam flour-mills, sugar-works, distilleries, wool-washing, &c.) give occupation to about 23,000 workers (£1,700,000 yearly returns). Domestic and petty trades are on the increase in the villages, and new ones are introduced. More than 1,000,000 pairs of boots (£200,000), 600,000 ikons and shrines (£19,000), toys, caps, various pottery, &c., are made in the villages, but even so great numbers of peasants are compelled to go elsewhere in search of work. The province pays about £1,400,000 of direct and indirect taxes, and £90,000 of municipal and village taxes a year. Notwithstanding the active efforts of the county and district councils (*zemstvo*), less than 10 per cent. of the population read and write. The province is crossed from north to south and from west to south by two main lines of railway, having several branches. The trade in grain, hemp, hempseed oil, sheepskins, hides, tallow, felt goods, wax, honey, and leather goods is very brisk. There are fifteen districts, the chief towns of which are Kursk, Byelgorod (21,850), Dmitriev (7315), Fatezh (4959), Graivoron (7669), Korocha (14,405), Lgov (5376), Novyi Oskol (2762), Oboyañ (11,872), Putivl (8965), Rylsk (11,415), Staryi Oskol (16,662), Shchigry (3329), Sudzha (12,856), Tim (7380). Many villages, such as Borisovka (25,080), Veliko-Mikhailovka (20,700), are more important than the district towns, there being twenty-two more villages which have from 5000 to 12,000 inhabitants. (P. A. K.)

Kursk, capital of the above province. It is built on two hills, having an altitude of 770 feet, the slopes of which are covered with orchards. It has a public garden, and has become the seat of several societies (medical, musical, educational, and for sport). Besides the usual gymnasia for boys and girls, there is a school for teachers. There are four newspapers. Its factories (steam flour-mills, distilleries, tobacco-works, hemp-crushing mills, tanneries, soap-works, iron-works) employ about 1000 workers. It has a great yearly fair (*korennaya*), to which horses, cattle, hides, sheepskins, furs, down, bristle, wax, tallow, and all sorts of manufactured goods, making an aggregate value of £55,000, are brought, and during which considerable commercial operations in all sorts of raw produce are concluded. Population, 52,896 (but one seemingly correct estimate puts it 62,803 for 1895).

Kurunegala, the chief town in the north-western province of Ceylon. It was in 1902 the terminus of the Northern railway (59 miles from Colombo), which was planned to run, 200 miles farther, to the northernmost coast of the Jaffna peninsula. Kurunegala is the centre of rice, cocoanut palm, tea, coffee, and cacao cultivation. The population of the town is 5300; of the district (1901), 246,618; of the province (1901), 345,427.

Kuruntwad, a native state of India, in the Deccan division of Bombay, forming part of the Southern Mahratta Jagirs. Originally created in 1772 by a grant from the Peshwa, the state has been subdivided since 1811 between a senior and a junior branch. The territory of both is widely scattered among other native states and British districts. Area of the senior branch, 174 square miles; population (1891), 43,809; gross revenue, Rs.2,01,860; police, 114; 13 schools, with 696 pupils. Area of junior branch, 134 square miles; population (1891), 13,528; gross revenue, Rs.1,48,094; police, 72; 10 schools, with 364 pupils; joint tribute, Rs.9619. The chiefs, whose title is Patwardhan, are Brahmans by caste. The junior branch was in 1902 represented by two cousins, ruling jointly. The town of KURUNTWAD, in which both branches have their residence, is on the right bank of the Panchganga river near its junction with the Kistna. Population, 9136.

Kustanaisk, a district town of Russian Central Asia, in the province of Turgai, on the Tobol river, 600 miles east of Orenburg. It is situated in a very fertile district of the steppes (prairies), the first buildings were erected in 1871, and it has since grown with a quite American rapidity. The immigrants from Russia, attracted by the fertility of the land, built a large village which became the centre of the district administration in 1884, and a town in 1893, under the name of Nicolaevsk, changed later into Kustanaisk. It has several schools for boys and girls, a Russian and Kirghiz progymnasium for girls, a society for promoting primary education, which keeps a "church-school," two libraries—one for the peasants—and a depôt for school-books to supply the schools of the district. A cathedral has been built by private subscription. There are already 20 tanneries, 3 tallow houses, 3 potteries, and a fair which is a centre for trade in cattle, while its trade returns are such as to make of it a rival to Orenburg and Troitsk. Population (1895), 16,136; (1897), 14,065 (settled only).

Küstendil, the chief town of a department in the principality of Bulgaria, situated in a mountainous country, on a small affluent of the Strouma, 43 miles south-west of Sofia by rail. The streets are narrow and uneven, and the majority of the houses are of clay or wood. The town is chiefly notable for its hot mineral springs, in connexion with which there are nine bathing establishments. The vine is largely cultivated in the district. Some remains survive of the Roman period, when the town was known as Pautalia, Ulpia Pautalia, and Pautalia Aurelii. In the 10th century it became the seat of a bishopric, being then and during the Middle Ages known as Velbuzd. After the overthrow of the Servian kingdom it came into the possession of Constantine, brother of the despot John Drajas, and a vassal of Turkey. In the 15th century it was known as Velbuska Banja, and more commonly as Konstantinova Banja (Constantine's Bath), from which has developed the Turkish name Küstendil. Population (1900), 12,003.

Kustendji. See Constanta.

Küstenland, The (coastland or littoral), common name for the three crownlands of the Austro-Hungarian monarchy, Görz and Gradisca, Istria, and Trieste. Their combined area is 2976 square miles, and their population (1890) 695,384, and (1900) 755,183. They are united for certain administrative purposes under the governor of Trieste, the legal and financial authorities of which also exercise jurisdiction over the entire littoral. (See separate articles.) In 1898 the educational establishments included 3 theological seminaries, 5 gymnasia, 4 real schools, 58 technical and special schools (including those for girls), and 432 elementary schools. The latter were attended by about 72 per cent. of the children. In 1890 the percentage of illiterates was 47, an improvement of 9 per cent. on the returns of 1880. This high ratio is due chiefly to the backward condition of the Slav majority. Of the 81 periodicals and newspapers published, 54 were in Italian, 17 in Slovene, 4 in German, and 2 in Serbo-Croatian, the remainder being polyglot Greek and French. The trade of this part of the empire is concentrated in Trieste (*q.v.*). In 1898 the entire Küstenland had 378 miles of railway, nearly 3150 miles of roads, and 74 miles of navigable inland waterways. There were 190 post and 101 telegraph offices, with 752 miles of line and 2062 miles of wire. In all three crownlands, as also in Dalmatia, sea-fishing affords occupation to a large number of the inhabitants. In 1897–98 the value of the yield amounted to about £222,370. The important work of reafforesting the Karst district, which extends over portions of Görz, Gradisca, Istria, Trieste, and even Carniola, was taken up tentatively as long ago as 1866. For a number of years small grants were made for experimental planting, which since 1875–76 has been proceeded with in a more systematic and more thorough fashion. Between 1881 and 1887 special reafforesting commissions were formed, and provided with funds contributed partly by the State and partly by the crownlands concerned. The results thus far are considered very satisfactory. Politically, the situation in the Küstenland is characterized by the bitter strife between the Slav majority and the dominant Italian element, which turns mainly on the efforts of the former to secure educational facilities in their own language. The animosity between the two nationalities is as great as that between the Czechs and Germans.

See Ruthner. *Das Küstenland und das Königreich Dalmatien.* Vienna, 1880.—Jackson. *Dalmatia, the Quarnero and Istria, with Cettinje and the island of Grado (and Aquileja).* Oxford, 1887.
(Æ. O'N.)

Kutaiah, or Kutaya, a town of western Asia Minor, connected by a branch line with the main line, Eski-shehr–Afiún Kara-hissar, of the Anatolian railway.

Kutais, a government of Transcaucasia, Russia, on the Black Sea. Area, 14,082 square miles. The province consists of four distinct parts: (1) the lowlands, watered by the Rion, and continued to the north-west, along the sea-shore, by the narrow strip of Samurzakañ and Abhazia; (2) the slopes of the main Caucasus range; (3) the western slopes of the Suram mountains, which separate Kutais from the eastern portion of the great Transcaucasian valley occupied by the province of Tiflis; and (4) the slopes of the Little Caucasus, as well as a portion of its plateau, watered by the Chorokh and its tributary, Ajaris-tskhali, which formerly constituted the Batum province. The main range, on the frontiers of the province, has many high snow-clad peaks, of which the Dykh-tau (17,054 feet), the Shkhara (17,049 feet), and the Adish (16,291 feet) are the main ones. More than 50 glaciers of the first class are already known on the southern slopes of this portion of the main range. Many secondary ridges and spurs shoot off the main range, forming narrow high valleys (see Caucasus). The Suram mountains reach only from 3000 to 4000 feet of altitude, while the Ajar-Akhaltsykh ridge of the Little Caucasus attains from 8500 to 9343 feet in its highest peaks, and is crossed by a picturesque pass, Zekari (about 8000 feet), leading to the watering-place of Abbas-tuman. The districts of Batum and Artvin in the south-west are filled up by the spurs of the Pontic range, 9000 to 11,243 feet high (peak Karchkhal), the Arsian ridge separating them from the plateau of Kars. Deep gorges, through which tributaries of the Chorokh rush to the main river, intersect these highlands, forming most picturesque gorges in their upper courses. The lowlands occupy over 2400 square miles. They are mostly in the littoral region, but extremely fertile higher up the Rion.

Granites, gneisses, and crystalline slates enter into the composition of the main range, with Palæozoic, Jurassic, and Cretaceous deposits in its lower parts. The Suram mountains consist, on their western slopes, chiefly of granites and gneisses, while the highlands of the Little Caucasus consist almost exclusively of lower Tertiary deposits. The *climate* is very moist and warm. The winters are often without frost at all in the lowlands, while the lowest temperatures ever observed are 18° Fahr. at Batum and 9° at Poti. The mountains condense the moisture brought by the west winds, and the yearly amount of rain varies from 50 to 120 inches. The chief rivers are the Rion, which enters the Black Sea at Poti; the Chorokh, which enters the same sea at Batum; and the Ingur, the Kodor, and the Bzyb, also flowing into the Black Sea in Abhazia. The vegetation is extremely rich, its character suggesting the sub-tropic regions of Japan. The *population* belongs almost entirely to the Kartvelian or Georgian group, and is distributed as follows:—Imeretians, 45 per cent.; Mingrelians and Lazes, 23 per cent.; Gurians, 8 per cent.; Georgians, 1·5 per cent.; Svanes, 1·5 per cent.; of other nationalities there are 6·5 per cent. of Abhazians, 3 per cent. of Turks, 2 per cent. of Armenians, 0·5 per cent. of Russians, and so on: 87 per cent. of the population are Greek Orthodox, and only 10 per cent. Mussulmans. The total population was 1,075,861 in 1897, of whom 508,468 were women and 77,702 lived in towns. In some districts the density was 104 inhabitants per square mile. The land, among both landlords and peasants, is extremely subdivided, and, owing to an excellent cultivation, fetches very high prices. The chief crops in 1896 were Indian corn, 1,600,000 quarters; wheat, 124,000 quarters; barley, 47,000 quarters; *panicum italicum*, beans, rye, hemp, potatoes, and tobacco. Indian corn is exported. Some plantations of cotton-trees have also been laid down. The vine, olive, mulberry, and all sorts of fruit trees are cultivated, as also many exotic plants (eucalyptus, cork-oak, camellia, and even tea). Manganese ore is the chief mineral, and is extracted for a considerable export (160,000 to 180,000 tons every year), besides coal, lead, and silver ores, copper, naphtha, some gold, lithographic stone, marble, &c. Factories are still in infancy. A railway runs from the Caspian Sea, *viâ* Tiflis and the Suram tunnel, to Kutais, and thence to Poti and Batum, and from Kutais to the Kvirili coal and manganese mines. The export of both local produce and goods shipped by rail from other ports of Transcaucasia is considerable, Batum and Poti being the two chief ports of Caucasia. It is divided into 7 districts, of which the chief towns are Kutais, capital of the province (32,492); Lailashi (834), chief town of Legchum, of which Svanetia makes a separate administrative unit (*pristavstvo*); Ozurgeti (4694); Oni, chief town of Racha; Senak (101); Kvirili, of Sharopan district; Zugdidi; and 3 semi-military districts—Batum (28,512), Artvin (6622), and Sukhum-kale (7809). (P. A. K.)

Kutais, capital of the above province, situated on both banks of the Rion (480 feet in altitude), and connected by a branch railway (5 miles) with the main line. It is well provided with gymnasia and other schools for boys and girls, has a school of gardening, a public library, book-shops, a large champagne factory, &c. Population, 32,492, of whom about 16,000 are Kartvelians, 3000 Armenians, 3000 Jews, and 2000 Russians.

Kutno, a district town of Russian Poland, government and 83 miles west of Warsaw by rail. It has several woollen, linen, wool-knitting and printed cotton factories, and distilleries, and is the centre of a considerable trade in corn. Population (1895), 11,665, two-thirds of whom were Jews.

Kuttenberg, a mining town and seat of the administration of a government district in Bohemia, and a station on the Austrian North-Western railway, 40 miles east by south of Prague. An iron-foundry constitutes the chief addition to the industry of the place, which includes sugar-refining, brewing, the manufacture of cotton and woollen stuffs, leather goods and agricultural implements. On 12th–16th September 1899 it was the scene of a sensational trial of a Jew named Hilsner on a charge of so-called "ritual murder," which was made the starting-point of an anti-Semitic agitation. Population (1890), 13,563; (1900), 14,799, mostly Czech.

Kuty, a town in the government district of Kosów, Galicia, Austria, 35 miles west of Czernowitz. The principal industry is the manufacture of morocco leather, which, together with the pitch, tar, and rosin recovered in the neighbouring woods, form its principal articles of export. Population (1890), 6353; (1900), 6702, mostly German-speaking Jews. The adjoining village of Kuty Stare, or Old Kuty, has a population of 4425, mostly Ruthenians.

Kuznetsk, two district towns of Russia. 1. European Russia, government and 150 miles north-north-east of Saratov, 74 miles by rail east of Penza. It has grown rapidly since the development of the railway system in the Volga basin. It has manufactures of agricultural machinery and hardware, in a number of small factories and workshops, besides tanneries, rope-works, boot- and shoe-making in houses, and there is considerable trade in grain, salt, and a variety of wooden goods exported to the treeless regions of south-east Russia. Population (1897), 23,849. 2. In West Siberia, Altai region, government and 210 miles south-east of Tomsk, on upper Tom river, of which it is the head of the navigation. It has trade in grain, cattle, furs, cedar, nuts, wax, and honey, and tallow is shipped northwards. It is the centre of an important mining district. Population, 8980.

Kwangchow Bay, or KWANGCHOW WAN, a coaling station on the south coast of China, acquired, along with other concessions, by the French Government in April 1898. It is situated on the east side of the peninsula of Lienchow, in the province of Kwangtung, and directly north of the island of Hainan. It is held on lease for 99 years on similar terms to those by which Kiaochow is held by Germany, Port Arthur by Russia, and Wei-hai-wei by Great Britain. The cession includes the islands lying in the bay; these enclose a roadstead 18 miles long by 6 miles wide, with admirable natural defences and a depth at no part of less than 33 feet. The bay forms the estuary of the Ma-Tshé river, navigable by the largest men-of-war for 12 miles from the coast. The limits of the concession inland were fixed in November 1899. On the left bank of the Ma-Tshé France gained from Kao Chow Fu a strip of territory 11 miles by 6 miles, and on the right bank a strip 15 miles by 11 miles from Leï Chow Fu. The country is well populated; the capital and chief town is Leï Chow. The cession carries with it full territorial jurisdiction during the continuance of the lease. In January 1900 it was placed under the authority of the Governor-General of Indo-China, who in the same month appointed a civil administrator over the country, which was divided into three districts. A mixed tribunal has been instituted, but the local organization is maintained for purposes of administration. In addition to the territory acquired, the right has been given to connect the bay by railway with the city and harbour of Ompon, situated on the west side of the peninsula, and in consequence of difficulties which were offered by the provincial government on the occasion of taking possession, and which compelled the French to have recourse to arms, the latter demanded and obtained exclusive mining rights in the three adjoining prefectures. Two lines of French steamships call at the bay. By reason of the great strategical importance of the bay and the possibilities of considerable commercial development in the country, owing to the presence of large coal-beds in the near neighbourhood, much importance is attached by the French to the acquirement of Kwangchow Wan.

Kwanza, a river of West Africa, with a course of about 700 miles, entirely within the Portuguese territory of Angola. The actual source has not yet been visited, but probably lies in about 13° 40′ S., on the Bihe plateau, at an altitude of over 5000 feet. The Portuguese travellers Capello and Ivens reached in 1878 a point in 13° 3′ S., where they heard of a lake called Mussombo, from which the stream was supposed to rise; but they were unable to reach it. Just north of 12° they found the Kwanza about 60 yards wide and 13 to 16 feet deep. From this point to 10°, during which interval it flows north-westwards, receiving many tributaries, especially the Loando from the east, its course is imperfectly known. In about 10°, and at intervals during its westerly passage through the outer plateau escarpments, its course is broken by rapids, the river flowing in a well-defined valley flanked by higher ground. The lowest fall is that of Kambamba, or Livingstone, with a drop of 70 feet, below which it is navigated by small steamers, though very shallow in the dry season. There is a shifting bar at its mouth, which can only be crossed with great caution, but as a railway now runs from

St Paul de Loanda to Ambaca, the use of the river as a waterway has become of less importance.

See Alexanderson. "On the River Quanza," *Journal R.G.S.*, 1876.—Capello and Ivens. *From Benguela to . . . Yacca.* London, 1882. (E. HE.)

Kyaukpyu, a district in the Arakan division of Lower Burma, on the eastern coast of the Bay of Bengal. In 1891 the population numbered 163,832, of whom 145,223 were Buddhists and Jains, 13,882 aborigines (mostly Chins), 4301 Mahommedans, 290 Hindus, and 136 Christians (91 of whom were natives); in 1901 it was 167,594, showing an increase since 1891 of 2·3 per cent. There were in 1898–99, 1105 villages in the district, paying a revenue of Rs.4,73,035. Of a total area of 2,807,680 acres, the area cultivated in 1898–99 was 137,559. The rainfall in 1898–99 was 17·645 inches. The chief town, Kyaukpyu, had a population in 1891 of 3549. It has a municipal committee of twelve members, three *ex officio*, and nine appointed by the local government, and there is a third-class district jail. Ramri is also a municipal town. It had a population in 1891 of 3317. Kyaukpyu is a port under the Indian Ports Act (X. of 1889), and the steamers of the British India Navigation Company call there once a week going and coming between Rangoon and Calcutta. There were 106,549 gallons of earth-oil produced in 1898–99 from the Kyaukpyu oil-wells. The amount has remained nearly stationary for some years.

Kyauksè, a district in the Meiktila division of Upper Burma, with an area of approximately 1273 square miles, and a population in 1891 of 126,622, and in 1901 of 141,296. It is also known as the *Ko-kayaing*, so called from the original nine canals of the district. The district consists of a generally level strip running north and south at the foot of the Shan Hills, and of a hilly region rising up these hills to the east, and including the Yeyaman tract, which lies between 21° 30′ and 21° 40′ N. and 96° 15′ and 96° 45′ E., with peaks rising to between 4500 and 5000 feet. This tract is rugged and scored by ravines, and is very sparsely inhabited. The Panlaung and Zawgyi rivers from the Shan States flow through the district and are utilized for the numerous irrigation canals. Notwithstanding this, much timber is floated down, and the Panlaung is navigable for small boats all the year round. Rain is very scarce (26·03 inches, 1898–99), but the canals supply ample water for cultivation and all other purposes. They are said to have been dug by King Nawrahtā in 1092. He is alleged to have completed the system of nine canals and weirs in three years' time. Others have since been constructed. Since the annexation many were in serious disrepair, but most of them have been greatly improved by the construction of proper regulators and sluices. Two-thirds of the population are dependent entirely on cultivation for their support, and this is mainly rice on irrigated land. In the Yeyaman tract the chief cultivation is *taungya* or hill rice. The great bulk of the population is pure Burmese, but in the hills there are a good many Danus, a cross between Shans and Burmese. In 1891 the classification according to religion was —Buddhists and Jains, 122,771; Mahommedans, 3133; Hindus, 528; and Christians, 190. The railway runs through the centre of the paddy-producing area, and feeder roads open up the country as far as the Shan foothills. The greater part of the district consists of state land, the cultivators being tenants of Government, but there is a certain amount of hereditary freehold. The total area of cultivated state land is 137,100 acres, and of non-state land 68,205 acres. Kyauksè town is situated on the Zawgyi river, and is well laid out in regular streets, covering an area of about a square mile. It has a population of approximately 7201, mostly Burmese, with a native-of-India trading colony. Above it are some bare rocky hillocks, picturesquely studded with pagodas.

Kyd, Thomas (1558–1594), one of the most important of the Elizabethan dramatists who preceded Shakespeare, remained until the last decade of the 19th century in what appeared likely to be impenetrable obscurity. Owing to the industry, however, of certain English and German scholars, a great deal of light has been thrown on the life and writings of Kyd. He is now known to have been the son of Francis Kyd, citizen and scrivener of London, and to have been baptized in the church of St Mary Woolnoth, Lombard Street, on 6th November 1558. His mother, who survived her son, was named Agnes or Anna. In October 1565 Kyd entered the newly-founded Merchant Taylors' School, where Edmund Spenser and Thomas Lodge must at different times have been his school-fellows. It is thought that Kyd did not proceed to either of the universities; he certainly followed, soon after leaving school, his father's business as a scrivener. But Nash describes him as a "shifting companion that ran through every art and throve by none." He was very early attracted to literature and the stage. Newton's translation of Seneca, printed in 1581, had, without question, a strong influence on the imagination and style of Kyd. Professor Boas has made a very interesting analysis of the traces of contemporary literature to be found in Kyd's existing writings. It is believed that he produced his famous play, *The Spanish Tragedy*, about 1586; the earliest surviving quarto is undated. This drama enjoyed all through the age of Elizabeth and even of James I. and Charles I. so unflagging a success that it has been styled the most popular of all old English plays. Certain expressions in Nash's preface to the 1589 edition of Greene's *Menaphon* may be said to have started a whole world of speculation with regard to Kyd's activity. Much of this is still very puzzling; nor is it really understood why Ben Jonson called him "sporting Kyd." In 1592 there was added a sort of prologue to *The Spanish Tragedy*, called *The First Part of Jeronimo*, not printed till 1605. This is not regarded by the latest critics of the dramatist as being his work. On the other hand, it becomes more and more certain that what German criticism calls the *Ur-Hamlet*, the original draft of the tragedy of the Prince of Denmark, was a lost work by Kyd, probably composed by him in 1587. This theory has been very elaborately worked out by Professor Sarrazin, and confirmed by Professor Boas; these scholars are doubtless right in holding that traces of Kyd's play survive in the first two acts of the 1603 First Quarto of *Hamlet*, but in our opinion they go too far in attributing much of the actual language of the last three acts to Kyd. Kyd's next work was in all probability the tragedy of *Soliman and Perseda*, written perhaps in 1588 and published in 1592. No copy of the first edition has come down to us; but it was reprinted after Kyd's death, in 1599. In the summer or autumn of 1590 Kyd seems to have given up writing for the stage, and to have entered the service of an unnamed lord, who employed a troop of "players." Kyd was probably the private secretary of this nobleman, in whom Professor Boas sees Robert Radcliffe, afterwards fifth earl of Sussex. To the wife of the earl (Bridget Morison of Cassiobury) Kyd dedicated in the last year of his life his translation of Garnier's *Cornelia* (1594), the only work to which Kyd attached his name. Two prose works of the dramatist have survived, a treatise on domestic economy, *The Householder's Philosophy*, 1588; and a sensational account of *The most wicked and secret Murdering of John Brewer, Goldsmith*, 1592. That many of Kyd's plays and poems have been lost is proved by the fact that fragments exist, attributed to him, which are found in no surviving context. Towards the close of his life Kyd was brought into relations with Marlowe which place his character in rather a painful light. It would seem that in 1590, soon after he entered the service of his nobleman, Kyd formed the acquaintance of Marlowe. If the former is to be believed, he shrank at once from the latter, as a man "intemperate and of a cruel heart," and "irreligious." This, however, was said by Kyd with the rope round his neck, and is scarcely consistent with a good deal of apparent intimacy between him and Marlowe. When, in May 1593, the "lewd libels" and "blasphemies" of Marlowe came before the notice of the Star Chamber, Kyd was immediately arrested, papers of his having been found "shuffled" with some of Marlowe's, who was imprisoned a week later. The pretence on which Kyd was arrested was the suspicion of his having attached a seditious libel to the wall of the Dutch churchyard. Kyd was put to the torture, but nothing was obtained from him in the way of confession. The most serious point made against him was the discovery in his chamber of a paper of "vile heretical conceits denying the deity of Jesus Christ." Kyd, in an agony of apprehension, asserted that he knew nothing of this document, and tried to shift the responsibility of it upon Marlowe, but he was kept in prison until after the death of that poet (1st June 1593). When he was at length dismissed, his patron refused to take him back into his service. The poet fell into utter destitution, and sank under the weight of "bitter times and privy broken passions." He must have died late in 1594, and on the 30th of December of that year his parents renounced their administration of the goods of their deceased son, in a document of great importance lately discovered by Professor Schick. This posthumous repudiation of the tortured and beggared poet by his respectable parents is the last touch needed to complete the gloomy portrait of Kyd which recent scholarship has filled up.

The importance of Kyd, as the pioneer in the wonderful movement of secular drama in England, gives great interest to his works, and we are now able at last to assert what many critics have long conjectured, that he takes in that movement the position of a leader and almost of an inventor. Regarded from this point of view, *The Spanish Tragedy* is a work of extraordinary value, since it is the earliest specimen of effective stage poetry existing in English literature. It had been preceded only by the pageant-poems of Peele and Lyly, in which all that constitutes in the modern sense theatrical technique and effective construction was entirely absent. These gifts, in which the whole power of the theatre as a place of general entertainment was to consist, were supplied earliest among English playwrights to Kyd, and were first exercised by him, so far as we can see, in 1586. This, then, is a more or less definite starting-date for Elizabethan drama, and of peculiar value to its historians. Curiously enough, *The Spanish Tragedy*, which was the earliest stage-play of the great period, was also the most popular, and held its own right through the careers of Shakepeare, Ben Jonson, and Fletcher. It was not any shortcoming in its harrowing and exciting plot, but the tameness of its archaic versification, which probably led in 1602 to its receiving "additions," which have been a great stumbling-block to the critics. It is known that Ben Jonson was paid for these additional scenes, but they are extremely unlike all other known writings of his, and several scholars have independently conjectured that Webster wrote them. Of Kyd himself it seems needful to point out that neither the Germans nor even Professor Boas seems to realize how little definite merit his poetry has. He is important, not in himself, but as a pioneer. The influence of Kyd is marked on all the immediate predecessors of Shakespeare, and the bold way in which scenes of violent crime were treated on the Elizabethan stage appears to be directly owing to the example of Kyd's innovating genius. His relation to *Hamlet* has already been noted, and *Titus Andronicus* presents and exaggerates so many of his characteristics that Mr Sidney Lee and others have supposed that tragedy to be a work of Kyd's touched up by Shakespeare. Professor Boas, however, brings cogent objections against this theory, founding them on what he considers the imitative inferiority of *Titus Andronicus* to *The Spanish Tragedy.* The German critics have pushed too far their attempt to find indications of Kyd's influence on later plays of Shakespeare. The extraordinary interest felt for Kyd in Germany is explained by the fact that *The Spanish Tragedy* was long the best known of all Elizabethan plays abroad. It was acted at Frankfurt in 1601, and published soon afterwards at Nuremberg. It continued to be a stock piece in Germany until the beginning of the 18th century; it was equally popular in Holland, and potent in its effect upon Dutch dramatic literature. Kyd's works were first collected and his life written by Professor Frederick S. Boas in 1901. The principal German authorities are Sarrazin (1892), Fischer (1893), Gassner (1894), Fleischer (1896), and Schick (1898). (E. G.)

Kyffhäuser, a double line of hills in Thuringia, Germany, of which the northern looks steeply down upon the valley of the Goldene Aue, and is crowned by a couple of ruined castles—Rothenburg (1440 feet) on the west, and Kyffhausen (1542 feet) on the east. The latter, built probably in the 10th century, was frequently the residence of the Hohenstaufen emperors, and was finally destroyed in the 16th century. It is surmounted by an imposing monument to the Emperor William I., 213 feet high, the equestrian statue of the emperor alone being 31 feet high. According to a popular and long-accepted legend, the Emperor Barbarossa (Frederick I.) sits asleep beside a marble table in the interior of the mountain, surrounded by his knights, awaiting the destined day when he shall awaken and lead the united peoples of Germany against the enemies of the empire, and so inaugurate an era of unexampled glory. But G. Vogt has advanced cogent reasons (see *Hist. Zeitschrift*, vol. xxvi. pp. 131–187) for believing that the real hero of the legend is the last of the great Hohenstaufen emperors, namely Frederick II., not Frederick I. Around him gradually crystallized the hopes of the German peoples, and to him they looked for help in the hour of their sorest need. But this is not the only legend of a slumbering future deliverer which lives on in Germany. Similar hopes cling to the memory of Charlemagne, sleeping in a hill near Paderborn; to that of Wedekind, in a hill in Westphalia; to Siegfried, in the hill of Geroldseck; and to Henry I., in a hill near Goslar. And the legend has its parallel amongst other peoples—*e.g.*, the English looked for the second coming of King Arthur, the Danes for that of Holger Danske, the Swedes for that of King Olaf, the Portuguese for that of Dom Sebastian, the ancient Persians for that of Rustam, and so forth.

Kyôsai, Sho-fu (1831–1889), Japanese painter, was born at Koga in the province of Shimotsuke, Japan, in 1831. After working for a short time, as a boy, with Kuniyoshi, he received his artistic training in the studio of Kanô Dôhaku, but soon abandoned the formal traditions of his master for the greater freedom of the popular school. During the political ferment which produced and followed the revolution of 1867, Kyôsai attained a considerable reputation as a caricaturist. He was three times arrested and imprisoned by the authorities of the Shogunate. Soon after the assumption of effective power by the Mikado, a great congress of painters and men of letters was held, at which Kyôsai was present. He again expressed his opinion of the new movement in a caricature, which had a great popular success, but also brought him into the hands of the police, this time of the opposite party. Kyôsai must be considered as the greatest successor of Hokusai (of whom, however, he was not a pupil), and as the first political caricaturist of Japan. His work —like his life—is somewhat wild and undisciplined, and "occasionally smacks of the *saké* cup." But if he did not possess Hokusai's dignity, power, and reticence, he substituted an exuberant fancy, which always lends interest to draughtsmanship of very great technical excellence. In addition to his caricatures, Kyôsai painted a large number of pictures and sketches, often choosing subjects from the folk-lore of his country. A fine collection of these works is preserved in the British Museum; and there are also good examples in the National Art Library at South Kensington, and the Musée Guimet at Paris. Among his illustrated books may be mentioned *Yehon Taka-kagami*, Illustrations of Hawks (5 vols. 1870, &c.); *Kyôsai Gwafu* (1880); *Kyôsai Dongwa; Kyôsai Raku-gwa; Kyôsai Riaku-gwa; Kyôsai Mangwa* (1881); *Kyôsai Suigwa* (1882); and *Kyôsai Gwaden* (1887). The latter is illustrated by him under the name of Kawanabe Tôyoku, and two of its four volumes are devoted to an account of his own art and life. He died in 1889, at the age of fifty-eight.

See GUIMET (É.) and REGAMEY (F.). *Promenades Japonaises.* Paris, 1880.—ANDERSON (W.). *Catalogue of Japanese Paintings in the British Museum.* London, 1886.—MORTIMER MENPES. "A Personal View of Japanese Art: A Lesson from Kyôsai," *Magazine of Art*, 1888. (E. F. S.)

Kyshtym, a town and iron-works of Russia, government of Perm, and 56 miles by rail east of Tchelyabinsk, on the Siberian main line, and on a river of the same name which connects two lakes. The official name is Upper (Verkhne) Kyshtymskiy Zavod, in order to distinguish it from the Lower (Nizhne K.) works, situated 2 miles lower down the same river. Nearly 26,000 tons of iron and iron goods are turned out yearly at these two works, which employ more than 2500 workers. Population, 12,331.

Labiche, Eugène Marie (1815–1888), French dramatist, was born in Paris on 5th May 1815, of *bourgeois* parentage. On leaving school he began reading for the bar, but literature had more powerful attractions, and he was hardly twenty years old when he gave to the *Chérubin* —an impertinent little magazine, long vanished and forgotten—a short story, entitled, in the cavalier style of the period, *Les plus belles sont les plus fausses.* A few others followed much in the same strain, but failed to catch the attention of the public. Labiche, as far as we are able to conjecture from his private correspondence, was much impressed by the great works of the flourishing romantic school. Very little trace, however, of its influence can be found in his first literary attempts. He tried his hand at dramatic criticism in the *Revue des Théâtres,* and in 1838 made a double venture on the stage. The small Théâtre du Panthéon produced, amid some signs of popular favour, a drama of his, *L'avocat Loubet,* while a vaudeville, *Coyllin ou l'homme infiniment poli,* written in collaboration with Marc Michel, and given at the Palais Royal, introduced for the first time to the Parisians a provincial actor who was to become and to remain a great favourite with them, Grassot, the famous low comedian. In the following year Labiche, still doubtful about his true vocation, published a romance called *La Clé des Champs.* M. Halévy, his successor at the Academy and his panegyrist, informs us that the publisher became a bankrupt soon after the novel was out. "A lucky misadventure, for," the biographer concludes, "this timely warning of Destiny sent him back to the stage, where a career of success was awaiting him." There was yet another obstacle in the way. When he married, he solemnly promised to his wife's parents that he would renounce once for all a profession then considered incompatible with moral regularity and domestic happiness. But a year afterwards his wife spontaneously released him from his vow, and Labiche many years afterwards recalled the incident when he dedicated the first edition of his complete works—"To my wife." Labiche, in conjunction with Varin, Marc Michel, Clairville, and Dumanoir, contributed comic plays interspersed with couplets to various Paris theatres. The series culminated in the memorable farce in five acts, *Un chapeau de paille d'Italie* (August 1851). It remains to this day an accomplished specimen of the French *imbroglio* in which some one is in search of something, but does not find it till five minutes before the curtain falls. Prior to that date Labiche had been only a successful *vaudevilliste* among a crowd of others; but a twelvemonth later he made a new departure in *Le Misanthrope et l'Auvergnat.* All the plays given for the next twenty-five years, although constructed on the old plan, contained a more or less appreciable dose of that comic observation and good sense which gradually raised the French farce almost to the level of the comedy of character and manners. "Of all the subjects," he said, "which offered themselves to me, I have selected the *bourgeois.* Essentially mediocre in his vices and in his virtues, he stands half-way between the hero and the scoundrel, between the saint and the profligate." During the second period of his career Labiche had the collaboration of Delacour, Choler, and a few others. When it is asked what share in the authorship and success of the plays may be claimed for those men, we shall answer in Émile Augier's words: "The distinctive qualities which secured a lasting vogue for the plays of Labiche are to be found in all the comedies written by him with different collaborators, and are conspicuously absent from those which they wrote without him." All that is known of his literary methods leads to the same conclusion, namely, that he was both the leading spirit and the working hand in the combined effort. A more useful and more important collaborator he found in Geoffroy, whom he had known as a *débutant* in his younger days, and who remained his faithful interpreter to the last. Geoffroy impersonated the *bourgeois* not only to the public, but to the author himself; and it may be assumed that Labiche, when writing, could see and hear Geoffroy acting the character and uttering, in his pompous, fussy way, the words that he had just committed to paper.

Célimare le bien-aimé, Le Voyage de Perrichon, La Grammaire, Un Pied dans le Crime, La Cagnotte, may be quoted here as the happiest productions of Labiche. In 1877 he deliberately brought his connexion with the stage to a close, and retired to his rural property in Sologne. There he could be seen every day, dressed as a farmer,

THE CALLIGRAPHER ONO-NO-TŌFŪ WATCHING THE PERSEVERANCE OF THE FROGS (a similar story to that of Bruce and the Spider). Painted by KYÔSAI.

(*Victoria and Albert Museum.*)

THE STORY OF THE HARES AND THE WICKED RACOON-DOG (*Tanuki*); THE OLD WOMAN MEETING THE RACOON IN THE DISGUISE OF HER HUSBAND. Painted by KYÔSAI in 1868.

(*Victoria and Albert Museum.*)

with low-brimmed hat, thick gaiters, and an enormous stick, superintending the agricultural work and busily engaged in reclaiming land and marshes. His lifelong friend, Augier, visited him in his principality, and, being left alone one day in the library, took to reading his host's dramatic productions, scattered here and there in the shape of theatrical *brochures*. The result was that he strongly advised Labiche to publish a collected and revised edition of his works. The suggestion, first declined as a joke and long resisted, was finally accepted and carried into effect. Labiche's comic plays, in ten volumes, were issued, by successive instalments, during 1878 and 1879. The success was even greater than had been expected by the author's most sanguine friends. It had been commonly admitted that these plays owed their popularity in a great measure to the favourite actors who had appeared in them; but it was now discovered that, on the contrary, all, with the exception of Geoffroy, had introduced into them a grotesque and caricatural element, thus hiding from the spectator, in many cases, the true comic vein and delightful delineation of human character. The amazement turned into admiration, and the *engouement* became so general that very few dared grumble or appear scandalized when, in 1880, Labiche was elected to the French Academy. It was fortunate that, in former years, he had never dreamt of attaining this high distinction; for, as M. Pailleron justly observed, while trying to get rid of the little faults which were in him, he would have been in danger of losing some of his sterling qualities. But when the honour was bestowed upon him, he enjoyed it with his usual good sense and quiet modesty. He died in Paris on 23rd January 1888.

Some foolish admirers have placed him on a par with Molière, but it will be enough to say that he was something better than a public *amuseur*. Many of his plays have been transferred to the English stage. They are, on the whole, as sound as they are entertaining. Love is practically absent from his theatre. In none of his plays did he ever venture into the depths of feminine psychology, and womankind is only represented in them by pretentious old maids and silly, insipid, almost dumb, young ladies. He ridiculed marriage according to the invariable custom of French playwrights, but in a friendly and good-natured manner which always left a door open to repentance and timely amendment. He is never coarse, never suggestive. After he died, the French farce, which he had raised to something akin to literature, relapsed into its former grossness and unmeaning complexity. (A. FI.)

LABOUR LEGISLATION.

I. UNITED KINGDOM.

Factories and Workshops.—Since 1878 most important developments of legislation for the protection of labour in industry have been made in the division of the law which relates particularly to factories and workshops. The Act of 1878 remained until 1901, although much had been meanwhile superimposed, a monument to the efforts of the great factory reformers of the first half of the 19th century, and the general groundwork of safety for workers in factories and workshops in the main divisions of sanitation, security against accidents, physical fitness of workers, general limitation of hours and times of employment for young workers and women. The Act of 1901, which came into force 1st January 1902, was an amending as well as a consolidating Act. Comparison of the two Acts shows, however, that, in spite of the advantages of further consolidation and helpful changes in arrangement of sections and important additions which tend towards a specialized hygiene for factory life, the fundamental features of the law as fought out in the 19th century remain untouched. So far as the law has altered in character, it has done so by gradual development of certain sanitary features, originally subordinate, and not by retreat from its earlier aims.

The precise effect of the new law as a whole, with its considerable amendments, has in working yet to be tested, but its general intention can be made clear by reference to the Acts and decisions which it embodies.

Additions to Act of 1878.

The Act of 1878, in a series of Acts from 1883 to 1895, received striking additions, based (1) on the experience gained in other branches of protective legislation, *e.g.*, development of the method of regulation by "special rules" and administrative inquiry into accidents under Coal Mines Acts; (2) on the findings of royal commissions and parliamentary inquiries, *e.g.*, increased control of "outwork" and domestic workshops, and limitation of "overtime"; (3) on the development of administrative machinery for enforcing the more modern law relating to public health, *e.g.*, transference of administration of sanitary provisions in workshops to the local sanitary authorities; (4) on the trade union demand for means for securing trustworthy records of wage-contracts between employer and workman, *e.g.*, the section requiring particulars of work and wages for piece-workers. The first additions to the Act of 1878 were, however, almost purely attempts to deal more adequately than had been attempted in the code of 1878 with striking instances of trades injurious to health, without any suggestion of a groundwork for future regulation of other injurious or dangerous trades. Thus the Factory and Workshop Act of 1883 provided that white-lead factories should not be carried on without a certificate of conformity with certain conditions, and also made provision for special rules, on lines superseded by those laid down in the Act of 1891, applicable to any employment in a factory or workshop certified as dangerous or injurious by the Secretary of State. The Act of 1883 also dealt with sanitary conditions in bakehouses, a class of workplaces liable to be a menace to public health as well as injurious to workers if the strictest hygienic conditions are not fully observed. Certain definitions and explanations of previous enactments touching overtime and employment of a child in any factory or workshop were also included in the Act of 1883. A class of factories in which excessive heat and humidity seriously affected the health of operatives was next dealt with in the Cotton Cloth Factories Act, 1889. This provided for special notice to the Chief Inspector from all occupiers of cotton cloth factories (*i.e.*, any room, shed, or workshop, or part thereof, in which weaving of cotton cloth is carried on) who intend to produce humidity by artificial means; regulated both temperature of workrooms and amount of moisture in the atmosphere, and provided for tests and records of the same; and fixed a standard minimum volume of fresh air (600 cubic feet) to be admitted in every hour for every person employed in the factory. Power was retained for the Secretary of State to modify by order the standard for the maximum limit of humidity of the atmosphere at any given temperature. A short Act of two clauses in 1897 extended this power to other measures for the protection of health, recommended by a departmental committee appointed to inquire into the working of the Act of 1889.

The special measures from 1878 to 1889 gave valuable precedents for further developments of special hygiene in factory life, but the next advance, in the Factory and Workshop Act, 1891, following as it did on the House of Lords Committee on the sweating system and the Berlin International Labour Conference, extended over much wider ground. Its principal objects were: (*a*) to render administration of the law relating to workshops more efficient, particularly as regards sanitation; with this end in view it made the primary controlling authority for sanitary matters in workshops the local sanitary authority (now known as the District Council), acting by their officers, and giving them for the purpose the powers of the less numerous body of factory inspectors, while at the same time the provisions of the Public Health Acts replaced in workshops the very similar sanitary provisions of the Factory Acts; (*b*) to provide for greater security against accidents and more efficient fencing of machinery in factories; (*c*) to extend the method of regulation of unhealthy or dangerous occupations by application of special rules and requirements to any incident of employment (other than in a domestic workshop) certified by the Secretary of State to be dangerous or injurious to health or dangerous to life or limb; (*d*) to raise the age of employment of children and restrict the employment of women immediately after childbirth; (*e*) to require particulars of rate of wages to be given with work to piece-workers in certain branches of the textile industries; (*f*) to amend the Act of 1878 in various subsidiary ways, with the view of improving the administration of its principles, *e.g.*, by increasing the means of checking the amount of overtime worked, empowering inspectors to enter workplaces used as dwellings without a justice's warrant, and the imposition of minimum penalties in certain cases. On this Act followed a period of four years of greatly accelerated administrative activity and application of the new powers to make detailed regulations for the promotion of special hygiene in unhealthy industries. No fewer than sixteen trades were in four years scheduled by the Secretary of State as dangerous to health. The manner of preparing and establishing suitable rules (greatly modified by the Act of 1901) will be dealt with below.

The Factory and Workshop Act, 1895, followed thus on a period of exercise of new powers of administrative regulation (the period being also that during which the Royal Commission on Labour made its wide survey of industrial conditions), and after two successive annual reports of the Chief Inspector of Factories had embodied reports and recommendations from the women inspectors, who in 1893 were first added to the inspectorate. Again, the chief features of an even wider legislative effort than that of 1891 were the increased stringency and definiteness of the measures for securing hygienic and safe conditions of work. Some of these measures, however, involved the introduction of new principles, as in the provision for the prohibition of the use of a dangerous machine or structure by the order of a magistrate's court, and the power to include in the special rules drawn up in pursuance of section 8 of the Act of 1891, the prohibition of the employment of any class of persons, or the limitation of the period of employment of any class of persons in any process scheduled by order of the Secretary of State. These last two powers have both been exercised, and with the exercise of the latter passed away, without opposition, the absolute freedom of the employer of the adult male labourer to carry on his manufacture without legislative limitation of the hours of labour. Second only in significance to these new developments was the addition, for the first time since 1867, of new classes of workplaces not covered by the general definitions in section 93 of the Consolidating Act of 1878, viz.: (*a*) laundries (with special conditions as to hours, &c.); (*b*) docks, wharves, quays, warehouses, and premises on which machinery worked by power is temporarily used for the purpose of the construction of a building or any structural work in connexion with the building (for the purpose only of obtaining security against accidents). Other entirely new provisions in the Act of 1895, later strengthened by the Act of 1901, were the requirement of a reasonable temperature in workrooms, the requirement of lavatories for the use of persons employed in any department where poisonous substances are used, the obligation on occupiers and medical practitioners to report cases of industrial poisoning; and the penalties imposed on an employer wilfully allowing wearing apparel to be made, cleaned, or repaired in a dwelling-house where an inmate is suffering from infectious disease. Another provision was new, which aimed at empowering the Secretary of State to specify classes of outwork and areas with a view to the regulation of the sanitary condition of premises in which outworkers are employed. Owing, however, to the conditions attached to its exercise, no case was found in which this power could come into operation, and the Act of 1901 deals with the matter on new lines. The requirement of annual returns from occupiers of persons employed, and the competency of the person charged with infringing the Act to give evidence in his defence, were two important new provisions calling for notice, as also the adoption of the powers to direct a formal investigation of any accident on the lines laid down in section 45 of the Coal Mines Regulation Act, 1887. Other sections, relating to sanitation and safety, were developments of previous regulations rather than fresh departures, *e.g.*, the fixing of a standard of overcrowding, provision of sanitary accommodation separate for each sex where the standard of the Public Health Act Amendment Act of 1890 had not been adopted, power to order a fan or other mechanical means to carry off injurious gas, vapour, or other impurity (the previous power covering only dust). Under the head of safety, the fencing of machinery and definition of accidents were made more precise, young persons were prohibited from cleaning dangerous machinery, and additional safeguards against risk of injury by fire or panic were introduced. On the question of employment the two foremost amendments lay in the almost complete prohibition of overtime for young persons, and the restriction of the power of an employer to employ protected persons outside his factory or workshop on the same day that he had employed them in the factory or workshop. Under the head of particulars of work and wages to piece-workers an important and new power, highly valued by the workers, was given to apply the principle with the necessary modifications by order of the Secretary of State to industries other than textile.

In 1899 an indirect modification of the limitation to employment of children was effected by the Elementary Education Amendment Act, which, by raising from eleven to twelve years the minimum age at which a child may, by the bye-laws of a local authority, obtain a total or partial exemption from the obligation to attend school, made it unlawful for an occupier to take into employment any child under twelve years in such a manner as to prevent full-time attendance at school. The age of employment became generally thereby the same as it has been for employment at a mine above ground since 1887. The Act of 1901 makes the prohibition of employment of a child under twelve years of age in a factory or workshop direct and absolute. Under the divisions of sanitation, safety, fitness for employment, special regulation of dangerous trades, special control of bake-

The Act of 1901.

houses, exceptional treatment of creameries, new methods of dealing with home work and outworkers, important additions have been made to the general law by the Act of 1901, as also in various regulations for strengthened administrative control. New general sanitary provisions are those prescribing: (*a*) ventilation *per se* for every workroom, and empowering the Secretary of State to fix a standard of sufficient ventilation; (*b*) drainage of wet floors; (*c*) the power of the Secretary of State to define in certain cases what shall constitute sufficient and suitable sanitary accommodation. New safety provisions are those relating to—(*a*) Examination and report on steam boilers; (*b*) prohibition of employment of a child in cleaning below machinery in motion; (*c*) power of the District Council to make bye-laws for escape in case of fire. The most important administrative alterations are the following: (*a*) A justice engaged in the same trade as, or being officer of an association of persons engaged in the same trade as, a person charged with an offence may not act at the hearing and determination of the charge; (*b*) ordinary supervision of sanitary conditions under which outwork is carried on is transferred to the District Council, full power being reserved to the Home Office to intervene in case of neglect or default by any District Council.

The following paragraphs aim at presenting an idea of the scope of the modified and amended law, as a whole, adding where clearly necessary reference to the effect of the Acts of 1878 to 1889, which ceased to apply after 31st December 1901:—

Definitions.

The workplaces to which the Act applies are, first, "factories" and "workshops"; secondly, laundries, docks, wharves, &c., enumerated above as introduced and regulated partially only by the Act of 1895. Apart from this secondary list, and having regard to workplaces which remain undefined by the law, the Act may broadly be said to apply to premises, rooms, or places in which manual labour, with or without the aid of mechanical power, is exercised for gain in or incidental to the making, altering, repairing, ornamenting, or finishing or adapting for sale of any article or part of any article. If steam, water, or other mechanical power is used in aid of the manufacturing process, the workplace is a factory; if not, it is a workshop. There is, however, a list of eighteen classes of works (brought under the factory law for reasons of safety, &c., before workshops generally were regulated) which are defined as factories whether power is used in them or not. Factories are, again, subdivided into textile and non-textile: they are textile if the machinery is employed in preparing, manufacturing, or finishing cotton, wool, hair, silk, flax, hemp, jute, tow, China grass, cocoanut fibre, or other like material either separately or mixed together, or mixed with any other material, or any fabric made thereof; all other factories are non-textile. The distinction turns on the historical origin of factory regulation, the earliest places calling for regulation having been the textile factories, and the regulations remain in some respects slightly more stringent than in the non-textile factories and workshops, though the general provisions are almost the same. Three special classes of workshops have for certain purposes to be distinguished from ordinary workshops, which include tenement workshops: (*a*) Domestic workshops, *i.e.*, any private house, room, or place, which, though used as a dwelling, is by reason of the work carried on there a workshop, and in which the only persons employed are members of the same family, dwelling there alone—in these women's hours are unrestricted; (*b*) Women's workshops, in which neither children nor young persons are employed—in these a more elastic arrangement of hours is permissible than in ordinary workshops; (*c*) Workshops in which men only are employed—these come under the same general regulations in regard to sanitation as other workshops, also under the provisions of the Factory Act as regards security, and, if certified by the Secretary of State, may be brought under special regulations. They are otherwise outside the scope of the Act of 1901.

The persons to whom the regulations apply in the above-defined workplaces are *children*, *i.e.*, persons between the ages of twelve and fourteen, *young persons*, *i.e.*, boys or girls between the ages of fourteen (or if an educational certificate has been obtained, thirteen) and eighteen years of age, and *women*, *i.e.*, female persons above the age of eighteen; these are all "protected" persons to whom the general provisions of the Act, inclusive of the regulation of hours and times of employment, apply. To adult men generally those provisions broadly only apply which are aimed at securing sanitation and safety in the conduct of the manufacturing process.

The person generally responsible for observance of the provisions of the law, whether these relate to health, safety, limitation of the hours of labour, or other matters, is the *occupier* (a term undefined in the Act) of the factory, workshop, or laundry. There are, however, limits to his responsibility: (*a*) generally, where the occupier has used due diligence to enforce the execution of the Act, and can show that another person, whether agent, servant, workman, or other person, is the real offender; (*b*) specially in a factory the sections relating to employment of protected persons, where the owner or hirer of a machine or implement driven by mechanical power is some person other than the occupier of the factory, the owner or hirer, so far as respects any offence against the Act committed in relation to a person who is employed in connexion with the machine or implement, and is in the employment or pay of the owner or hirer, shall be deemed to be the occupier of the factory; (*c*) for the one purpose of reporting accidents, the actual employer of the person injured in any factory or workshop is bound under penalty immediately to report the same to the occupier; (*d*) so far as relates to sanitary conditions, fencing of machinery, affixing of notices in *tenement* factories, the *owner* (as defined by the Public Health Act, 1875,) generally speaking, takes the place of the occupier.

Employment in a factory or workshop includes work whether for wages or not: (*a*) in a manufacturing process or handicraft, (*b*) in cleaning any place used for the same, (*c*) in cleaning or oiling any part of the machinery, (*d*) any work whatsoever incidental to the process or handicraft, or connected with the article made. Persons found in any part of the factory or workshop, where machinery is used or manufacture carried on, except at meal-times, or when machinery is stopped, are deemed to be employed until the contrary is proved. The Act, however, does not apply to employment for the sole purpose of repairing the premises or machinery, nor to the process of preserving and curing fish immediately upon its arrival in the fishing boats in order to prevent the fish from being destroyed or spoiled, nor to the process of cleaning and preparing fruit so far as is necessary to prevent it from spoiling during the months of June, July, August, and September. Certain light handicrafts carried on by a family only in a private house or room at irregular intervals are also outside the scope of the Act.

Sanitation.

The foremost provisions are those relating to the sanitary condition of the workplaces and the general security of every class of worker. Every factory must be kept in a cleanly condition, free from noxious effluvia, ventilated in such a manner as to render harmless, so far as practicable, gases, vapours, dust, or other impurities generated in the manufacture; must be provided with sufficient and suitable sanitary conveniences separate for the sexes; must not be overcrowded (not less than 250 cubic feet during the day, 400 during overtime, for each worker). In these matters the law of public health takes in workshops the place of the Factory Act, the requirements being substantially the same. Although, however, primarily the officers of the District Council enforce the sanitary provisions in workshops, the Government factory inspectors may give notice of any defect in them to the District Council in whose district they are situate; and if proceedings are not taken within one month by the latter, the factory inspector may act in default and recover expenses from the District Council. This power does not extend to domestic workshops which are under the law relating to public health so far as general sanitation is concerned. General powers are reserved to the Secretary of State, where he is satisfied that the Factory Act or law relating to public health as regards workplaces has not been carried out by any District Council, to authorize an inspector during a period named in his order to act instead of the District Council. Other general sanitary provisions administered by the Government inspectors are the requirement in factories and workshops of washing conveniences where poisonous substances are used; adequate measures for securing and maintaining a reasonable temperature of such a kind as will not interfere with the purity of the air in each room in which any person is employed; maintenance of sufficient means of ventilation in every room in a factory or workshop (in conformity with such standard as may be prescribed by order of the Secretary of State); provision of a fan to carry off injurious dust, gas, or other impurity, and prevent their inhalation in any factory or workshop; drainage of floors where wet processes are carried on. For laundries and bakehouses there are further sanitary regulations; *e.g.*, in laundries all stoves for heating irons shall be sufficiently separated from any ironing room, and the floors shall be "drained in such a manner as will allow the water to flow off freely"; and in bakehouses a system supplying water to a bakehouse must be quite separate from that supplying water to a water-closet, and the latter may not communicate directly with the bakehouse. Use of underground bakehouses (*i.e.*, a baking room with floor more than three feet below the ground adjoining) is prohibited, except where already used at the passing of the Act; further, in these cases, after 1st January 1904, a certificate as to suitability in light, ventilation, &c., must be obtained from the District Council. In other trades certified by the Secretary of State further sanitary regulations may be made to increase security for health by special rules to be presently touched on. The Secretary of State may also make sanitary requirements a condition of granting such exceptions to the general law as he is empowered in some cases to grant. In factories, as distinct from workshops, a periodical lime washing (or washing with hot water and soap where paint and varnish have been used) of all inside walls and ceilings once at least in every fourteen months is required (in bakehouses once in six months). As regards sufficiency and suitability of sanitary accommodation, any standard determined by order of the Secretary of State shall be observed in the districts to which it is made applicable.

Security and accidents.

Security in the use of machinery is provided for by precautions as regards the cleaning of machinery in motion and working between the fixed and traversing parts of self-acting machines driven by power, by fencing of machinery, and by empowering inspectors to obtain an order from a court of summary jurisdiction to prohibit the use, temporarily or absolutely, of machinery, ways, works or plant, including use of a steam boiler, which cannot be used without danger to life and limb. Every hoist and fly-wheel directly connected with mechanical power, and every part of a water-wheel or engine worked by mechanical power, and every wheel race, must be fenced, whatever its position, and every part of mill-gearing or dangerous machinery must either be fenced or be in such position that it is as safe as if fenced. No protected persons may clean any part of mill-gearing in motion, and children may further not clean any part of or below manufacturing machinery in motion by aid of mechanical power; young persons further may not clean any machinery if the inspector notifies it to the occupier as dangerous. Security as regards the use of dangerous premises is provided for by empowering courts of summary jurisdiction, on the application of an inspector, to prohibit their use until the danger has been removed. The District Council or, in London, the County Council, or in case of their default the factory inspector, can require certain provisions for escape in case of fire in factories and workshops, and for this purpose have special powers to make bye-laws. The means of escape must be kept free from obstruction. Certain provisions are also made for doors to open outwards in each room in which more than ten persons are employed, and to prevent the locking, bolting, or fastening of doors so that they cannot easily be opened from inside when any person is employed or at meals inside the workplace. Further, provisions for security may be provided in special regulations. Every boiler for generating steam in a factory or workshop or place where the Act applies must have a proper safety valve, a steam gauge, and a water gauge, and every such boiler, valve, and gauge must be maintained in proper condition. Examination by a competent person must take place at least once in every fourteen months. The occupier of any factory or workshop may be liable for penal compensation not exceeding £100 in case of injury or death due to neglect of any provision or special rule, the whole or any part of which may be applied for the benefit of the injured person or his family, as the Secretary of State determines. When a death has occurred by accident in a factory or workshop, the coroner must advise the Government inspector for the district of the place and time of the inquest. The Secretary of State may order a formal investigation of the circumstances of any accident, as in the case of mines (§§ 45 and 46 of the Act of 1887). Careful and detailed provisions are made for the reporting by occupiers to inspectors (and in some cases to certifying surgeons also) and entry in the registers at factories and workshops of accidents entailing absence from ordinary employment, and of cases of lead, phosphorus, arsenical and mercurial poisoning, or anthrax. The duty of reporting these industrial cases of poisoning is also laid on medical practitioners under whose observation they come. The list of classes of poisoning can be extended by the Secretary of State's order.

Certificates of physical fitness for employment must be obtained by the occupier from the certifying surgeon for the district for all persons under sixteen years of age employed in a factory, and an inspector may suspend any such persons for re-examination in a factory, or for examination in a workshop, when "disease or bodily infirmity" unfits the person, in his opinion, for the work of the place. An occupier of a factory or workshop or laundry shall not knowingly allow a woman to be employed therein within four weeks after childbirth.

Hours of protected persons.

The employment of children, young persons, and women is regulated as regards ordinary and exceptional hours of work, ordinary and exceptional meal-times, length of spells, and holidays. The outside limits of ordinary periods of employment and holidays are broadly the same for textile factories as for non-textile factories and workshops; the main difference lies in the requirement of not less than a total two hours' interval for meals out of the twelve, and a limit of four and a half hours for any spell of work, a longer weekly half holiday, and a prohibition of overtime, in textile factories, as compared with a total one and a half hours' interval for meals and a limit of five hours for spells and (conditional) permission of overtime in non-textile factories. The hours of work in all these cases must be specified, and from Monday to Friday may be between 6 A.M. and 6 P.M., or 7 A.M. to 7 P.M.; in non-textile factories and workshops the hours also may be taken between 8 A.M. and 8 P.M., or by order of the Secretary of State for special industries 9 A.M. to 9 P.M. Between these outside limits, with the proviso that meal-times must be fixed and limits as to spells observed, women and young persons may be employed the full time, children on the contrary only half time, on alternate days, or in alternate sets attending school half time regularly. On Saturdays, in textile factories in which the period commences at 6 A.M. all manufacturing work must cease at 12 if not less than one hour is given for meals, or 11.30 if less than one hour is given for meals (half an hour extra allowed for cleaning), and in non-textile factories and workshops at 2 P.M., 3 P.M., or 4 P.M., according as the hour of beginning is 6 A.M., 7 A.M., or 8 A.M. In "domestic workshops" the total number of hours for young persons and children must not exceed those allowed in ordinary workshops, but the outside limits for beginning and ending are wider; and the case is similar as regards hours of women in "women's workshops." Employment outside a factory or workshop in the business of the same is limited in a manner similar to that laid down in the Shop Hours Act, to be touched on presently. Overtime in certain classes of factories, workshops, and warehouses attached to them is permitted, under conditions specified in the Acts, for women, to meet seasonal or unforeseen pressure of business, or where goods of a perishable nature are dealt with, for young persons only in a very limited degree in factories liable to stoppage for drought or flood, or for an unfinished process. These and other cases of exceptional working are under minute and careful administrative regulations. Broadly these same regulations as to exceptional overtime apply in *laundries*, but the ordinary regulation of the period of employment does not; in them the period may be daily changed by the occupier, and the main general limit is to sixty hours a week for women and young persons, and thirty hours a week for children; the only regulation with regard to meal-times is that protected persons may not be employed for more than five hours without being allowed at least half an hour for a meal. Night work is allowed in certain specified industries under conditions for male young persons, but for no other workers under eighteen, and overtime for women may never, except in laundries, be later than 10 P.M. or before 6 A.M. Sunday work is prohibited except in laundries; and in factories, workshops, and laundries six holidays (generally the Bank holidays) must be allowed in the year. In creameries in which women and young persons are employed the Secretary of State may by special order vary the beginning and end of the daily period of employment, and allow employment for not more than three hours on Sundays and holidays.

Dangerous and unhealthy industries.

The general provisions of the Act may be supplemented where specially dangerous or unhealthy trades are carried on, by special regulations to meet the necessities of the case. This was provided for in the law in force until 31st December 1901, as in the new Act, and the power to establish rules had been exercised between 1892 and 1901 in the case of twenty-two trades or processes where injury arose either from handling of dangerous substances, such as lead and lead compounds, phosphorus, arsenic, or various chemicals, or where there is inhalation of irritant dust or noxious fumes, or where there is danger of explosion or infection of anthrax. Before the rule could be drawn up under the Acts of 1891 to 1895, the Secretary of State had to certify that in the particular case or class of cases in question (*e.g.*, process or machinery), there was, in his opinion, danger to life or limb or risk of injury to health; thereupon the Chief Inspector might propose to the occupier of the factory or workshop such special rules or measures as he thought necessary to meet the circumstances. The occupier might object or propose modifications, but if he did not the rules became binding in twenty-one days; if he objected, and the Secretary of State did not assent to any proposed modification, the matters in difference had to be referred to arbitration, the award in which finally settled the rules or requirement to be observed. In November 1901, in the case of the earthenware and china industry, the last arbitration of the kind was opened and partly concluded; certain points of difference were by the umpire adjourned for further consideration until May 1903. These points touch: (*a*) the nature or form of the poisonous material used; (*b*) medical examination and suspension of male adult workers. The parties to the arbitration were the Chief Inspector, on behalf of the Secretary of State, on the one hand, and the occupier or occupiers, on the other hand, but the workmen interested might be represented on the arbitration. In the establishing of the twenty-two sets of existing special rules only thrice has arbitration been resorted to, and only on two of these occasions were workmen represented. The provisions as to the arbitration were laid down in the first schedule to the Act of 1891, and were similar to those under the Coal Mines Regulation Acts. After rules were established the Secretary of State might from time to time propose new rules, or amendments of established rules, and the procedure was to be as nearly as possible the same as in the first instance. The rules might not only regulate conditions of employment, but also restrict or prohibit employment of any class of workers; where such restriction or prohibition affected adult workers the rules must be laid for forty days before both Houses of Parliament before coming into operation. The obligation to observe the rules in detail lies on workers as well as on occupiers, and the section in the Act of 1891 providing a penalty for non-observance was drafted, as in the case of the mines, so as to provide for a simultaneous fine for each (not exceeding two pounds for the worker, not exceeding ten pounds for the employer).

The provisions as to special regulations of the Act of 1901 touch primarily the method of procedure for making the regulations, but they also cover for the first time domestic workshops and add a power as to the kind of regulations that may be made; further, they strengthen the sanction for observance of any rules that may be established, by placing the occupier in the same general position as regards penalty for non-observance as in other matters under the Act. On the certificate of the Secretary of State that any manufacture, machinery, plant, process, or manual labour used in factories or workshops is dangerous or injurious to life, health, or limb, such regulations as appear to the Secretary of State to meet the necessity of the case may be made by him after he has duly published notice: (1) of his intention; (2) of the place where copies of the draft regulations can be obtained; and (3) of the time during which objections to them can be made by persons affected. The Secretary of State may modify the regulations to meet the objections made. If not, unless the objection is withdrawn or appears to him frivolous, he shall, before making the regulations, appoint a competent person to hold a public inquiry with regard to the draft regulations and to report to him thereon. The inquiry is to be made under such rules as the Secretary of State may lay down, and when the regulations are made, they must be laid as soon as possible before Parliament. Either House may annul these regulations or any of them, without prejudice to the power of the Secretary of State to make new regulations. The regulations may apply to all factories or workshops in which the certified manufacture, process, &c., is used, or to a specified class. They may, among other things, (*a*) prohibit or limit employment of any person or class of persons; (*b*) prohibit, limit, or control use of any material or process; (*c*) modify or extend special regulations contained in the Act.

Measures and particulars to piece-workers.

Although the Factory and Workshop Acts have not in any way directly regulated wages, they have made certain provision for securing to the worker that the amount agreed upon shall be received by him or her: (*a*) by extending every Act in force relating to the inspection of weights, measures, and weighing-machines for use in the sale of goods to those used in a factory or workshop for checking or ascertaining the wages of persons employed; (*b*) by ensuring that piece-workers in the textile trades (and other trades specified by the Secretary of State) shall receive, before commencing any piece of work, clear particulars of the wages applicable to the work to be done and of the work to which that rate is to be applied. Unless the particulars of work are ascertainable by an automatic indicator, they must be given to textile workers in writing, and in the case of weavers in the cotton, worsted, and woollen trades the particulars of wages must be supplied separately to each worker, and also shown on a placard in a conspicuous position. In other textile processes it is sufficient to furnish the particulars separately to each worker. The Secretary of State has used his powers to extend this protection to non-textile workers, with suitable modifications, in various branches of clothing and hardware industries. Under the new Act he further has power to extend this protection to outworkers.

Administration.

With a view to efficient administration of the Act (*a*) certain notices have to be conspicuously exhibited at the factory or workshop, (*b*) registers and lists kept, and (*c*) notices sent to the inspector by the occupier. Among the first the most important are the prescribed abstract of the Act, the names and addresses of the inspector and certifying surgeon, the period of employment, and specified meal-times (which may not be changed without fresh notice to the inspector), the number of persons who may legally be employed in each room, and prescribed particulars of exceptional employment; among the second are the general registers of children and young persons employed, of accidents, of overtime, and lists of outworkers; among the third are the notice of beginning to occupy a factory or workshop, which the occupier must send within one month, report of overtime employment, notice of accident, poisoning, or anthrax, and returns of persons employed, with such other particulars as may be prescribed. These must be sent to the Chief Inspector at intervals of not less than one and not more than three years, as may be directed by the Secretary of State.

The Secretary of State for the Home Department controls the administration of the Acts, appoints the inspectors referred to in the Acts, assigns to them their duties, and regulates the manner and cases in which they are to exercise the powers of inspectors defined in the Act. The Act, however, expressly assigns certain duties and powers to a chief inspector and certain to district inspectors. Many of the provisions of the Acts depend as to their operation on the making of orders by the Secretary of State. These orders may impose special obligations on occupiers and increase the stringency of regulations, may apply exceptions as to employment, or may relax regulations to meet special classes of circumstances. In certain cases, already indicated, his orders guide or determine the action of district councils, and, generally, in case of default by a council he may empower his inspectors to act as regards workplaces instead of the council, both under the Factory Acts and the Public Health Acts.

The powers of an inspector are to enter, inspect, and examine, by day or by night, at any reasonable time, any factory or workshop (or laundry, dock, &c.), or part of one, when he has reason to believe that any person is employed there; to take with him a constable if he has reasonable cause to expect obstruction; to require production of registers, certificates, &c., under the Acts; to examine, alone or in the presence of any other person, as he sees fit, every person in the factory or workshop, or in a school where the children employed are being educated; to prosecute, conduct, or defend before a court of summary jurisdiction any proceeding under the Acts; and to exercise such other powers as are necessary for carrying the Act into effect. The inspector has also the duty of enforcing the Truck Acts in places, and in respect of persons, under the Factory Acts. He may also have assigned to him by the Secretary of State the duty of enforcing the restrictions and conditions of any license for the employment of a child in places of public entertainment under the Prevention of Cruelty to Children Act, 1894. Certifying surgeons are appointed by the Chief Inspector subject to the regulations of the Secretary of State, and their chief duties are to examine workers under sixteen, and persons under special rules, as to physical fitness, and to investigate and report on accidents and cases of lead, phosphorus, or other poisoning, and anthrax.

In 1900 there were registered as under inspection 95,664 factories and 137,648 workshops (inclusive of laundries), 2097 docks, wharves, and quays, and 3907 warehouses. Of notices of accidents received there were 79,020, of which 1045 were fatal, and of cases of poisoning by lead, 1058; by mercury, 9; by phosphorus, 3; by arsenic, 22; and of anthrax, 37. Notices by inspectors to local sanitary authorities numbered 4542. Proceedings were taken by inspectors in 3287, and convictions obtained in 3151 cases.

Coal Mines.—The mode of progress to be recorded in the regulation of coal mines since 1872 can be contrasted in one aspect with the progress just recorded of factory legislation since 1878. Consolidation was earlier adopted when large amendments were found necessary, with the result that by far the greater part of the law is to be found in the Act of 1887 (50 and 51 Vict. cap. 58), which repealed and re-enacted, with amendments, the Coal Mines Acts of 1872 and 1886, and the Stratified Ironstone Mines (Gunpowder) Act, 1881. The Act of 1881 was simply concerned with rules relating to the use of explosives underground. The Act of 1886 dealt with three questions: (*a*) The election and payment of checkweighers (*i.e.*, the persons appointed and paid by miners in pursuance of section 13 of the Act of 1887 for the purpose of taking a correct account on their behalf of the weight of the mineral gotten by them, and for the correct determination of certain deductions for which they may be liable); (*b*) provision for new powers of the Secretary of State to direct a formal investigation of any explosion or accident, and its causes and circumstances, a provision which was later adopted in the law relating to factories; (*c*) provision enabling any relatives of persons whose death may have been caused by explosions or accidents in or about mines to attend in person, or by agent, coroners' inquests thereon, and to examine witnesses. The Act of 1887, which amended, strengthened, and consolidated these Acts and the earlier Consolidating Act of 1872, may also be contrasted in another aspect with the general Acts of factory legislation. In scope it formed, as its principal forerunner had done, a general code; and in some measure it went farther in the way of consolidation than the Factory Acts had done, inasmuch as certain questions, which in factories are dealt with by statutes distinct from the Factory Acts, have been included in the Mines Regulation Acts, *e.g.*, the prohibition of the payment of wages in public-houses, and the machinery relating to weights and measures whereby miners control their payment; further, partly from the less changing nature of the industry, but probably mainly from the power of expression gained for miners by their organization, the code, so far as it went, at each stage answered apparently on the whole more nearly to the views and needs of the persons protected than the parallel law relating to factories. This is strikingly seen in the evidence before the Royal Commission on Labour in 1892–94, where the repeated expressions of satisfaction on the part of the miners with the provisions as distinct from the administration of the code ("with a few trifling exceptions") are in marked contrast with the long and varied series of claims and contentions put forward for amendment of the Factory Acts.

Since the Act of 1887 there have followed only three minor Acts, based on the recommendation of the officials acting under the Acts, while two of them give effect to claims made by the miners before the Labour Commission. Thus, in 1894, the Coal Mines (Checkweigher) Act rendered it illegal for an employer ("owner, agent, or manager of any mine, or any person employed by or acting under the instructions of any such owner, agent, or manager") to make the removal of a particular checkweigher a condition of employment, or to exercise improper influence in the appointment of a checkweigher, carrying into effect the recommendations to the Labour Commission both of inspectors and miners. The need for this provision was demonstrated by a decision of the Court of Session in Edinburgh, which upheld an employer in his claim to the right of dismissing all the workmen and re-engaging them on condition that they would dismiss a particular checkweigher. In 1896 a short Act of seven sections extended the powers to propose, amend, and modify special rules, provided for representation of workmen on arbitration under the principal Act on any matter in difference, modified the provision for plans of mines in working and abandoned mines, amended three of the general rules (inspection before commencing work, use of safety lamp, and non-inflammable substances for stemming), and empowered the Secretary of State by order to prohibit or regulate the use of any explosive likely to become dangerous. In 1900 another brief Act raised the age of employment of boys underground from twelve to thirteen.

Act of 1887.

While the classes of mines regulated by the Act of 1887 are the same as those regulated by the Act of 1872 (*i.e.*, mines of coal, of stratified ironstone, of shale, and of fire-clay, including works above ground where the minerals are prepared for use by screening, washing, &c.), the interpretation of the term "mine" is rather wider and simpler, including "every shaft in the course of being sunk, and every level and inclined plane in the course of being driven, and all the shafts, levels, planes, works, tramways, and sidings, both below ground and above ground, in and adjacent to and belonging to the mine." Of the persons responsible under penalty for the observance of the Acts the term "owner" is defined precisely as in the Act of 1872, but the term "agent" is modified to mean "any person appointed as the representative of the owner in respect of any mine or any part thereof, and, as such, superior to a manager appointed in pursuance of this Act." Of the persons protected, the term "young person" disappears from the Act, and "boy," *i.e.*, "a male under the age of sixteen years," and "girl," *i.e.*, "a female under the age of sixteen years," take their place, and the term "woman" means, as before, "a female of the age of sixteen years and upwards." The prohibition of employment underground of women and girls remains untouched, and the prohibition of employment underground of boys has been successively extended from boys of the age of ten in 1872 to boys of twelve in 1887 and to boys of thirteen in 1900. The age of employment of boys and girls above ground in connexion with any mine is raised from ten years in 1872 to twelve years since 1887. The hours of employment of a boy below ground may not exceed fifty-four in any one week, nor ten in any one day from the time of leaving the surface to the time of returning to the surface. Above ground any boy or girl under thirteen (and over twelve) may not be employed on more than six days in any one week; if employed on more than three days in one week, the daily total must not exceed six hours, or in any other case ten hours. Protected persons above thirteen are limited to the same daily and weekly total of hours as boys below ground, but there are further provisions with regard to intervals for meals and prohibiting employment for more than five hours without an interval of at least half an hour for a meal. Registers must be kept of all protected persons, whether employed above or below ground. Section 38 of the Public Health Act, 1875, which requires separate and sufficient sanitary conveniences for persons of each sex, was first extended by the Act of 1887 to the portions of mines above ground in which girls and women are employed. Ventilation, the only other requirement in the Acts that can be classed as sanitary, is provided for in every mine in the "general rules" which are aimed at securing safety of mines, and which, so far as ventilation is concerned, seek to dilute and render harmless noxious or inflammable gases. The provision which prohibits employment of any persons in mines not provided with at least two shafts is made much more stringent by the Act of 1887 than in the previous code, by increasing the distance between the two shafts from 10 to 15 yards, and increasing the height of communications between them. Other provisions amended or strengthened are those relating to the following points: (*a*) Daily personal supervision of the mine by the certificated manager; (*b*) classes of certificates and constitution of board for granting certificates of competency; (*c*) plan of workings of any mine to be kept up to a date not more than three months previously at the office of the mine; (*d*) notice to be given to the inspector of the district by the owner, agent, or manager, of accidents in or about any mine which cause loss of life or personal injury: it is provided that the place where an explosion or accident occurs causing loss of life or serious personal injury shall be left for inspection for at least three days, unless this would tend to increase or continue a danger or impede working of the mine: this was new in the Act of 1887; (*e*) notice to be given of opening and abandonment of any mine: this was extended to the opening or abandonment of any seam; (*f*) plan of an abandoned mine or seam to be sent within three months; (*g*) formal investigation of any explosion or accident by direction of the Secretary of State: this provision, first introduced by the Act of 1886, was modified in 1887 to admit of the appointment by the Secretary of State of "any competent person" to hold the investigation, whereas under the earlier section only an inspector could be appointed.

General rules.

The "general rules" for safety in mines have been added to and strengthened in many ways since the Act of 1872. Particular mention may be made of rule 4 of the Act of 1887, relating to the inspection of conditions as to gas ventilation beyond appointed stations at the entrance to the mine or different parts of the mine; this rule generally removed the earlier distinction between mines in which inflammable gas has been found within the preceding twelve months, and mines in which it has not been so found; of rules 8, 9, 10, and 11, relating to the construction, use, &c., of safety lamps, which are more detailed and stringent than rule 7 of the Act of 1872, which they replaced; of rule 12, relating to the use of explosives below ground; of rule 24, which requires the appointment of a competent male person not less than twenty-two years of age for the purpose of working the machinery for lowering and raising persons at the mine; of rule 34, which first required provision of ambulances or stretchers with splints and bandages at the mine ready for immediate use; of rule 38, which strengthened the provision for periodical inspection of the mine by practical miners on behalf of the workmen at their own cost. With reference to the last-cited rule, it should be mentioned that during 1898 a Prussian mining commission visited Great Britain, France, and Belgium, with a view to studying and comparing the various methods of inspection by working miners established in these three countries. They found that, so far as the method had been applied, it was most satisfactory in Great Britain, where the whole cost is borne by the workers' own organizations, and they attributed part of the decrease in number of accidents per thousand employed since 1872 to the inauguration of this system.

Special rules.

The provisions as to the proposal, amendment, and modification of "special rules," last extended by the Act of 1896, may be contrasted with those of the Factory Act. In the latter it is not until an industry or process has been scheduled as dangerous or injurious by the Secretary of State's order that occasion arises for the formation of special rules, and then the initiative rests with the Factory Department, whereas in mines it is incumbent in every case on the owner, agent, or manager to propose within three months of the commencement of any working, for the approval of the Secretary of State, special rules best calculated to prevent dangerous accidents, and to provide for the safety, convenience, and proper discipline of the persons employed in or about the mine. These rules may, if they relate to lights and lamps used in the mine, description of explosives, watering and damping of the mine, or prevention of accidents from inflammable gas or coal dust, supersede any general rule in the principal Act. Apart from the initiation of the rules, the methods of establishing them, whether by agreement or by resort to arbitration of the two parties (*i.e.*, the mine owners and the Secretary of State), are practically the same as under the Factory Act, but there is a special provision in the Mines Acts for enabling the persons working in the mine to transmit objections to the proposed rules, in addition to their subsequent right to be represented on the arbitration, if any.

Of the sections touching on wages questions, the prohibition of the payment of wages in public-houses remains unaltered, being re-enacted in 1887; the sections relating to payment by weight for amount of mineral gotten by persons employed, and for checkweighing the amount by a "checkweigher" stationed by the majority of workers at each place appointed for the weighing of the material, were revised, particularly as to the determination of deductions by the Act of 1887, with a view to meeting some of the problems raised by decisions on cases under the Act of 1872. The attempt seems not to have been wholly successful, the highest legal authorities having expressed conflicting opinions on the precise meaning of the terms "mineral contracted to be gotten." The whole history of the development of this means of securing the fulfilment of wage contract to the workers may be compared with the history of the sections affording protection to piece-workers by particulars of work and wages in the textile trades since the Factory Act of 1891.

Administration.

As regards legal proceedings, the chief amendments of the Act of 1872 are: the extension of the provision that the "owner, agent, or manager" charged in respect of any contravention by another person might be sworn and examined as an ordinary witness, to any person charged with any offence under the Act. The result of the proceedings against workmen by the owner, agent, or manager in respect of an offence under the Act is to be reported within twenty-one days to the inspector of the district. The powers of inspectors were extended to cover an inquiry as to the care and treatment of horses and other animals used in the mine, and as to the control, management, or direction of the mine by the manager.

In 1900 the number of coal mines reported on was 3384, and the number of persons employed below ground was 624,223, of whom 47,663 were under 16 years of age. Above ground 155,829 were employed, of whom 4808 were women and girls. The number of separate fatal accidents was 962, causing the loss of 1012 lives. Of prosecutions by far the greater number were against workmen, numbering 646; owners and managers were prosecuted in 115 cases, and convictions obtained in 61 cases.

Quarries.—From 1878 until 1894 open quarries (as distinct from underground quarries regulated by the Metalliferous Mines Regulation Act) were regulated only by the Factory Acts so far as they then applied. It was laid down in section 93 of the Act of 1878 (41 Vict. c. 16), that "any premises or place shall not be excluded from the definition of a factory or workshop by reason only that such premises, &c., are or is in the open air," thereby overruling the decision in *Kent* v. *Astley* that quarries in which the work, as a whole, was carried on in the open air were not factories; in a schedule to the same Act quarries were defined as "any place not being a mine in which persons work in getting slate, stone, coprolites, or other minerals." The Factory Act of 1891 made it possible to bring these places in part under "special rules" adapted to meet the special risks and dangers of the operations carried on in them, and by order of the Secretary of State they were certified, 27th December 1892, as dangerous, and thereby subject to special rules. Until then it was, as reported by one of H.M. Inspectors of Factories, the case that quarries had been placed under the Factory Acts without insertion of appropriate rules for their safe working, and that many of them were "developed in a most dangerous manner without any regard for safety, but merely for economy," and that managers of many had "scarcely seen a quarry until they became managers." In his report for 1892 it was recommended by H.M. Chief Inspector of Factories that quarries should be subject to the jurisdiction of H.M. Inspectors of Mines. At the same time currency was given, by the published reports of the evidence before the Royal Commission on Labour, to the wish of large numbers of quarrymen that open as well as underground quarries should come under more specialized Government inspection. In 1893 a committee of experts, including inspectors of mines and of factories, was appointed by the Home Office to investigate the conditions of labour in open quarries, and to make recommendations. This committee proposed rules covering points not provided for by the Factory Acts, but pointed out that they could not be enforced under existing legislation, and that no special rules applied in open quarries where neither women nor young persons were employed, and they expressed the opinion that further legislation was necessary.

In 1894 the Quarries Act was passed, which brought every quarry, as defined in the Factory Act, 1878, any part of which is more than 20 feet deep, under certain of the provisions of the Metalliferous Mines Acts, and under the inspection of the inspectors appointed under those Acts; further, preventing conflict of jurisdiction, it transferred the duty of enforcing the Factory and Workshop Acts, so far as they apply in quarries over 20 feet deep, from the Factory to the Metalliferous Mines inspectors. The provisions of the Metalliferous Mines Acts, 1872 and 1875, applied to quarries, are those relating to payment of wages in public-houses, notice of accidents to the inspector, appointment and powers of inspectors, arbitration, coroners' inquests, special rules, penalties, certain of the definitions, and the powers of the Secretary of State finally to decide disputed questions whether places come within the application of the Acts. For other matters, and in particular fencing of machinery and employment of women and young persons, the Factory Acts apply, with a proviso that nothing shall prevent the employment of young persons (boys) in three shifts for not more than eight hours each. In 1899 it was reported by H.M. Inspectors of Mines that special rules for safety had been established in over 2000 quarries. The absence or deficiency of external fencing to a quarry dangerous to the public has been since 1887 (50 and 51 Vict. c. 19) deemed a nuisance liable to be dealt with summarily in the manner provided by the Public Health Act, 1875.

In 1900, 93,895 persons were employed, of whom 60,631 worked inside the actual pits or excavations, and 33,264 outside. Compared with 1899, there was a total decrease of 4100 in the number of persons employed, 3528 being among inside workers. Fatal accidents resulted in 127 deaths; compared with 1899 there was an increase of 10 in the number of deaths. As Prof. Le Neve Foster points out, this exceeds the average death-rate of underground workers at mines under the Coal Mines Acts during the last ten years, in spite of the quarrier "having nothing to fear from explosions of gas, underground fires, or inundations." He attributes the difference to a lax observance of precautions which may in time be remedied by stringent administration of the law. In 1900 there were 92 prosecutions against owners or agents, with 67 convictions, and 13 prosecutions of workers, with 12 convictions.

Payment of wages in public-houses.

In 1883 a short Act of five sections extended to all "workmen" who are manual labourers other than miners, with the exception of domestic or menial servants, the prohibition of payment of wages in public-houses, beer-shops, and other places for the sale of spirituous or fermented liquor, laid down in the Coal Mines Regulations and Metalliferous Mines Regulation Acts. The places covered by the prohibition include any office, garden, or place belonging to or occupied with the places named, but the Act does not apply to such wages as are paid by the resident, owner, or occupier of the public-house, beer-shop, and other places included in the prohibition to any workman *bonâ fide* employed by him. The penalty for an offence against this Act is one not exceeding £10 (compare the limit of £20 for the corresponding offence under the Coal Mines Act), and all offences may be prosecuted and penalties recovered in England and Scotland under the Summary Jurisdiction Acts. The Act, however, does not apply to Ireland, and no special inspectorate is charged with the duty of enforcing the Act, whether in relation to employés in factories, shops, docks, or elsewhere.

Shop Hours.—In four brief Acts, 1892 to 1899, the first very limited steps have been taken towards the regulation of the employment of shop assistants. In place of such general codes as apply to factories, laundries, mines—touching security, hygiene, limitation of daily periods, provision for holidays, &c.—only three kinds of protective requirement are binding on employers of shop assistants: (1) Limitation of the weekly total of hours of work of persons under eighteen years of age to seventy-four inclusive of meal-times; (2) prohibition of the employment of such persons in a shop on the same day that they have, to the knowledge of the employer, been employed in any factory or workshop for a longer period than would, in both classes of employment together, amount to the number of hours permitted to such persons in a factory or workshop; (3) provision for the supply of seats by the employer, in all rooms of a shop or other premises where goods are retailed to the public, for the use of female assistants employed in retailing the goods—the seats to be in the proportion of not fewer than one to every three female assistants. The first two of these requirements are contained in the Act of 1892, which also prescribed that a notice, referring to the provisions of the Act, and stating the number of hours in the week during which a young person may be lawfully employed in the shop, shall be kept exhibited by the employer; the third requirement was first provided by the Act of 1899. The two intervening Acts of 1893 and 1895 are merely supplementary to the Act of 1892; the former providing for the salaries and expenses of the inspectors which the council of any county or borough (and in the City of London the Common Council) were empowered by the Act of 1892 to appoint for the execution of the Act; the latter providing a penalty of forty shillings for failure of an employer to keep exhibited the notice of the provisions of the Acts which in the absence of a penalty it had hitherto been impossible to enforce. The penalty for employment contrary to the Acts is a fine not exceeding one pound for each person so employed, and for failure to comply with the requirement as to seats, a fine not exceeding three pounds for a first offence, and for any subsequent offence a fine of not less than one pound and not exceeding five pounds.

Meaning of "shop."

A wide interpretation is given by the Act of 1892 to the class of workplace to which the limitation of hours applies. "Shop" means retail and wholesale shops, markets, stalls, and warehouses in which assistants are employed for hire, and includes licensed public-houses and refreshment houses of any kind. The person responsible for the observance of the Acts is the "employer" of the "young persons" (*i.e.*, persons under the age of eighteen years), whose hours are limited, and of the "female assistants" for whom seats must be provided. Neither the term "employer" nor "shop assistant" (used in the title of the Act of 1899) is defined; but other terms have the meaning assigned to them in the Factory and Workshop Act, 1878. The "employer" has, in case of any contravention alleged, the same power as the "occupier" in the Factory Acts to exempt himself from fine on proof of due diligence and of the fact that some other person is the actual offender. The provisions of the Act of 1892 do not apply to members of the same family living in a house of which the shop forms part, or to members of the employer's family, or to any one wholly employed as a domestic servant.

In London, where the County Council has appointed 6 men and 3 women inspectors to apply the Acts of 1892 to 1899, there were, in 1900, 73,929 premises under inspection. All were visited at least once during the year, some repeatedly, and in 9204 irregularities were found. Proceedings were instituted in 117 cases, resulting in 93 convictions. In 1900 the number of young persons under the Acts were: indoors, 10,239 boys and 4428 girls; outdoors, 35,019 boys, 206 girls. As regards the Act of 1899, in only 1088 of the 14,844 shops affected in London was there failure to provide seats for the women employed in retailing goods. The Chief Officer of the Public Control Department reports that with very few exceptions the law is complied with at the end of the first year of its application.

As regards cleanliness, ventilation, drainage, water-supply, and sanitary condition generally, shops have been since 1878 (by 41 Vict. c. 16, sect. 101) subject to the provisions of the Public Health Act, 1875, which apply to all buildings, except factories under the Factory Acts, in which any persons, whatever their number be, are employed. Thus, broadly, the same sanitary provisions apply in shops as in workshops, but in the former these are enforced solely by the officers of the local authority, without reservation of any power, as in workshops for the Home Office inspectorate, to act in default of the local authority.

Shop assistants, so far as they are engaged in manual, not merely clerical labour, come also under the provisions of the Truck Acts 1831 to 1887, and in all circumstances they fall within the sections directed against unfair and unreasonable fines in the Truck Act of 1896; but, unlike employés in factories, workshops, laundries, and mines, they are left to apply these provisions so far as they can themselves, since neither Home Office inspectors nor officers of the local authority have any powers to administer the Truck Acts in shops.

Truck.—Setting aside the special Hosiery Manufacture (Wages) Act, 1874, which was aimed at a particular abuse appearing chiefly in the hosiery industry—the practice of making excessive charges on wages for machinery and frame rents—only two Acts have been added to the general law against truck since the Act of 1831, which repealed all prior Acts and which still remains the principal Act. The first of the two was the Truck Amendment Act, 1887, which amended and extended the Act without adding any distinctly new principle; the second was the Truck Act of 1896, which was directed towards providing remedies for matters clearly shown by various decisions under the earlier Truck Acts to be outside the scope of the principles and provisions of those Acts. Under the earlier Acts the main objects were: (1) to make the wages of workmen, *i.e.*, the reward of labour, payable only in current coin of the realm, and to prohibit whole or part payment of wages in food or drink or clothes or any other articles; (2) to forbid agreements, express or implied, between employer and workmen as to the manner or place in which, or articles on which, a workman shall expend his wages, or for the deduction of the price of articles (other than materials to be used in the labour of the workmen), supplied by the employer, from wages.

The Truck Act, 1887.

The Act of 1887 added a further prohibition by making it illegal for an employer to charge interest on any advance of wages, "whenever by agreement, custom, or otherwise a workman is entitled to receive in anticipation of the regular period of the payment of his wages an advance as part or on account thereof." Further, it strengthened the section of the principal Act which provided that no employer shall have any action against his workman for goods supplied at any shop belonging to the employer, or in which the employer is interested, by (*a*) securing any workman suing an employer for wages against any counter-claim in respect of goods supplied to the workman by any person under any order or direction of the employer, and (*b*) by expressly prohibiting an employer from dismissing any worker on account of any particular time, place, or manner of expending his wages. Certain exemptions to the prohibition of payment otherwise than in coin were provided for in the Act of 1831, if an agreement were made in writing and signed by the worker, viz., rent, victuals dressed and consumed under the employer's roof, medicine, fuel, provender for beasts of burden used in the trade, materials and tools for use by miners, advances for friendly societies or savings banks; in the case of fuel, provender, and tools, there was also a proviso that the charge should not exceed the real and true value. The Act of 1887 amended these provisions by requiring a correct annual audit in the case of deductions for medicine or tools, by permitting part payment of servants in husbandry in food, drink (not intoxicants) or other allowances, and by prohibiting any deductions for sharpening or repairing workmen's tools except by agreement not forming part of the condition of hiring. Two important administrative amendments were made by the Act of 1887: (1) a section similar to that in the Factory and Mines Acts was added, empowering the employer to exempt himself from penalty for contravention of the Acts on proof that any other person was the actual offender and of his own due diligence in enforcing the execution of the Acts; (2) the duty of enforcing the Acts in factories, workshops, and mines was imposed upon H.M. Inspectors of the Factory and Mines Departments respectively of the Home Office, and to their task they were empowered to bring all the authorities and powers which they possessed in virtue of the Acts under which they are appointed; these inspectors thus prosecute defaulting employers and recover penalties under the Summary Jurisdiction Acts, but they do not undertake civil proceedings for improper deductions or payments which would lie with workmen under the Employers and Workmen Act, 1875. The persons to whom the benefits of the Act applied were added to by the Act of 1887, which repealed the complicated list of trades contained in the principal Act and substituted the simpler definition of the Employers and Workmen Act just referred to. Thus the Acts 1831 to 1887, and also the Act of 1896, apply to all workers (men, women, and children) engaged in manual labour, except domestic servants; they apply not only in mines, factories, and workshops, but, to quote the published Home Office Memorandum on the Acts, "in all places where work-people are engaged in manual labour under a contract with an employer, whether or no the employer be an owner or agent or a parent, or be himself a workman; and therefore a workman who employs and pays others under him must also observe the Truck Acts." The law thus covers outworkers for a contractor or subcontractor. A decision of the High Court at Dublin in 1900 (*Squire* v. *Sweeney*) strengthened the inspectors in investigation of offences committed amongst outworkers by supporting the contention that inquiry and exercise of all the powers of an inspector could legally take place in parts of an employer's premises other than those in which the work is given out. It defined for Ireland, in a narrower sense than had hitherto been understood, the classes of outworkers protected, by deciding that only such as were under a contract personally to execute the work were covered.

Persons benefited by Truck Acts.

At the time of the passing of the Act of 1887 it seems to have been generally believed that the obligation under the principal Act to pay the "entire amount of wages earned" in coin precluded and rendered illegal any deductions from wages in respect of fines. Important decisions in 1888 and 1889 showed this belief to have been ill-founded. The essential point lies in the definition of the word "wages" as the "recompense, reward, or remuneration of labour," which implies not necessarily any gross sum in question between employer and workmen where there is a contract to perform a certain piece of work, but that part of it, the real *net* wage, which the workman was to get as his *recompense* for the labour performed. As soon as it became perfectly clear that excessive deductions from wages as well as payments by workers for materials used in the work were not illegal, and that deductions or payments by way of compensation to employers or by way of discipline might legally (with the single exception of fines for lateness for women and children, regulated by the Employers and Workmen Act, 1875) even exceed the degree of loss, hindrance, or damage to the employer, it also came clearly into view that further legislation was desirable in order to extend the principles at the root of the Truck Acts. It was desirable, that is to say, to hinder more fully the unfair dealing that may be encouraged by half-defined customs in work-places, on the part of the employer in making a contract, while at the same time leaving the principle of freedom of contract as far as possible untouched. The Truck Act of 1896 regulates the conditions under which deductions can be made by or payments made to the employer, out of the "sum contracted to be paid to the worker," *i.e.*, out of any gross sum whatever agreed upon between employer and workman. It makes such deductions or payments illegal unless they are in pursuance of a contract; and it provides that deductions (or payments) for (*a*) fines, (*b*) bad work and damaged goods, (*c*) materials, machines, and any other thing provided by the employer in relation to the work shall be reasonable, and that particulars of the same in writing shall be given to the workman. In none of the three cases mentioned is the employer to make any profit; neither by fines, for they may only be imposed in respect of acts or omissions which cause, or are likely to cause, loss or damage; nor by sale of materials, for the price may not exceed the cost to the employer; nor by deductions or payments for damage, for these may not exceed the actual or estimated loss to the employer. Fines and charges for damage must be "fair and reasonable having regard to all the circumstances of the case," and no contract could make legal a fine which a court held to be unfair to the workman in the sense of the Act. The contract between the employer and workman must either be in writing signed by the workman, or its terms must be clearly stated in a notice constantly affixed in a place easily accessible to the workman, who shall be entitled, on request, to obtain from the employer a copy of the notice free of charge. On each occasion when a deduction or payment is made, full particulars in writing must be supplied to the workman. The employer is bound to keep a register of deductions or payments, and to enter therein particulars of any fine made under the contract, specifying the amount and the nature of the act or omission in respect of which the fine was imposed. This register must be at all times open to inspection by inspectors of mines or factories, who are also entitled to make a copy of the contract or any part of it. This Act as a whole applies to all workmen included

Meaning of "wages."

The Truck Act, 1896.

under the earlier Truck Acts; but, further, the sections relating to fines apply also in the case of any shop assistants. The latter, however, apparently are left to enforce the provisions of the law themselves, as no inspectorate is empowered to intervene on their behalf. In these and other cases a prosecution under the Truck Acts may be instituted by any person. Any workman or shop assistant may recover any sum deducted by or paid to his employer contrary to the Act of 1896, provided that proceedings are commenced within six months, and that where he has acquiesced in the deduction or payment he shall only recover the excess over the amount which the court may find to have been fair and reasonable in all the circumstances of the case. It is expressly declared in the Act that nothing in it shall affect the provisions of the Coal Mines Acts with reference to payment by weight, or legalize any deductions, from payments made, in pursuance of those provisions. The powers and duties of inspectors are extended to cover the case of a laundry, and of any place where work is given out by the occupier of a factory or workshop or by a contractor or sub-contractor. Power is reserved for the Secretary of State to exempt by order specified trades or branches of them in specified areas from the provisions of the Act of 1896, if he is satisfied that they are unnecessary for the protection of the workmen. This power has been exercised only in respect of one highly organized industry, the Lancashire cotton industry. The effect of the exemption is not to prevent fines and deductions from being made, but the desire for it demonstrated that there are cases where leaders among workers feel competent to make their own terms on their own lines without the specific conditions laid down in this Act. The reports of H.M. Inspectors of Factories demonstrate that in other industries much work has to be done under this Act, and knowledge of a highly technical character to be acquired, before opinions can be formed as to the reasonableness and fairness, or the contrary, of many forms of deduction. For the year 1898 it was reported that convictions were obtained for breaches, in factories and workshops, of the various Truck Acts in 66 cases out of 82 taken before the courts, an average penalty of 10s. 9d. having been imposed. In the year 1899, 20 convictions were obtained in 38 cases, the average penalty being £20, 0s. 5d. In 1900, 26 cases were taken into court, and 21 convictions were obtained, the average penalty being 18s. 5d.

II. Continental Europe.

In comparing legislation affecting factories, mines, shops, and truck in the chief industrial countries of the Continent with that of Great Britain, it is essential to a just view that inquiry should be extended beyond the codes themselves to the general social order and system of law and administration in each country. Further, as a starting-point, special comparison of the definitions and the sanctions of each industrial code must be recognized as necessary, for these vary in all. In so brief a summary as is appended here no more is possible than an outline indication of the main general requirements and prohibitions of the laws as regards: (1) hours and times of employment, (2) ordinary sanitation and special requirements for unhealthy and dangerous industries, (3) security against accidents, and (4) prevention of fraud and oppression in fulfilment of wage contracts. As regards the first of these subdivisions, in general in Europe the ordinary legal limit is rather wider than in Great Britain, being in most cases not less than 11 hours a day, and the administrative discretion in granting exceptions rather more elastic. The weekly half-holiday is a peculiarly British institution. On the other hand, in several European countries, notably France, Austria, and Russia, the legal maximum day applies to adult as well as youthful labour, and not only to specially protected classes of persons. As regards specialized sanitation for unhealthy factory industries, German regulations appear to be most nearly comparable with British. Mines' labour regulation in several countries, having an entirely different origin linked with ownership of mines, is only in few and most recent developments comparable with British Mines Regulation Acts. In regulation of shops, Germany, treating this matter as an integral part of her imperial industrial code, has advanced farther than has Great Britain. In truck legislation most European countries appear to have been influenced by the far earlier laws of Great Britain, although in some respects Belgium, with her rapid and recent industrial development, has made interesting original experiments.

France.—Hours of labour were, in France, first limited in factories (*usines et manufactures*) for adults by the law of 9th September 1848 to 12 in the 24. Much uncertainty existed as to the class of workplaces covered, and various interpretations were given. Finally, in 1885, an authoritative decision defined them as including: (1) Industrial establishments with motor power or continual furnaces, (2) workshops employing over 20 workers. In 1851, under condition of notification to the local authorities, exceptions, still in force, were made to the general limitation, in favour of certain industries or processes, among others for letterpress and lithographic printing, engineering works, work at furnaces and in heating workshops, manufacture of projectiles of war, and any work for the Government in the interests of national defence or security. The limit of 12 hours was reduced, as regards works in which women or young workers are employed, in 1900 to 11, and was to be successively reduced to 10½ hours and to 10 hours at intervals of two years from April 1900. This labour law for adults was preceded in 1841 by one for children, which prevented their employment in factories before 8 years of age and prohibited night labour for any child under 13. This was strengthened in 1874, particularly as regards employment of girls under 21, but it was not until 1892 that the labour of women was specially regulated by a law still in force, with certain amendments in 1900. Under this law factory and workshop labour is prohibited for children under 13 years, though they may begin at 12 if qualified by the prescribed educational certificate and medical certificate of fitness. The limit of daily hours of employment is the same as for adult labour, and, similarly, from 1st April 1902 was 10½, and two years later will be 10 hours in the 24. Notice of the hours must be affixed, and meal-times or pauses with absolute cessation of work of at least 1 hour must be specified. One day in the week, not necessarily Sunday, must be given for entire absence from work, in addition to eight recognized annual holidays. Night labour—that is, work between 9 P.M. and 5 A.M.—is prohibited for workers under 18 years, and only exceptionally permitted, under conditions, for girls and women over 18 in specified trades. In mines and underground quarries employment of women and girls is prohibited except at surface works, and at the latter is subject to the same limits as in factories. Boys of 13 years may be employed in certain work underground, but under 16 years may not be employed more than 8 hours in the 24 from bank to bank. As in Great Britain, distinct services of inspection enforce the law in factories and mines respectively. In factories and workshops an inspector may order re-examination as to physical fitness for the work imposed of any worker under 16; certain occupations and processes are prohibited—*e.g.*, girls under 16 at machines worked by treadles, and the weights that may be lifted, pushed, or carried by girls or boys under 18 are carefully specified. The law applies generally to philanthropic and religious institutions where industrial work is carried on, as in ordinary trading establishments; and this holds good even if the work is by way of technical instruction. Domestic workshops are not controlled unless the industry is classed as dangerous or unhealthy; introduction of motor power brings them under inspection. General sanitation in industrial establishments is provided for in a law of 1893, and is supplemented by administrative regulations for special risks due to poisons, dust, explosive substances, gases, fumes, &c. Ventilation, both general and special, lighting, provision of lavatories, cloakrooms, good drinking water, drainage, and cleanliness are required in all workplaces. In many industries women, children, and young workers are either absolutely excluded from specified unhealthy processes, or are admitted only under conditions. As regards shops and offices, the only labour laws are: one which protects apprentices against overwork (law of 22nd February 1851), and one (law of 29th December 1900) which requires that seats shall be provided for women and girls employed in retail sale of articles. The latter law is enforced by the inspectors of factories. In France there is no special penal legislation against abuses of the truck system, or excessive fines and deductions from wages, although bills have frequently been before Parliament. Indirect protection to workers is no doubt in many cases afforded in organized industries by the action of the *Conseils de Prud'hommes.*

Belgium.—In 1848 in Belgium the Commission on Labour proposed legislation to limit, as in France, the hours of labour for adults, but this never passed, though repeated attempts were made to secure it. Belgian regulation of labour in industry remains essentially, in harmony with its earliest beginnings in 1863 and onwards, a series of specialized provisions to meet particular risks of individual trades, and did not, until 1899, give any adherence to a common principle of limitation of hours and times of labour for "protected" persons. This was in the law of 13th December 1889, which applies to mines, quarries, factories, workshops, classed as unhealthy, wharves and docks, transports. As in France, industrial establishments having a charitable or philanthropic or educational character are included. The persons protected are girls and women under 21 years, and boys under 16; and women over 21 years only find a place in the law through the prohibition of their employment within four weeks after childbirth. Just as the hours of labour of adult women remain absolutely unlimited by law, so are the hours of boys from 16 to 21. The absolute prohibitions of employment are: for children under 12 years in any industry, manufacturing or mining or transport, and for women and girls under 21 years below the surface in working of mines. Boys under 16 years and women and girls under 21 years may in general not be employed before 5 A.M. or after 9 P.M., and one day in the seven is to be set apart for rest from employment; to these rules, however, exception may be made either by royal decree for classes or groups of processes, or by local authorities in exceptional cases. The exceptions may be applied, generally, only to workers over 14 years, but in mines, by royal decree, boys over 12 years may be employed from 4 A.M. The law of 1889 fixes only a maximum of 12 hours of effective work, to be interrupted by pauses for rest of not less than 1½ hours, empowering the king by decree to formulate more precise limits suited to the special circumstances of individual industries. Royal decrees have accordingly laid down the conditions for twenty-six groups, including textile trades, manufacture of paper, pottery, glass, clothing, mines, quarries, engineering and printing works. In some the daily limit is 10 hours, but in more 10½ or 11 hours. In a few exceptionally unhealthy trades, such as the manufacture of lucifer matches, vulcanization of india-rubber by means of carbon bisulphide, the age of exclusion from employment has been raised, and in the last-named process hours have been reduced to 5, broken into two spells of 2½ hours each. As a rule the conditions of health and safeguarding of employments in exceptionally injurious trades have been sought by a series of decrees under the law of 1863 relating to public health in such industries. Under this, special regulations for safety of workers have been introduced in manufactures of white-lead, oxides of lead, chromate of lead, lucifer match works, rag and shoddy works; and for dangers common to many industries, provisions against dust, poisons, accidents, and other risks to health or limb have been codified in a decree of 1896. In 1898 a law was passed to enable the authorities to deal with risks in quarries under the same procedure. Safety in mines (which are not private property, but state concessions to be worked under strict state control) has been provided for since 1810. In matters of hygiene, however, until 1899 the powers of the public health authorities to intervene were insufficient, and a law was passed authorizing the Government to make regulations for every kind of risk in any undertaking, whether classed under the law of public health or not. By a special law of 1888 children and young persons under 18 years are excluded from employment as pedlars, hawkers, or in circuses, except by their parents, and then only if they have attained 14 years. Abuses of the truck system have, since 1887, been regulated with care. The chief objects of the law of 1887 were to secure payment in full to all workers, other than those in agriculture or domestic service, of wages in legal tender, to prohibit payment of wages in public-houses, and to secure prompt payment of wages. Certain deductions were permitted under careful control for specific customary objects: lodging, use of land, uniforms, food, firing. The law of 15th June 1896 regulates the affixing in workplaces, where at least five workers are employed, of a notice of the working rules, the nature and rate of fines, if any, and the mode of their application. Two central services, the mines inspectorate and the factory and workshop inspectorate, divide the duties above indicated. There is also a system of local administration of the regulations relating to industries classed as unhealthy, but the tendency has been more and more to give the supreme control in these matters to the factory service, with its expert staff.

Holland.—The first law for regulation of labour in manufacture was passed in 1874, and this related only to employment of children. In 1889, after many attempts had been made to amend the law, the basis of all existing regulations was established in the law of 5th May 1889, which applies to all industrial undertakings, excluding agriculture and forestry, fishing, stock-rearing. Employment of children under 12 years is prohibited, and hours are limited for young persons under 16 and for women of any age. These protected persons may be excluded by royal decree from unhealthy industries, and such industries are specified in a decree of 1897 which supersedes other earlier regulations. Hours of employment must not exceed 11 in the 24, and at least 1 hour for rest must be given between 11 A.M. and 3 P.M., which hour must not be spent in a work-room. Work before 5 A.M. or after 7 P.M., Sunday work, and work on recognized holidays is generally prohibited, but there are exceptions. Overtime from 7 to 10 P.M. under conditions is allowed for women and young workers, and Sunday work for women, for example, in butter and cheese making, and night work for boys over 14 in certain industries. Employment of women within four weeks of childbirth is prohibited. Notices of working hours must be affixed in workplaces. Underground work in mines is prohibited for women and young persons under 16, but only two mines, employing in all some 300 persons, are worked in Holland. In 1895 the first legislative provision was made for protection of workers against risk of accident or special injury to health. Sufficient cubic space, lighting, ventilation, sanitary accommodation, reasonable temperature, removal of noxious gases or dust, fencing of machinery, precautions against risk from fire and other matters are provided for. The manufacture of lucifer matches by means of white phosphorus has been forbidden by a law of 28th May 1901. No penal provision against truck exists in Holland, but possibly abuses of the system are prevented by the existence of industrial councils representing both employers and workers, with powers to mediate or arbitrate in case of disputes between the two parties.

Switzerland.—In Switzerland separate cantonal legislation prepared the way for the general Federal labour law of 1877 on which subsequent legislation rests. Such legislation is also cantonal as well as Federal, but in the latter there is only amplification or interpretation of the principles contained in the law of 1877, whereas cantonal legislation covers industries not included under the Federal law, *e.g.*, single workers employed in a trade (*métier*) and employment in shops, offices, and hotels. The Federal law is applied to factories, workshops employing young persons under 18 or more than 10 workers, and workshops in which unhealthy or dangerous processes are carried on. Mines are not included, but are regulated in some respects as regards health and safety by cantonal laws. Further, the Law of Employers' Liability, 1881–87, which requires in all industries precautions against accidents and reports of all serious accidents to the cantonal governments, applies to mines. This led, in 1896, to the creation of a special mining department, and mines, of which there are but few, have to be inspected once a year by a mining engineer. The majority of the provisions of the Federal labour law apply to adult workers of both sexes, and the general limit of the 11-hours' day, exclusive of at least 1 hour for meals, applies to men as well as women. The latter have, however, a legal claim, when they have a household to manage, to leaving work at the dinner-hour half an hour earlier than the men. Men and unmarried women may be employed in such subsidiary work as cleaning before or after the general legal limits. On Saturdays and eves of the eight public holidays the 11-hours' day is reduced to 10. Sunday work and night work are forbidden, but exceptions are permitted conditionally. Night work is defined as 8 P.M. to 5 A.M. in summer, 8 P.M. to 6 A.M. in winter. Children are excluded from employment in workplaces under the law until 14 years of age, and until 16 must attend continuation schools. Zürich canton has strengthened the law by fixing the working day for women at 10 hours generally, and 9 hours on Saturdays and eves of holidays. In the German cantons girls under 18 years are not permitted to work overtime; in all cantons except Glarus the conditional overtime of 2 hours must be paid for at an enhanced wage.

Sanitary regulations and fencing of machinery are provided for with considerable minuteness in a Federal decree of 1897. The plans of every new factory must be submitted to the cantonal government. In the case of lucifer match factories, not only the building but methods of manufacture must be submitted. Since 1901 the manufacture, sale, and import of matches containing white phosphorus have been forbidden. Women must be absent from employment during eight weeks before and after childbirth. In certain dangerous occupations, *e.g.*, where lead or lead compounds are in use, women may not legally be employed during pregnancy. Legislative provision against abuses of the truck system appears to be of earlier origin in Switzerland (17th century) than any other European country outside England (15th century). The Federal Labour Law, 1877, generally prohibits payment of wages otherwise than in current coin, and provides that no deduction shall be made without an express contract. Some of the cantonal laws go much farther than the British Act of 1896 in forbidding certain deductions; *e.g.*, Zürich prohibits any charge whatever for cleaning, warming, or lighting workrooms, or for hire of machinery. By the Federal law fines may not exceed half a day's wage. Administration of the labour laws is divided between inspectors appointed by the Federal Government and local authorities, under supervision of the cantonal governments. The Federal Government forms a court of appeal against decisions of the cantonal governments.

Germany.—Regulation of the conditions of labour in industry throughout the German Empire is provided for in the Imperial Industrial Code and the orders of the Federal Council based thereon. This Code is based on earlier industrial codes of the separate states, but more especially on the Code of 1869 of the North German Confederation. It applies in whole or in part to all trades and industrial occupations, with the exception of transport, fisheries, and agriculture. Mines are only included so far as truck, Sunday and holiday rest, prohibition of employment underground of female labour, limitation of the hours of women and young workers are concerned; otherwise the regulations for protection of life and limb of miners vary, as do the mining laws of the different states. In order to estimate the force of the Industrial Code in working, it is necessary to bear in mind the complicated political history of the Empire, the separate administration by the federated states, and the generally considerable powers vested in administration of initiating regulations. The Industrial Code expressly retains power for the states to initiate certain additions or exceptions to the Code which in any given state may form part of the law regulating factories there. The Code (unlike the Austrian Industrial Code) lays down no general limit for a normal working day for adult male workers, but since 1891 full powers were given to the Imperial Government to limit hours for any classes of workers in industries where excessive length of the working day endangers the health of the worker (R. G. O. § 120*e*). Previously application had been made of powers to reduce the working day in such unhealthy industries as silvering of mirrors by mercury and the manufacture of white-lead. Separate states had, under mining laws, also limited hours of miners. Sunday rest was, in 1891, secured for every class of workers, commercial, industrial, and mining. Annual holidays were also secured on Church festivals. These provisions, however, are subject to exceptions under conditions. An important distinction has to be brought out when we turn to the regulations for hours and times of labour for protected persons (women, young persons, and children). Setting aside for the moment hours of shop assistants (which are under special sections since 1900), it is to "factory workers" and not to industrial workers in general that these limits apply, although they may be, and in some instances have been, further extended—for instance, in ready-made clothing trades—by imperial decree to workshops. The term "factory" (*Fabrik*) is not defined in the Code, but it is clear from various decisions of the Supreme Court that it only in part coincides with the English term, and that some workplaces, where processes are carried on by aid of mechanical power, rank rather as English workshops. The distinction is rather between wholesale manufacturing industry, with subdivision of labour, and small industry, where the employer works himself. Certain classes of undertaking, viz., forges, timber-yards, dock-yards, brickfields, and open quarries, are specifically ranked as factories. Employment of protected persons at the surface of mines and underground quarries, and in salt works and ore-dressing works, and of boys underground comes under the factory regulations. These exclude children from employment under 13 years, and even later if an educational certificate has not been obtained; until 14 years hours of employment may not exceed 6 in the 24. Germany, unlike Great Britain, France, and Switzerland, requires a shorter day for young persons than for women—10 hours for the former, 11 hours for the latter. Women over 16 years may be employed 11 hours. Night work is forbidden, *i.e.*, work between 8.30 P.M. and 5.30 A.M. Overtime may be granted to meet special unforeseen pressure or for work on perishable articles, under conditions, by local authorities and the higher administrative authorities. Prescribed meal-times are—an unbroken half-hour for children in their 6 hours; for young persons a mid-day pause of 1 hour, and half an hour respectively in the morning and afternoon spells; for women, an hour at mid-day, but women with the care of a household have the claim, on demand, to an extra half-hour, as in Switzerland. No woman may be employed within four weeks after childbirth, and unless a medical certificate can then be produced, the absence must extend to six weeks. Notice of working periods and meal-times must be affixed, and copies sent to the local authorities. Employment of protected persons in factory industries where there are special risks to health or morality may be forbidden or made dependent on special conditions. All industrial employers alike are bound to arrange and maintain workrooms and machinery, and to organize labour in such a manner as to secure workers against injury to health and to ensure good conduct and propriety. Sufficient light, suitable cloak-rooms and sanitary accommodation, and ventilation to carry off dust, vapours, and other impurities are especially required. Dining-rooms may be ordered by local authorities. Fencing and provision for safety in case of fire are required in detail. The work of the trade accident insurance associations in their work of preventing accidents is especially recognized in provisions for special rules in dangerous or unhealthy industries. Officials of the state factory departments are bound to give opportunity to trustees of the trade associations to express an opinion on special rules. In a large number of industries the Federal Council has laid down special rules comparable with those for unhealthy occupations in Great Britain. The relations between the state inspectors of factories and the ordinary police authorities are regulated in each state by its constitution. Prohibitions of truck in its original sense—that is, payment of wages otherwise than in current coin—apply to any persons under a contract of service with an employer for a specified time for industrial purposes; members of a family working for a parent or husband are not included; outworkers are covered. Control of fines and deductions from wages applies only in factory industries and shops employing at least 20 workers. Shop hours are regulated by requiring shops to be closed generally between 9 P.M. and 5 A.M., by requiring a fixed mid-day rest of 1½ hours and at least 10 hours' rest in the 24 for assistants. These limits can be to a certain extent modified by administrative authority. Notice of hours and working rules must be affixed. During the hours of compulsory closing sale of goods on the streets or from house to house is forbidden. Under the Commercial Code, as under the Civil Code, every employer is bound to adopt every possible measure for maintaining the safety, health, and good conduct of his employés. By an order of the Imperial Chancellor under the Commercial Code seats must be provided for commercial assistants and apprentices.

Austria.—The Industrial Code of Austria, which in its present outline (modified by later enactments) dates from 1883, must be carefully distinguished from the Industrial Code of the kingdom of Hungary. The latter is, owing to the predominantly agricultural character of the population, of later origin, and hardly had practical force before the law of 1893 provided for inspection and prevention of accidents in factories. No separate mining code exists in Hungary, and conditions of labour are regulated by the Austrian law of 1854. The truck system is repressed on lines similar to those in Austria and Germany. As regards limitation of hours of adult labour, Hungary may be contrasted with both those empires in that no restriction of hours applies either to men's or women's hours, whereas in Austrian factories both are limited to an 11-hours' day with exceptional overtime for which payment must always be made to the worker. The Austrian Code has its origin, however, like the British Factory Acts, in protection of child labour against abuse in the end of the 18th and beginning of the 19th century. Its present scope is determined by the Imperial "Patent" of 1859, and all industrial labour is included except mining, transport, fisheries, forestry, agriculture, and domestic industries. Factories are defined as including industries in which a "manufacturing process is carried on in an enclosed place by the aid of not less than twenty workers working with machines, with subdivision of labour, and under an employer who does not himself manually assist in the work." In smaller handicraft industries the compulsory guild system of organization still applies. In every industrial establishment, large or small, the sanitary and safety provisions, general requirement of Sunday rest, and annual holidays (with conditional exceptions), prohibition of truck and limitation of the ages of child labour apply. Night work for women, 8 P.M. to 5 A.M., is prohibited only in factory industries; for young workers it is prohibited in any industry. Pauses in work are required in all industries; 1 hour at least must be given at mid-day, and if the morning and afternoon spells exceed 5 hours each, another half-hour's rest at least must be given. Children may not be employed in industrial work before 12 years, and then only 8 hours a day at work that is not injurious and if educational requirements are observed. The age of employment is raised to 14 for "factories," and similarly there the work must be such as will not hinder physical development. Women may not be employed in regular industrial occupation within one month after childbirth. In certain scheduled unhealthy industries, where certificates of authorization from local authorities must be obtained by intending occupiers, conditions of health and safety for workers can be laid down in the certificate. The Minister of the Interior is empowered to draw up regulations prohibiting or making conditions for the employment of young workers or women in dangerous or unhealthy industries. The provisions against truck cover not only all industrial workers engaged in manual labour under a contract with an employer, but also shop-assistants; the special regulations against fines and deductions apply to factory workers and shops where at least 20 workers are employed. In mines under the law of 1884, which supplements the general mining law, employment of women and girls underground is prohibited; boys from 12 to 16 and girls from 12 to 18 may only be employed at light work above ground; 14 is the earliest age of admission for boys underground.

The shifts from bank to bank must not exceed 12 hours, of which not more than 10 may be effective work. Sunday rest must begin not later than 6 A.M., and must be of 24 hours' duration. These last two provisions do not hold in case of pressing danger for safety, health, or property. Sick and accident funds and mining associations are legislated for in minutest detail. The general law provides for safety in working, but special rules drawn up by the district authorities lay down in detail the conditions of health and safety. As regards manufacturing industry, it is important to note that the Industrial Code lays no obligation on employers to report accidents, and that until the Accident Insurance Law of 1889 came into force no statistics were available. In Austria, unlike Germany, the factory inspectorate is organized throughout under a central chief-inspector.

Scandinavian Countries.—The latest legislation in these countries is, as might be expected, in the two countries where manufacturing industry has the widest scope. In Sweden the Factory Law was amended in January 1901; in Denmark in July 1901. Until that year, however, Norway was in some respects in advance of the other two countries by its law of 1892, which applied to industrial works, including metal works of all kinds and mining. Women were thereby prohibited from employment: (*a*) underground; (*b*) in cleaning or oiling machinery in motion; (*c*) during six weeks after giving birth to a child, unless provided with a medical certificate stating that they might return at the end of four weeks without injury to health; (*d*) in dangerous, unhealthy, or exhausting trades during pregnancy. Further, work on Sundays and public holidays is prohibited to all workers, adult and youthful, with conditional exceptions under the authority of the inspectors. Children over 12 are admitted to industrial work on obtaining certificates of birth, of physical fitness, and of elementary education. The hours of children are limited to 6, with pauses, and of young persons (of 14 to 18 years) to 10, with pauses. Night work between 8 P.M. and 6 A.M. is prohibited. All workers are entitled to a copy of a code of factory rules containing the terms of the contract of work drawn up by representatives of employés with the employers and sanctioned by the inspector. Health and safety in working are provided for in detail in the same law of 1892. Special rules may be made for dangerous trades, and in 1899 such rules were established for match factories, similar to some of the British rules, but notably providing for a dental examination four times yearly by a doctor. In Denmark, regulation began with unhealthy industries, and it was not until the law of 1901 came into force, on 1st January 1902, that children under 12 years have been excluded from factory labour. In Sweden this 12 years' limit has for some time held in the larger factories, but now the scope has been extended so that it corresponds with the Norwegian law. The hours of children are, in Denmark, 6½ for those under 14 years; in Sweden 6 for those under 13 years. Young persons may not in either country work more than 10 hours daily, and night work, which is forbidden for persons under 18 years, is now defined as in Norway. Women may not be employed in industry within four weeks of childbirth, except on authority of a medical certificate. All factories in Sweden where young workers are employed are subject to medical inspection once a year. Fencing of machinery and hygienic conditions (ventilation, cubic space, temperature, light) are regulated in detail. In Denmark the use of white phosphorus in manufacture of lucifer matches has been prohibited since 1874.

Italy and Spain.—The wide difference between the industrial development of these southern Latin countries and the two countries with which this summary begins, and the far greater importance of the agricultural interests, produce a situation, as regards labour legislation, which makes it convenient to touch on the limited scope of their regulations at the close of the series. It was stated by competent and impartial observers from each of the two countries, at the International Congress on Labour Laws held at Brussels in 1897, that the lack of adequate measures for protection of child-labour and inefficient administration of such regulations as exist was responsible for abuse of their forces that can be found in no other European countries. "Their labour in factories, workshops, and mines constitutes a veritable martyrdom" (Spain). "I believe that there is no country where a sacrifice of child life is made that is comparable with that in certain Italian factories and industries" (Italy). In neither country is there any limitation of women's hours, but in Spain a step in this direction has been taken by a law of 1900, which was to take effect in 1902, in regulations for reduction of hours of labour for adults to 11, normally, in the 24. Hours of children under 14 must not exceed 6 in any industrial work nor 8 in any commercial undertaking. Labour before the age of 10 years and night work between 6 P.M. and 5 A.M. was prohibited, and powers were taken to extend the prohibition of night work to young persons under 16 years. The labour of children in Italy is still regulated in the main by a law of 1886, but a royal decree of 1899 has strengthened it by classing night work for children under 12 years as "injurious," such work being thereby generally prohibited for them, though exceptions are admitted; at the same time it was laid down that children from 12 to 15 years might not be employed for more than 6 hours at night. The law of 1886 prohibits employment of children under 9 years in industry and under 10 years in underground mining. It is in the direction of fencing and other safeguards against accidents and as regards sanitary provisions, both in industrial workplaces and in mines, that Italy has made most advance since her law of 1890 for prevention of accidents.

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See also Arbitration and Conciliation, Employers' Liability, Strikes and Lockouts, Social Progress (*Hours of Labour*), Trades Unions. (A. M. An.)

III. United States.

Under the general head of Labour Legislation all American statute laws regulating labour, its conditions, and the relation of employer and employé must be classed. It includes what is properly known as factory legislation. Labour legislation belongs to the last half of the 19th century, so far as the United States is concerned. Like England in the far past, the United States in colonial days undertook to regulate wages and prices, and later the employment of apprentices. Legislation relating to wages and prices was long ago abandoned, but the laws affecting the employment of apprentices still exist in some form, although the conditions of employment have changed so materially that apprenticeships are not entered as of old; but the laws regulating the employment of apprentices were the basis on which English legislation found a foothold when Parliament wished to regulate the labour of factory operatives. The whole code of labour laws of the present time is almost entirely the result of the industrial revolution which took place during the latter part of the 18th century, under which the domestic or hand-labour system was gradually but rapidly displaced through the introduction of power machinery. As this revolution took place in the United States at a somewhat later date than in England, where it began, the labour legislation necessitated by it belongs to a later date. The factory, so far as textiles are concerned, was firmly established in America during the period from 1820 to 1840, and it was natural that the English legislation found friends and advocates in the United States, although the more objectionable conditions accompanying the English factory were not to be found there.

Early attempts to regulate hours.

The first attempt to secure legislation regulating factory employment related to the hours of labour, which were very long, the day's work consisting of from twelve to thirteen hours. As machinery was introduced it was felt that the day's work should be shortened, as the tension resulting from speeded machines and the close attention required in the factory ought to be accompanied by a shorter work-day. This view took very firm hold of the operatives, and was the chief cause of the agitation which has resulted in a great body of laws applying in very many directions. The labour legislation as it exists now can be classified into two general branches—first, that relating to the conditions of employment; second, that relating to the protection of employés from practices tending to prevent them from obtaining or retaining employment. As early as 1806 the caulkers and shipbuilders of New York City agitated for a reduction of hours to ten per day, but no legislation followed their efforts. There were several attempts in the early years of the 19th century to secure some regulation relative to hours, but there was no general agitation prior to 1831. As Massachusetts was the state which first recognized the necessity of regulating employment (following in a measure, and so far as conditions demanded, the English labour or factory legislation), the history of such legislation in that state is indicative of that in the United States, and as it would be impossible in this article to give a detailed history of the origin of laws in the different states, the dates of their enactment, and their provisions, it is best to follow primarily the course of the Eastern states, and especially that of Massachusetts, where the first general agitation took place and the first laws were enacted. That state in 1836 regulated by law the question of the education of young persons employed in manufacturing establishments. There was no legislation until 1863 coming under the head of this article, except laws relating to the subject of education of children in factories. The question of regulating the hours of labour was warmly discussed in 1832, and several legislative committees and commissions reported upon it, but no specific action on the general question of hours of labour secured the indorsement of the Massachusetts legislature until 1874, although the day's labour of children under twelve years of age was limited to ten hours in 1842. Ten hours constituted a day's labour, on a voluntary basis, in many trades in Massachusetts and other parts of the country as early as 1853, while in the shipbuilding trades this was the work-day in 1844. In April 1840 President Van Buren issued an order "that all public establishments will hereafter be regulated, as to working hours, by the ten-hours system." After this the short-hours movement did not progress with any rapidity, or even persistency, yet there was a constantly increasing belief that a shorter work-day should prevail. The real aggressive movement began in 1845, through numerous petitions to the Massachusetts legislature urging a reduction of the day's labour to eleven hours, but nothing came of these petitions at that time. Again, in 1850, a similar effort was made, and also in 1851 and 1852, but the Bills failed. Then there was a period of quiet until 1865, when an unpaid commission made a report relative to the hours of labour, and recommended the establishment of a bureau of statistics for the purpose of collecting data bearing upon the labour question. This was the first step in this direction in any country. The first bureau of the kind was established in Massachusetts in 1869, but meanwhile, in accordance with reports of commissions and the address of Governor Bullock in 1866, and the general sentiment which then prevailed, the legislature passed an Act regulating in a measure the conditions of the employment of children in manufacturing establishments; and this is one of the first laws of the kind in the United States, although the first legislation in the United States relating to the hours of labour which the writer has been able to find, and for which he can fix a date, was enacted by the state of Pennsylvania in 1849, the law providing that ten hours should be a day's work in cotton, woollen, paper, bagging, silk, and flax factories.

Employment of children.

The Massachusetts law of 1866 provided, firstly, that no child under the age of ten years should be employed in any manufacturing establishment, and that no child between the ages of ten and fourteen years should be so employed unless he had attended some public or private school at least six months during the year preceding such employment, and, further, that such employment should not continue unless the child attended school at least six months in each and every year; secondly, a penalty not exceeding $50 for every owner or agent or other person knowingly employing a child in violation of the Act; thirdly, that no child under the age of fourteen should be employed in any manufacturing establishment more than eight hours in any one day; fourthly, that any parent or guardian allowing or consenting to employment in violation of the Act should forfeit a sum not to exceed $50 for each offence; fifthly, that the Governor instruct the state constable and his deputies to enforce the provisions of all laws for regulating the employment of children in manufacturing establishments, and to prosecute violations thereof. The same legislature also created a commission of three persons, whose duty it was to investigate the subject of hours of labour in relation to the social, educational, and sanitary condition of the working classes. In 1867 a fundamental law relating to schooling and hours of labour of children employed in manufacturing and mechanical establishments was passed by the Massachusetts legislature. It differed from the Act of the year previous in some respects, going deeper into the general question. It provided that no child under the age of ten years should be employed in any manufacturing or mechanical establishment of the commonwealth, and that no child between the ages of ten and fifteen years should be so employed unless he had attended school, public or private, at least three months during the year next preceding his employment. There were some provisions relating to residence, &c., and a further provision that no time less than 120 half days of actual schooling should be deemed an equivalent of three months, and that no child under the age of fifteen years should be employed in any manufacturing or mechanical establishment more than sixty hours any one week. The law also provided penalties for violation. It repealed the Act of 1866.

In 1869 began the establishment of that chain of offices in the United States, the principle of which has been adopted by other countries, known as bureaus of statistics of labour, their especial purpose being the collection and dissemination of information relating to all features of industrial employment. As a result of the success of the first bureau, bureaus are in existence in thirty-one states, in addition to the United States Department of Labour.

A special piece of legislation which belongs to the commonwealth of Massachusetts, so far as experience shows, was that in 1872, providing for cheap morning and evening trains for the accommodation of working men living in the vicinity of Boston. Great Britain had long had such trains, which were called parliamentary trains. Under the Massachusetts law some of the railways running out of Boston furnished the accommodation required, and the system has since been in operation.

In different parts of the country the agitation to secure legislation regulating the hours of labour became aggressive again in 1870 and the years immediately following, there being a constant repetition of attempts to secure the enactment of a ten-hours law, but in Massachusetts all the petitions failed till 1874, when the legislature of that commonwealth established the hours of labour at sixty per week not only for children under eighteen years of age, but for women, the law providing that no minor under eighteen years and no woman over that age should be employed by any person, firm, or corporation in any manufacturing establishment more than ten hours in any one day. In 1876 Massachusetts reconstructed its laws relating to the employment of children, although it did not abrogate the principles involved in earlier legislation, while in 1877 the commonwealth passed Factory Acts covering the general provisions of the British laws. The law of 1877 went beyond any previous laws, which, as shown, related to the employment of women and children so far as hours were concerned. It provided for the general inspection of factories and public buildings, the provisions of the law relating to dangerous machinery, such as belting, shafting, gearing, drums, &c., which the legislature insisted must be securely guarded, and that no machinery other than steam engines should be cleaned while running. The question of ventilation and cleanliness was also attended to. Dangers connected with hoistways, elevators, and well-holes were minimized by their protection by sufficient trap-doors, while fire-escapes were made obligatory on all establishments of three or more storeys in height. All main doors, both inside and outside, of manufacturing establishments, as well as those of churches, school-rooms, town halls, theatres, and every building used for public assemblies, should open outwardly whenever the factory inspectors of the commonwealth deemed it necessary. These provisions remain in the laws of Massachusetts, and other states have found it wise to follow them; but to make such laws of any value to the working people of the country, there needed to be inspectors having the power to examine and recommend, and in many cases to order, the safeguarding of machinery and all the devices used in the factory from which there was any danger.

Factory legislation, 1877.

All the states in the Union where textile factories prevail, except some of the Southern states, have legislation similar to that which has been described for Massachusetts, although not always to such an elaborate extent. Some of the Northern and Middle states, however, have extensive codes of factory laws, the aim of which is to protect the lives and the limbs of the operatives, and to secure healthful, sanitary surroundings. The legislation of different states varies according to the nature of the industries carried on therein. Those where mining predominates and iron-works are found have laws which are especially applicable to such industries. Miners are protected both as to the hours and conditions of their labour. But the attempts to enact laws restricting or fixing the hours of labour of adult males have not been successful as a rule. The state of Utah in its constitution has fixed the day's labour for adults in mining and certain industries. The doctrine that the adult male must be left at liberty to make his own contracts relative to his working time and his wages has been accepted everywhere as the proper rule. A number of states have laws which fix a day's labour in the absence of any contract, some of them fixing the day at eight hours, so that where an employer and an employé make a contract and do not specify what shall constitute a day's labour, eight hours would be ruled as the day's labour in any action which came before the courts. The United States Government provides by the law of 1868 that eight hours shall constitute a day's work for all labourers, workmen, and mechanics employed by or on behalf of the Government, and by an Act approved 1st August 1892 no officer of the Government can work the employés any longer than that, nor can a contractor having a contract under the Government call for a longer day than eight hours, although under some extraordinary emergency a longer day may be demanded. The day's work has not been fixed in the Southern states, where the textile manufactures have been expanded greatly in the past few years. In those states the day is from eleven to twelve hours, sixty-six hours per week being the prevailing rule. New Jersey has the shortest workday of any state, fifty-five hours per week; but this regulation is not observed, or at least only in slight degree, outside the silk industry. Sixty hours is the general rule under legislation, although Massachusetts now provides for fifty-eight hours. In addition to the body of laws regulating conditions of employment, there are a great many laws which relate to methods of employment, such as those authorizing fines for damage to goods, but such laws are vexatious and have not been approved, especially by employés.

Law concerning hours.

Some laws relating to the hours of labour have in some states been declared unconstitutional, not because the laws in controversy fixed the length of day, but because they undertook to regulate the labour of a certain class, thereby bringing the laws under the denomination of class legislation. As a rule, however, the courts have generally sustained the laws regulating conditions for the employment of women and children, on the ground that these are the wards of the state.

The second class of laws, those which protect employés from practices tending to prevent them from obtaining or retaining employment, touch broader and deeper principles than those referred to above. The laws themselves are to be found in the statutes of the Federal and state governments, and are directed against such practices. In addition to the laws bearing directly upon this point, action can be taken under them or under the common law by executive and judicial officers for the purpose of enforcing the provisions of the same or causing penalties provided for violations. The statutes themselves may be divided into three classes—those aimed at practices or deeds of employers of labour, those directed against the deeds of employés, and those providing for action to be taken by third parties. While this statement is true as a general proposition, there are, nevertheless, statutes aimed at the punishment of conspiracy and the prevention of intimidation, coercion, boycotting, and blacklisting, which apply to the acts of both employers and employés either by direct language or by inference. Most of the actions of either employers or employés to which these classes of laws apply are the results of labour disputes and their frequent consequences, such as strikes, lockouts, riotings, &c. Probably responsibility could not be fixed in cases of blacklisting under the common law, nor could some features of conspiracy, or what used to be called "unlawful combination," for under the common law at the present time workmen have the right to strike or leave

Intimidation, boycotting, blacklisting, &c.

work either singly or in combination at any time. They may take action for the purpose of improving their condition, and may use peaceful means, such as persuasion, &c., to induce other workmen either to strike or leave their employment or to refrain from accepting employment; but they must not use unlawful means, such as intimidation, force, coercion, &c., the use of such means being regarded as conspiracy. No state has passed any law attempting to change these principles, but some states have re-affirmed these principles by direct statutory provision. Many states have passed laws aimed at the suppression of blacklisting, boycotting, intimidation, coercion, and the use of force by either the employer or employé, and a large number of states have positively forbidden the practice of blacklisting. A few states have passed laws which in direct terms forbid boycotting. The conspiracy laws of a number of the states provide that the combining of two or more persons for the purpose of injuring the business of any other person, or preventing one from obtaining employment, or causing the discharge of any one, are conspiracy and punishable as such. There are many decisions of the highest courts of the states relating to boycotting, but they were made in cases arising under the conspiracy laws or under those laws which, while they do not forbid boycotting in terms, do forbid the use of threats, intimidation, and coercion, which really constitute the illegal features of a boycott. In regard to intimidation, coercion, &c., there are numerous statutes forbidding their use in any efforts made to compel others to do or not to do things which they have a legal right to do or to abstain from doing. It is undoubtedly true that these laws apply in cases of boycotting where intimidation or coercion is used. The writer does not know of any cases which have arisen or been decided in the courts on this particular feature, but the statutes relating to them have frequently been held to apply to employés engaged in strikes, and when attempting to use the boycott and to prevent the employment of new men.

The illegal acts of strikers have been the subject of legislation. When strikes are in progress, especially those of railway employés, many acts are often committed, either by the strikers or their sympathizers, with a view to preventing the employers from using their property and conducting their business. Such acts may be violent, as the destruction or injury of property, cars, buildings, locomotives, &c., or they may apply simply to the abandoning of a locomotive or train without warning. A number of states have passed laws intended to prevent such practices and to provide penalties for the commission of the acts alluded to. The statutes have various terms or provisions, and it is often difficult to make a separation or classification of them. They could all undoubtedly be used in the punishment of those attempting to obstruct the conduct of a business by the use of illegal means. Most of the laws enumerate and forbid the commission of certain deeds, and provide penalties for the violation of their provisions.

Closely connected with the class of legislation now under discussion is that relating to efforts made by employers to have no relations with labour organizations in the conduct of their business, and their endeavour in this connexion not to employ workmen who belong to such associations. Several states have passed laws making such practice on the part of employers unlawful. Many states have enacted laws prohibiting employers from coercing employés, by threats of loss of employment, &c., to vote or not to vote for particular candidates for office or for particular measures, and from discharging employés on account of the way in which their votes have been cast.

The laws relating to apprentices are numerous and voluminous, but, as in England, they do not now have great force, because of the practical abrogation of the apprenticeship system through the operation of the modern methods of production. The number of apprentices who may enter a particular trade has been limited in many cases by the trade unions, but there has been no attempt in the United States, except in one state, to prevent such limitation. The state of Georgia has a law to the effect that if any two or more persons shall associate themselves in any society or organization with intent of preventing, in any manner, any person or persons from apprenticing themselves to learn and practice any trade, &c., they shall, upon conviction, be punished as prescribed by the criminal code.

Liens which a workman may place upon buildings and other constructions on which he has been employed are subject to laws legitimately relating to labour. These laws are numerous and bulky, and every state has them. So, state insolvency laws, and the bankruptcy Acts of the Federal Government require that wages shall be paid in full out of the assets of the bankrupt before a dividend is made to general creditors.

A few states have laws upon their statute-books intended to prohibit the employment of sailors in work upon wharves, &c., thus preventing the ordinary wharf labourers, stevedores, &c., from being supplanted in their ordinary employment.

Arbitration.

The laws just treated relate almost entirely to acts either of employers or of employés, but there is another form of law, namely, that providing for action to be taken by others in the effort to prevent workmen from losing employment, either by their own acts or by those of their employers, or to settle any differences which arise out of controversies relating to wages, hours of labour, terms and conditions of employment, rules, &c. These laws provide for the arbitration of labour disputes (see ARBITRATION AND CONCILIATION), and many states have provided for the creation of boards of arbitration, before which, by mutual consent, disputes and controversies between employers and employés may be adjusted. At least three states (New York, Massachusetts, and New Jersey) have had considerable experience under this class of legislation, but while, as stated, quite a number of states have laws for such boards, they have not been carried into effect, except in rare instances. The Federal Government, also, has a law providing for conciliation and arbitration in controversies arising between employers and employés where inter-state commerce is involved. No state in the Union has yet provided for compulsory arbitration, although some of the features of the Pennsylvania law and of that of Kansas are construed as providing for compulsory arbitration.

The judicial enforcement of labour laws.

The enforcement of laws by executive or judicial action is an important matter relating to labour legislation, for without action such laws would remain dead letters. Under the constitutions of the states, the governor is the commander-in-chief of the military forces, and he has the power to order the militia or any part of it into active service in case of insurrection, invasion, tumult, riots, or breaches of the peace or imminent danger thereof. Frequent action has been taken in the case of strikes with the view of preventing or suppressing violence threatened or happening to persons or property, the effect being, however, that the militia protects those working or desiring to work, or the employers. The President of the United States may use the land and naval forces whenever by reason of insurrection, domestic violence, unlawful obstructions, conspiracy, combinations, or assemblages of persons it becomes impracticable to enforce the laws of the land by the ordinary course of judicial proceedings, or when the execution of the laws is so hindered by reason of such events that any portion or class of the people are deprived thereby of their rights and privileges under the constitution and laws of the country. Under this general power the United States forces have been used for the protection of both employers and employés indirectly, the purpose being, as in the states, to protect mails and to see that the laws are carried out.

The power of the courts to interfere in labour disputes is through the injunction and punishment thereunder for contempt of court. It is a principle of law that when there are interferences, actual or threatened, with property or with rights of a pecuniary nature, and the common or statute law offers no adequate and immediate remedy for the prevention of injury, a court of equity may interpose and issue its order or injunction as to what must or must not be done, a violation of which writ gives the court which issued it the power to punish for contempt. The doctrine is that something is necessary to be done to stop at once the destruction of property and the obstruction of business, and the injunction is immediate in its action. This writ has been resorted to frequently for the indirect protection of employés and employers.

Employers' liability.

Employers' liability laws, which belong entirely to modern legislation, have been passed for the purpose of enabling an employé to recover damages from his employer under certain conditions when he has been injured through accident occurring in the works of the employer. The common-law maxim that the principal is responsible for the acts of his agent does not apply where two or more persons are working together under the same employer and one of the employés is injured through the carelessness of his fellow-employé, although the one causing the accident is the agent of the principal, who under the common law would be responsible. The old Roman law and the English and American practice under it held that the co-employé was a party to the accident. The injustice of this rule is seen by a single illustration. A weaver in a cotton factory, where there are hundreds of operatives, is injured by the neglect or carelessness of the engineer in charge of the motive power. In such a case, under the common law, the weaver could not recover damages from the employer, because he was the co-employé of the engineer. So, one of thousands of employés of a railway system, sustaining injuries through the carelessness of a switchman whom he never saw, could recover no damages from the railway company, both being co-employés of the same employer. The injustice of this application of the common-law rule has been recognized, but the only way to avoid the difficulty was through specific legislation providing that under such conditions as those just related, and similar ones, the doctrine of co-employment should not apply, and that the workman should have the same right to recover damages as a passenger upon a railway train. This legislation has upset some of the most notable distinctions of law.

The first agitation for legislation of this character occurred in England in 1880. There are now a number of states in the Union which have enacted statutes fixing the liability of employers under certain conditions and relieving the employé from the application of the common-law rule. Of course, where the employé himself is contributory to the injuries resulting from an accident he cannot recover, nor can he recover in some cases where he knows of the danger from the defects of tools or implements employed by him. The legislation upon the subject is exceedingly interesting, and involves many features of legislation which need not be described here, such as those concerning the power of employés to make a contract, and those defining the conditions, often elaborate, which lead to the liability of the employer and the duties of the employé, and the relations in which damages for injuries sustained in employment may be recovered from the employer.

AUTHORITIES.—*Second Special Report, U.S. Department of Labour*, giving all the labour laws in force in the United States in 1896, with annotations of decisions of courts; bi-monthly *Bulletin of Department of Labour*, containing laws passed since those published in the foregoing and decisions of courts relating to legislation concerning employers and employés.—"Employer and Employee under the Common Law," and "Protection of Workmen in their Employment," *Bulletins Nos. 1 and 26*, respectively, *U.S. Department of Labour.*—"Inspection of Factories and Workshops in the United States," *Bulletin No. 12, U.S. Dept. of Labour.*—WRIGHT. *Industrial Evolution of the United States*, chaps. xxi., xxii., and xxiii.—RENO. *A Treatise on the Law of Employers' Liability Acts.*—STIMSON. *Handbook to the Labour Laws of the United States*, and *Labour in its Relations to Law.* (C. D. W.)

Labrador, a great peninsula in British North America, bounded on the E. by the North Atlantic, on the N. by Hudson Strait, on the W. by Hudson and James Bays, and on the S. by an arbitrary line extending eastwards from the south-east corner of Hudson Bay, near 51° N., to the mouth of the Moisie river, on the Gulf of St Lawrence, in 50° N., and thence eastwards by the Gulf of St Lawrence. It extends from 50° to 63° N., and from 55° to 80° W., and embraces an approximate area of 511,000 square miles. Recent explorations and surveys have added greatly to the knowledge of this vast region, and have shown that much of the peninsula is not a land of "awful desolation," but a well-wooded country, containing latent resources of value in its forests, fisheries, and minerals.

Geology.—The peninsula is a very ancient plateau, formed largely of crystalline schists and gneisses associated with granites and other igneous rocks, all of archæan age; there are also large areas of non-fossiliferous, stratified limestones, cherts, shales, and iron ores, the unaltered equivalents of part of the schists and gneisses. Narrow strips of Silurian rocks occur along the low-lying southern and western shores, but there are nowhere else indications of the peninsula having been below sea-level since an exceedingly remote time. During the Glacial period the country was covered by a thick mantle of ice, which flowed out radially from a central collecting-ground. Owing to the extremely long exposure to denudation, to the subsequent removal of the greater part of the decomposed rock by glaciers, and to the unequal weathering of the component rocks, it is now a plateau, which ascends somewhat abruptly within a few miles of the coast-line to heights of between 500 and 2000 feet. The interior is undulating, and traversed by ridges of low, rounded hills, seldom rising more than 500 feet above the surrounding general level.

Physical Geography.—The highest portion of the plateau extends east and west between 52° and 54° N., where an immense granite area lies between the head-waters of the larger rivers of the four principal drainage basins; the lowest area is between Hudson Bay and Ungava Bay in the north-west, where the general level is not more than 500 feet above the sea. The only mountains are the range along the Atlantic coast, extending from the Strait of Belle Isle to Cape Chidley; in their southern half they rarely exceed 1500 feet, but increase in the northern half to a general elevation of upwards of 2000 feet, with numerous sharp peaks between 3000 and 5000 feet. Owing to the exceedingly long period of denudation, the coasts are deeply indented by long irregular bays and fringed with rocky islands, especially along the high

Atlantic coast, where the shore-line is very irregular, and long narrow fiords penetrate inland. Hamilton Inlet, 250 miles north of the Strait of Belle Isle, is the longest of these bays, with a length of 150 miles and a breadth varying from 2 to 30 miles. The surface of the outer portions of the plateau is deeply seamed by valleys, cut into the crystalline rocks by the natural erosion of rivers, depending for their length and depth upon the volume of water flowing through them. The valley of the Hamilton river is the greatest, and forms a continuation of the valley of the Inlet, and extends 300 miles farther inland, while its bottom lies from 500 to 1500 feet below the surface of the plateau into which it is cut. The depressions between the low ridges of the interior are occupied by innumerable lakes, many of great size, including Mistassini, Michikamau, Clearwater, Kaniapiskau, and Seal, all from 50 to 100 miles long. The streams discharging these lakes, before entering their valleys, flow on a level with the country and occupy all depressions, so that they frequently spread out into lake-expansions and are often divided into numerous channels by large islands. The descent into the valleys is usually abrupt, being made by heavy rapids and falls; the Hamilton, from the level interior, in a course of 10 miles falls 900 feet into the head of its valley, this descent including a sheer drop of 315 feet at the Grand Falls, which, taken with the large volume of the river, makes it the greatest fall in North America. The rivers of the northern and western watersheds drain about two-thirds of the peninsula; the most important of the former are the Koksoak, the largest river of Labrador, with a length of over 500 miles, the George, Whale, and Payne rivers, all flowing into Ungava Bay. The large rivers flowing westwards into Hudson Bay are the Povungnituk, Kogaluk, Great Whale, Big, East Main, and Rupert, varying in length from 300 to 500 miles. The rivers flowing south are comparatively short and exceedingly rapid, the Moisie, Romaine, Natashquan, and St Augustine being the most important, and all about 300 miles long. The Atlantic coast range throws most of the drainage northwards into the Ungava basin, and only small streams fall into the ocean, except the Hamilton, North-west, and Kenamou, which empty into the head of Hamilton Inlet.

Climate.—The climate, ranges from cold temperate on the southern coasts to arctic on Hudson Strait, and is generally so rigorous that it is very doubtful if the country is fit for agriculture north of 51°, except on the low grounds near the coast. On James Bay good crops of potatoes and other roots are grown at Fort George, 54° N., while about the head of Hamilton Inlet, on the east coast, and in nearly the same latitude, similar crops are easily cultivated. On the outer coasts the climate is more rigorous, being affected by the floating ice borne southwards on the Arctic current. In the interior at Mistassini, 50° 30′ N., a crop of potatoes is raised annually, but they rarely mature. No attempts at agriculture have been made elsewhere inland. Owing to the absence of grass plains, there is little likelihood that it will ever be a grazing district. There are only two seasons in the interior: winter begins early in October, with the freezing of the small lakes, and lasts until the middle of June, when the ice on rivers and lakes melts and summer suddenly bursts forth. From unconnected observations the lowest temperatures of the interior range from −50° F. to −60° F., and are slightly higher along the coast. The mean summer temperature of the interior is about 55° F., with frosts during every month in the northern portion. On the Atlantic coast and in Hudson Bay the larger bays freeze solid between the 1st and 15th of December, and these coasts remain ice-bound until late in June. Hudson Strait is usually sufficiently open for navigation about the 10th of July.

Minerals.—The mineral wealth is quite undeveloped. Thick beds of excellent iron ore cover large areas in the interior and along the shores of Hudson and Ungava Bays. Large areas of mineralized Huronian rocks have also been discovered, similar to areas in other parts of Canada, where they contain valuable deposits of gold, copper, nickel, and lead; good prospects of these metals have been found.

Vegetation.—The southern half is included in the sub-Arctic forest belt, and nine species of trees constitute the whole arborescent flora of this region; these species are the white birch, poplar, aspen, cedar, Banksian pine, white and black spruce, balsam fir, and larch. The forest is continuous over the southern portion to 53° N., the only exceptions being the summits of rocky hills and the outer islands of the Atlantic and Hudson Bay, while the low margins and river valleys contain much valuable timber. To the northward the size and number of barren areas rapidly increase, so that in 55° N. more than half the country is treeless, and two degrees farther north the limit of trees is reached, leaving, to the northward, only barrens covered with low Arctic flowering plants, sedges, and lichens.

Fisheries.—The fisheries along the shores of the Gulf of St Lawrence and of the Atlantic are at present the most valuable resources of Labrador, and form practically the only industry of the white population scattered along the coasts, as well as of a large proportion of the inhabitants of Newfoundland. The census (1891) of Newfoundland gave 10,478 men, 2081 women, and 828 children employed in the Labrador fishery in 861 vessels, of which the tonnage amounted to 33,689 tons; the total catch being 488,788 quintals of cod, 1275 tierces of salmon, and 3828 barrels of herring, which, compared with the customs returns for 1880, showed an increase of cod and decreases of salmon and herring. The salmon fishery along the Atlantic coast is now very small, the decrease being probably due to excessive use of cod-traps on that coast. The cod fishery is now carried on along the entire Atlantic coast and into the eastern part of Ungava Bay, where excellent catches have been made since 1893. The annual value of the fisheries on the Canadian portion of the coast is about $350,000. The fisheries of Hudson Bay and of the interior are wholly undeveloped, and remain another source of future wealth, as both the bay and the large lakes of the interior are known to be well stocked with several species of excellent fish, including Arctic trout, brook trout, lake trout, white fish, sturgeon, and cod.

Population.—The population is approximately 14,500, or about one person to every 35 square miles; it is made up of 3500 Indians, 2000 Eskimo, and 9000 whites. The last are confined to the coasts and to the few Hudson Bay Company's trading posts of the interior. On the Atlantic coast they are largely immigrants from Newfoundland, together with descendants of English fishermen and Hudson Bay Company's servants. To the north of Hamilton Inlet they are of more or less mixed blood from marriage with Eskimo women. The Newfoundland census of 1901 gave 3634 as the number of permanent white residents along the Atlantic coast, and the Canadian census (1891) gave a white population of 5728, mostly French Canadians, scattered along the north shore of the Gulf of St Lawrence, while the whites living at the inland posts did not exceed fifty persons. As regards the native population of Labrador, it is difficult to give more than a rough approximation of their numbers, owing to their habits of roving from one trading post to another, and the consequent liability of counting the same family several times if the returns are computed from the books of the various posts, the only available data for an exact enumeration. The following estimate is arrived at in this manner: Indians—west coast, 1200; Ungava Bay, 200; east coast, 200; south coast, 1900. Eskimo—Atlantic coast, 1000; south shore of Hudson Strait, 800; east coast of Hudson Bay, 500. The Indians roam over the southern interior in small bands, their northern limit being determined by that of the trees, on which they depend for fuel. They live wholly by the chase, and their numbers are dependent upon the deer and other animals; as a consequence there is a constant struggle between the Indian and the lower animals for existence, with great slaughter of the latter, followed by periodic famines among the natives, which greatly reduce their numbers and maintain an equilibrium. These famines have occurred several times since the Hudson Bay Company has been established, with the result that the native population has remained about stationary for the last two centuries. The Indians belong to the Algonquin family, and speak dialects of the Cree language. By contact with missionaries and fur-traders they are more or less civilized, and the great majority of them are Christians. Those living north of the St Lawrence are Roman Catholic, while the Indians of the western watershed have been converted by the missionaries of the Church Mission Society; the eastern and northern bands have not yet been reached by the missionaries, and are still pagans. The Eskimo of the Atlantic coast have long been under the guidance of the Moravian missionaries, and are well advanced in civilization; those of Hudson Bay have been taught by the Church Mission Society, and promise well; while the Eskimo of Hudson Strait alone remain without teachers, and are pagans. The Eskimo live along the coasts, only going inland for short periods to hunt the barren-ground caribou for their winter clothing; the rest of the year they remain on the shore or the ice, hunting seals and porpoises, which afford them food, clothing, and fuel. The Christianized Indians and Eskimo read and write in their own language; those under the teaching of the Church Mission Society use a syllabic character, the others make use of the ordinary alphabet.

Political Review.—The Labrador peninsula is divided politically between the Governments of Canada, Newfoundland, and the Province of Quebec. The Government of Newfoundland, under Letters Patent 28th March 1876, exercises jurisdiction along the Atlantic coast; the boundary between its territory and that of Canada is marked by a line running due north and south from Anse Sablon, on the north shore of the Strait of Belle Isle, to 52° N., the remainder of the boundary being as yet undetermined. The northern boundary of the Province of Quebec, as declared by the statutes of Canada, 61 Victoria, cap. 3, follows the East Main river to its source in Patamisk lake, thence by a line due east to the Ashuanipi branch of the Hamilton river; it then follows that river and Hamilton Inlet to the coast area under the jurisdiction of Newfoundland. The remainder of the peninsula, north of the Province of Quebec, by Order in Council 18th December 1897 was constituted Ungava District, an unorganized territory under the jurisdiction of the Government of the Dominion of Canada.

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(A. P. LO.)

Labuan (more correctly written Labuh-an, its meaning in the Malayan vernacular being "anchorage"), an island of the East Indian or Malayan Archipelago, which has been a British possession since 1848. On 1st January 1890 it was transferred for administrative purposes to the Chartered Company of British North Borneo, the Governor of the Company's territories being from that time forward the governor of Labuan also. As governor of Labuan he holds a commission from the Crown. After its transfer to the Chartered Company the colony still retained its own local laws. The island lies about six miles off the north-western coast of Borneo, opposite the northern end of the great bay of Brunei. Of the total area of 19,347 acres only some 1500 acres are sown with rice, but small tracts of land are covered by cocoanut and sago palms, and about fifty Chinese own vegetable gardens planted on Government ground. The neighbouring island of Pulau Dat is the site of a thriving cocoanut plantation, whence copra and nuts are exported in bulk. The African oil palms have not proved a success. At the time of its occupation a brilliant future was predicted for Labuan: its harbour was to make a second Singapore, and its coal deposits were to prove an unfailing source of wealth. The anticipations made of the wealth of the coal-fields have not been realized; after a succession of companies had liquidated or transferred their leases, the Labuan Borneo Company was formed in 1898, but it has since passed into liquidation. From the coal-mines near the village of Lubok Termiang, some ten miles of metre-gauge railway lead to Victoria Harbour. In 1898 the coal exported amounted to 36,901 tons. The population of Labuan numbered 5731 in 1881, but had decreased to 3361 in 1891. The mainland of Borneo, since its pacification by the Chartered Company, offered greater scope than formerly to native enterprise, and emigration from Labuan consequently ensued. There are about fifty European settlers living in the island, about ten per cent. of whom are women. The native population includes Malay fishermen, Chinese, Tamils, and Kadayans, Tutongs and other natives from the mainland of Borneo. Victoria Harbour is a naval saluting station, and possesses a good rifle-range. The harbour is commodious and well sheltered. The Eastern Extension Telegraph Company have a central station at Labuan, with cables to Singapore, Hong-Kong, and British North Borneo. The colony joined the Imperial Penny Postal Union in 1899. There is one hotel, a Roman Catholic church with a resident priest, a Church of England church which is visited periodically by a clergyman from the mainland, two native and Chinese schools, and a sailors' club built by the R.C. Mission and supported by voluntary contributions. The bishop of Singapore and Sarawak is also bishop of Labuan.

See KEPPEL. *Visit to Indian Archipelago*, London, 1853.—MUNDY. *Narrative of Events in Borneo.* London, 1848.—BURBAGE. *Gardens of the Sun.* London, 1880.—HATTON. *The New Ceylon; North Borneo.*—PRYER. *A Decade in Borneo.*—POSEWITZ. *Borneo.*—ROTH. *Borneo.*

(H. CL.)

Lace.—The chief incidents in connexion with making lace by hand and by machinery during the years which have elapsed since the article on Lace was written for the earlier volumes (ninth edition) of this work may be said to be (1) increased production, (2) developed ingenuity in the weaving by machinery of a greater variety of lace-like textures and ornaments than formerly, and (3) improvement in the design of ornament specially destined for translation into lace whether by hand or by machinery.

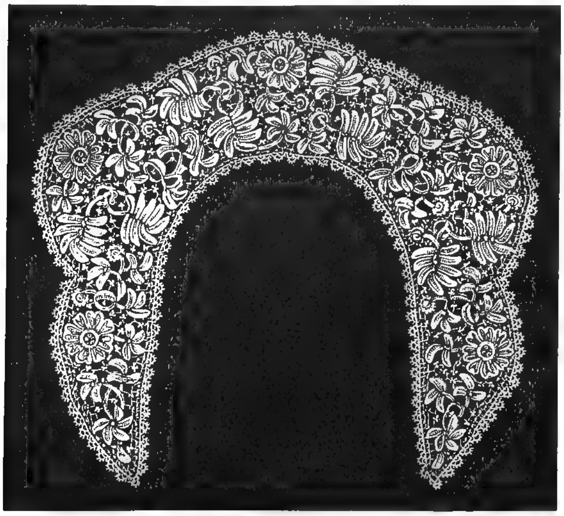

Fig. 1.—Collar of Irish Crochet Lace.

An extraordinary demand for hand-made laces has led to a revival of this distinctly domestic industry in many parts of Europe, but particularly in Belgium, where the social and economic conditions are, as they have been in the past, more conducive and more favourable than elsewhere to its pursuit at a sufficiently remunerative rate of wages. The production of hand-made laces in Belgium was in 1900 greater than that of France. The principal needle-made lace of Belgium is the "Point de Gaze"; "Duchesse" and Bruges laces are the chief pillow-made laces; whilst "Point Appliqué" and "Plat Appliqué" are frequently the results not only of combining needle-made and pillow work, but also of using them in conjunction with machine-made net. Ireland is the best producer of that substantial looped-thread work known as crochet, which must be regarded as a hand-made lace fabric. It is in this respect quite distinct in character from pseudo-laces, which are really embroideries with a lace-like appearance, *e.g.*, embroideries on net, cut and embroidered cambrics and fine linen. For such as these Ireland maintains a reputation in its admirable Limerick and Carrickmacross laces, which are made not only in Limerick and Carrickmacross, but also in Kinsale, Newry, Crossmaglen, and elsewhere. The demand from France for Irish crochet is now far beyond the supply, a condition which leads not only to the rapid repetition by Irish workers of old patterns, but tends also to a gradual debasement of both texture and ornament. Attempts have been made occasionally to counteract this tendency, with some success, as the specimens of Irish crochet in Figs. 1, 2, and 3 indicate.

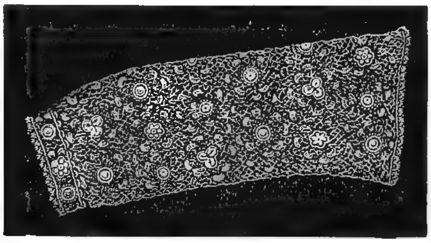

Fig. 2.—Lady's Sleeve of Irish Crochet Lace.

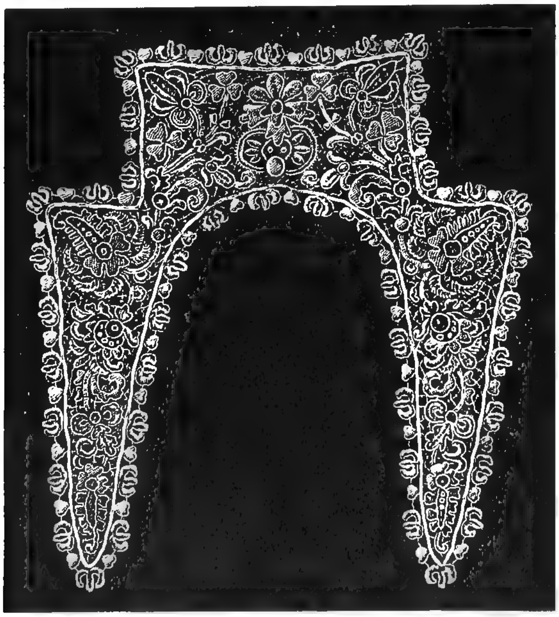

Fig. 3.—Collar and Bertha of Irish Crochet Lace.

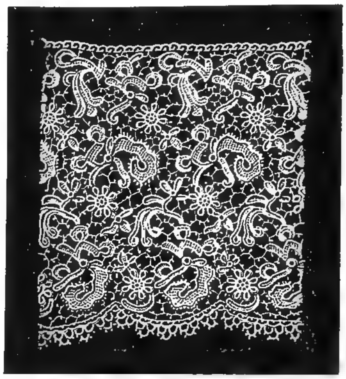

Fig. 4.—Machine-made Trimming Border in imitation of Irish Crochet Lace.

France continues to be faithful to her traditions in maintaining a lively and graceful taste, somewhat, however, at the risk of sacrificing that higher order of handwork which has supplied the world with the elaborate and delicate needle-point laces of Alençon and Argentan. Fashion of late years has called for ampler and more boldly effective laces, readily produced with both braids and cords and far less intricate needle or pillow work than was required for the dainty and smaller laces of earlier date. Other European countries, including Great Britain, do not compete successfully in hand lace-making with Belgium and France. An appreciable amount of pillow-made lace is annually supplied from Devonshire, Buckinghamshire, Bedfordshire, and Northumberland, but it is bought almost wholly for home and not foreign use. The English laces are made almost entirely in accordance with the precedents of the 19th century—that is to say, in definite lengths and widths, as for borders, insertions, and flounces. The recent demand, however, has been chiefly for large shaped articles, such as panels for dresses, long sleeves, complete skirts, jackets, blouses,

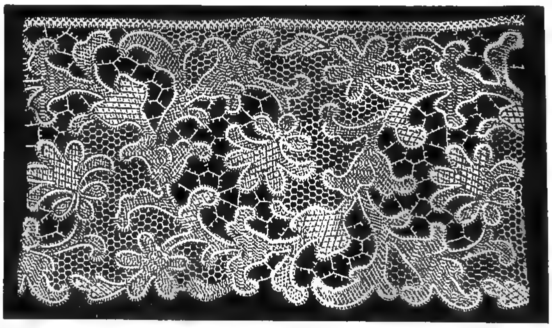

Fig. 5.—Border of Machine-made Lace in imitation of 17th-century Pillow Lace.

and fancifully-shaped collars of considerable dimensions. To make such things entirely of lace necessitates many modifications in the ordinary methods; the English lace-workers are slow to adapt their work in the manner requisite, and hence are far behind in the race to respond to the fashionable demand. No countries, indeed, succeed so well in promptly answering the variable call of fashion as France and Belgium.

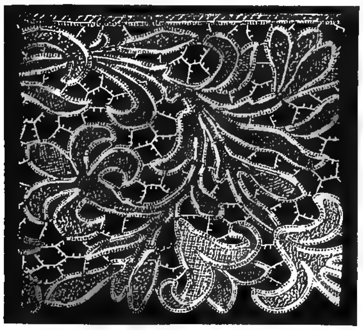
Fig. 6.—Border of Machine-made Lace in the style of 17th-century Pillow Guipure Lace.

As regards trade in lace, America probably buys more from Belgium than from France; France and England come next as purchasers of nearly equal quantities, after which come Russia and Italy.

In respect of lace-like fabrics made by machinery, British capital and labour are concerned in supplying the world with the more important quantity of curtains and hangings. France seems to take the lead in producing the more filmy and more delicate machine-made laces for wearing purposes; whilst Switzerland (St Gall) and Germany (Plauen in Saxony) are foremost in making by machinery imitations of the more solid laces, such as the Venetian raised or "Rose" needle-point laces and Irish crochet. The technical method of making laces by hand, whether on the pillow with bobbins or in the hand with a needle, has not altered. Plaiting threads on the pillow or looping them together by means of the needle are the same in principle and practice as they were throughout the 16th and 17th centuries, when the fostering and gradual perfection of the art of lace-making were proceeding in Europe.

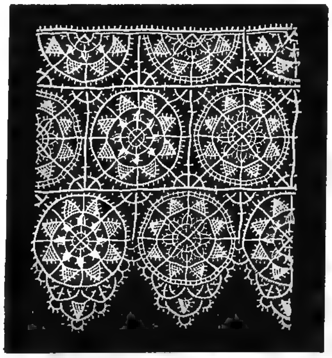
Fig. 7.—Machine-made Lace in imitation of 16th-century Needle-point "Reticella" Lace.

The Leavers lace-making machine, of which the principal features were briefly indicated in the earlier volumes of this Encyclopædia, has not undergone any essential change. Its mechanical principles for weaving the threads together and for rendering variety of ornament in pattern remain as they were, notwithstanding such relatively minor modifications as make it possible to produce readily laces having varied effects such as are shown in the specimens in Figs. 5 and 6. The machine imitations of the lighter and finely-meshed laces, for which the lace-makers at Valenciennes and Mechlin have long been famed, continue to be made in great quantities at Nottingham and Calais. Within recent years the texture and ornamental design in these fabrics have been so improved that they are worn even by those who not long ago considered hand-made materials to be indispensable. In another branch of lace-making by machinery, mechanical ingenuity, combined with chemical treatment, has led to surprising results (Figs. 4 and 7). Swiss and German manufacturers use machines in which a principle of the sewing-machine is involved. A fine silken tissue is thereby enriched with an elaborately raised cotton or thread embroidery. The whole fabric is then treated with chemical mordants which, whilst dissolving the silky web, do not attack the cotton or thread embroidery. A relief embroidery possessing the appearance of hand-made raised needle-point lace is thus produced. Figs. 8 and 9 give some idea of the high quality to which this admirable counterfeit has been brought.

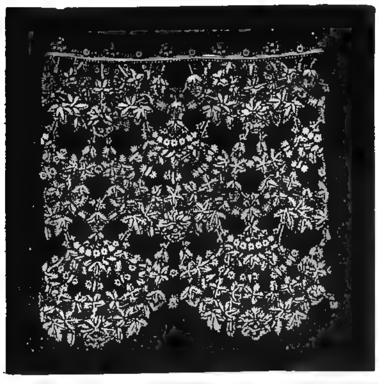
Fig. 8.—Machine-made Lace of Modern Design.

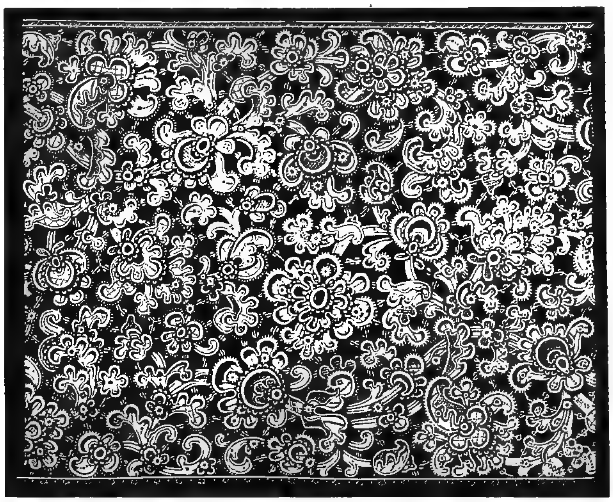
Fig. 9.—Machine-made Lace in imitation of 17th century Needle-point Lace "Gras point de Venise."

The success with which machinery can compete with the hand in the making of lace must be largely ascribed to the serious study given by those engaged in directing the manufacture by machinery, and to the various ornamental characteristics exhibited in types of hand-made work of former periods. Collections of these exist in museums and technical institutions, as for instance the Victoria and Albert museum in London, the Musée des Arts Décoratifs in Paris, and Museums at Lyons, Nuremberg, Berlin, Turin, and elsewhere. In such places the opportunity is presented of tracing in chronological sequence the stages of pattern and texture development, and thus a means is provided of acquiring a knowledge which has not been obtainable so readily in past times as it is now. This is a condition which gives vitality to both demand and supply.

In addition to books on lace mentioned at the end of the article in vol. xiv. (9th ed.), it will be useful to give here a brief list of other publications. In 1886 the Libraire Renouard, Paris, published a *History of Point d'Alençon*, written by Madame G. Despierres, which gives a close and interesting account of the industry, together with a list, compiled from local records, of makers and dealers from 1656 onwards.—*Embroidery and Lace: their manufacture and history from the remotest antiquity to the present day*, by Ernest Lefebure, lace-maker and administrator of the Ecole des Arts Décoratifs, translated and enlarged with notes by Alan S. Cole, was published by H. Grevel, London, 1888. It is a well-illustrated handbook for amateurs, collectors, and general readers.—Irish laces made from selected and recent designs are illustrated in the *Renascence of the Irish Art of Lace-making*, published in 1888 by Chapman and Hall, London.—*Anciennes Dentelles Belges formant la Collection de feue Madame Augusta Baronne Liedts et données au Musée de Grunthuis à Bruges*, published at Antwerp in 1889, consists of a folio volume containing upwards of 181 phototypes—many full size—of fine specimens of lace. The ascriptions of country and date of origin are occasionally inaccurate, on account of a too obvious desire to credit Bruges with being the birthplace of all sorts of lace work, much of which shown in this work is distinctly Italian.—The *Encyclopædia of Needlework*, by THÉRÈSE DE DILLMONT-DORNACH, Alsace, 1891, is a detailed guide to several kinds of embroidery, knitting, crochet, tatting, netting, and most of the essential stitches for needle-point lace. It is well illustrated with woodcuts and process blocks.—An exhaustive history of Russian lace-making is given in *La Dentelle Russe*, by Madame SOPHIE DAVIDOFF, published at Leipzig by Karl Hiersemann, 1895. Russian lace is principally pillow-work with rather heavy thread, and upwards of eighty specimens are reproduced by photo-lithography in this book.—A short account of the best-known varieties of *Point and Pillow Lace*, by A. M. S., London, John Murray, 1899, is illustrated with typical specimens of Italian, Flemish, French, and English laces, as well as with magnified details of lace, enabling any one to identify the plaits, the twists, and loops of threads in the actual making of the fabric.—*L'Industrie des Tulles et Dentelles Mécaniques dans le Pas de Calais, 1815–1900*, by HENRI HÉNON (Bélin Frères, Paris, 1900), is an important volume of over 600 pages of letterpress, interspersed with abundant process blocks of the several kinds of machine nets and laces made at Calais since 1815. It opens with a short account of the Arras hand-made laces, the production of which is now almost extinct. The book is sold for the benefit of a public subscription towards the erection of a statue in Calais to Jacquard, the inventor of the well-known apparatus by means of which all figured textile fabrics are manufactured. It is of some interest to note that machine net and lace making at Calais owe their origin to Englishmen, amongst whom "le sieur R. Webster arrivé à St Pierre-les-Calais en Décembre 1816, venant d'Angleterre, est l'un des premiers qui ont établi dans la communauté une fabrique de tulles," &c. *Lace-making in the Midlands: past and present*, is an ably-written little work by C. C. CHANNER and M. E. ROBERTS (Methuen, London, 1900) upon the lace-making industry in Buckinghamshire, Bedfordshire, and Northamptonshire, and contains many illustrations of laces made in these counties from the 17th century to the present time. (A. S. C.)

Lachine, an incorporated town in Jacques Cartier county, Quebec, Canada, situated eight miles by rail west of Montreal, on Lake St Louis, an expansion of the St Lawrence, and at the upper end of the Lachine canal. It is a station on the Grand Trunk railway and port of call for steamers plying between Montreal and the Great Lakes. It is a favourite summer resort for Montrealers. Population (1881), 2406; (1891), 3761; (1901), 5561.

Laconia, a city of New Hampshire, U.S.A., capital of Belknap county, on the Boston and Maine railroad, and on the west shore of Lake Winnepesaukee. It contains several villages, among them Laconia, Lakeport, and The Wiers. It contains the car-works of the Boston and Maine railroad. Population (1880), 3790; (1890), 6143; (1900), 8042, of whom 1770 were foreign-born and 21 were negroes.

Lacquer (JAPANESE).—No important new developments have taken place during modern times in Japan's lacquer manufacture. Her artists follow the old ways faithfully; and indeed it is not easy to see how they could do better. On the other hand, there has not been any deterioration; all the skill of former days is still active. The contrary has been repeatedly affirmed by foreign critics,[1] but no one really familiar with modern productions can entertain such a view. Lacquer-making, however, being essentially an art and not a mere handicraft, has its eras of great masters and its seasons of inferior execution. Men of the calibre of Kwôetsu Kwôrin, Ritsuô, Kajikawa, and Mitsutoshi must be rare in any age, and the epoch when they flourished is justly remembered with enthusiasm. But the *Meiji* era has had its Zeshin, and it has now Shirayama Fukumatsu, Kawanabe Icho, Shibayama Sôichi, Morishita Morihachi, and other lesser experts, all masters in designing and execution. Zeshin, shortly before he died, indicated Shirayama Fukumatsu as the man upon whom his mantle should descend, and that the judgment of this really great craftsman was correct cannot be denied by any one who has seen the works of Shirayama. He excels in his representations of landscapes and waterscapes, and has succeeded in transferring to gold-lacquer panels tender and delicate pictures of nature's softest moods—pictures that show balance, richness, harmony, and a fine sense of decorative proportion. Kawanabe Icho is celebrated for his representations of flowers and foliage, and Morishita Morihachi and Asano Saburo (of Kaga) are admirable in all styles,[2] but especially, perhaps, in the charming variety called *togi-dashi* (ground down), which is pre-eminent for its satin-like texture and for the atmosphere of dreamy softness that pervades the decoration. The *togi-dashi* design, when finely executed, seems to hang suspended in the velvety lacquer or to float under its silky surface. The magnificent sheen and richness of the pure *kin-makiye* (gold lacquer) are wanting, but in their place we have inimitable tenderness and delicacy.

New development.

The only branch of the lacquerer's art that can be said to have shown any marked development in the *Meiji* era is that in which parts of the decorative scheme consist of objects in gold, silver, *shakudo*, *shibuichi*, iron, or, above all, ivory or mother-of-pearl. It might indeed be inferred, from some of the essays published in Europe on the subject of Japan's ornamental arts, that this application of ivory and mother-of-pearl held a place of paramount importance. Such is not the case. Cabinets, fire-screens, plaques, and boxes resplendent with gold lacquer grounds carrying elaborate and profuse decoration of ivory and mother-of-pearl[3] are not objects that appeal to Japanese taste. They belong essentially to the catalogue of articles called into existence to meet the demand of the foreign market, being, in fact, an attempt to adapt the lacquerer's art to decorative furniture for European houses. On the whole it is a successful attempt. The plumage of gorgeously-hued birds—as peacocks, parroquets, pheasants, &c.—the blossoms of flowers (especially the hydrangea), the folds of thick brocade, microscopic diapers and arabesques, are built up with tiny fragments of iridescent shell, in combination with silver foil, gold lacquer, and coloured bone, the whole producing a rich and sparkling effect. In fine specimens the workmanship is extraordinarily minute, and every fragment of metal, shell, ivory, or bone, used to construct the decorative scheme, is imbedded firmly in its place. But in a majority of cases the work of building is done by means of paste and glue only, so that the result lacks durability. The employment of mother-of-pearl to ornament lacquer-grounds dates from a period as remote as the 8th century, but its use as a material for constructing decorative designs began in the 17th century, and was due to an expert called

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[1] Professor Rein, for example, in his great work on Japan, quotes with approval the opinion of a writer who predicts that "it will not be long before the last competent *makiye-shi* [lacquer-decorator] of the country has passed away."

[2] A large part of the work of lacquer-making is purely technical, namely, the part done by the *nurimono-shi*, who spreads the numerous coats of lacquer and performs the various processes of polishing and grinding. By him is produced what may be called "artisan lacquer"; that is to say, all varieties of lacquer that owe their beauties solely to quality and colour of surface, namely, monochromes, as mirror-black, vermilion, yellow, brown, green, cinnabar and other hues of red; grounds ornamented with a dust of gold, silver, mother-of-pearl, tin, or bronze; grounds inlaid with mother-of-pearl; marbled, wood-grained, and so forth. "Art lacquer," on the other hand, is that which, after emerging from the hands of the *nurimono-shi*, passes under those of the *makiye-shi*, who, briefly speaking, paints upon the surface of the lacquer a picture, whether of a landscape, a battle-scene, flowers, foliage, birds, insects, &c., or some more formal decoration of scrolls, arabesques, and diapers. The *makiye-shi* is a true artist.

[3] Obtained from the shell of the haliotis.

Shibayama, whose descendant, Shibayama Sôichi, now works in Tôkyô.

History and processes.

The following account of the history of the lacquer industry in Japan and the processes of manufacture is taken from the writer's *Japan*. Japan derived the art of lacquering from China (probably about the beginning of the 6th century), but she ultimately carried it far beyond Chinese conception. At first her experts confined themselves to plain black lacquer. From the beginning of the 8th century they began to ornament it with dust of gold or mother-of-pearl, and throughout the *Heian* epoch (9th to 12th century) they added pictorial designs, though of a formal character, the chief motives being floral subjects, arabesques, and scrolls. All this work was in the style known as *hira-makiye* (flat decoration); that is to say, having the decorative design in the same plane as the ground. In the days of the great dilettante Yoshimasa (1449–90), lacquer experts devised a new style, *taka-makiye*, or decoration in relief, which immensely augmented the beauty of the ware, and constituted a feature altogether special to Japan. Thus when, at the close of the 16th century, the *Taikô* inaugurated the fashion of lavishing all the resources of applied art on the interior decoration of castles and temples, the services of the lacquerer were employed to an extent hitherto unknown, and there resulted some magnificent work on friezes, coffered ceilings, door panels, altar-pieces, and cenotaphs. This new departure reached its climax in the Tokugawa mausolea of Yedo and Nikko, which are enriched by the possession of the most splendid applications of lacquer decoration the world has ever seen, nor is it likely that anything of comparable beauty and grandeur will be again produced in the same line. Japanese connoisseurs name the end of the 17th century as the golden period of the art, and so deeply rooted is this belief that whenever a date has to be assigned to any specimen of exceptionally fine quality, it is unhesitatingly referred to the time of Jôken-in (Tsunayoshi). It will thus be perceived that the three great stages in the history of lacquer industry were separated by intervals of 100 years; namely, the Yoshimasa development at the end of the 15th century, the *Taikô* development at the end of the 16th, and the *Jôken-in* climax at the end of the 17th. Beyond the last it is difficult to perceive any possibility of advance.

In the manufacture of Japanese lacquer there are three processes. The first is the extraction and preparation of the lac; the second, its application; and the third, the decoration of the lacquered surface. The lac, when taken from an incision in the trunk of the *Rhus vernicifera* (*urushi-no-ki*), contains approximately 70 per cent. of lac acid, 4 per cent. of gum arabic, 2 per cent. of albumen, and 24 per cent. of water. It is strained, deprived of its moisture, and receives an admixture of gamboge, cinnabar, acetous protoxide, or some other colouring matter. The object to be lacquered, which is generally made of thin white pine, is subjected to singularly thorough and painstaking treatment, one of the processes being to cover it with a layer of Japanese paper or thin hempen cloth, which is fixed by means of a pulp of rice-paste and lacquer. In this way the danger of warping is averted, and exudations from the wooden surface are prevented from reaching the overlaid coats of lacquer. There are numerous operations of luting, sizing, lacquering, polishing, drying, rubbing down, and so on, until, after many days' treatment, the object emerges with a smooth, lustre-like, dark-gray surface, and is ready to pass into the hands of the *makiye-shi*, or decorator. The latter is an artist; those who have performed the preliminary operations are merely skilled artisans. The *makiye-shi* may be said to paint a picture on the surface of the already lacquered object. He takes for subject a landscape, a seascape, a battle-scene, flowers, foliage, birds, fishes, insects—in short, anything. This he sketches in outline with a paste of white lead, and then, having filled in the details with gold and colours, he superposes a coat of translucid lacquer, which is finally subjected to careful polishing. If parts of the design are to be in relief, they are built up with a putty of black lacquer, white lead, camphor, and lamp-black. In all fine lacquers gold predominates so largely that the general impression conveyed by the object is one of glow and richness. It is also an inviolable rule that every part must show beautiful and highly finished work, whether it be an external or an internal part. The *makiye-shi* ranks almost as high as the pictorial artist in Japanese esteem. He frequently signs his works, and it results that a great number of names have been handed down during the past two centuries.

See also under JAPAN. (F. BY.)

Lacroma, a small island of the Austrian province of Dalmatia, south of Ragusa, remarkable for the beauty of its sub-tropical vegetation. It was a favourite resort of the Archduke Maximilian, afterwards emperor of Mexico, who restored the château and park, and of the Crown Prince Rudolph. It contains an old monastery, and the remains of a church said to have been founded by Richard Cœur de Lion now form part of the imperial château.

See *Lacroma*, an illustrated descriptive work by the Crown Princess Stephanie (Vienna, 1892).

Lacrosse, a city of Wisconsin, U.S.A., capital of Lacrosse county, on the east bank of the Mississippi river, at the mouths of the Lacrosse and the Black, at an altitude of 669 feet. Its plan is regular, and it has a good water-supply, owned by the city. It is on four railways: the Chicago, Burlington, and Quincy; the Chicago and North-Western; the Chicago, Milwaukee, and St Paul; and the Green Bay and Western. Its chief business in the manufacture of lumber. Its manufactures, according to the census of 1890, had a capital of $10,039,872, employed 4127 hands, and had a product valued at $9,157,501. Lumber was the principal product, with a value of $3,570,522, and next in value was flour, with $2,134,785. The assessed valuation of property, real and personal, was $12,381,952, the net debt of the city was but $401,029, and the rate of taxation $22.50 per $1000. Population (1890), 25,090; (1895), 28,769; (1900), 28,895, of whom 7222 were foreign-born and 56 were negroes.

Ladak.—Little has occurred in this remote outlying province of the upper Indus to bring it into prominence of late years. It is from Leh, its capital, that western Tibet is most readily accessible, and through Leh the trade of Lhasa ebbs and flows. It is this trade which gives Ladak sufficient local importance to justify the presence of a British political officer, who resides at Leh for half the year; whilst its geographical position renders it further notable as the starting-point of many adventurous journeys into the Tibetan highlands. As year by year the economic possibilities which lie beyond the Himalaya become better known, it is more clearly demonstrated that no great trade developments are to be expected from these Tibetan sources which have already been tested, so long as the spirit of determined opposition to the advance of European influence, and to the introduction of scientific methods, is maintained amongst Tibetan officials. With the gradual awakening of China there may hereafter be reflected some rays of enlightenment into these far-away borders of the "Celestial Empire," but at present there is more evidence of a decrease in Tibetan trade than of progress.

In 1896–97 the exports to British India from Tibet, chiefly passing through Leh, amounted to Rx.140,456, showing an increase on the previous year, but a decrease of Rx.5000 on the year before. The imports were Rx.69,406, which is lower than the two previous years. Ladak is, however, improving in its trade prospects apart from Tibet; and in 1896–97 the exports amounted to Rx.57,508, and imports to Rx.64,574. It is curious that both Ladak and Tibet import a considerable amount of treasure, for on the borders of western Tibet and within a radius of one or two hundred miles of Leh there centres a gold-mining industry which apparently only requires scientific development to render it enormously productive. Here the surface soil has been washed for gold, for more centuries than we can count, by bands of Tibetan miners who never work deeper into the soil than from 20 to 50 feet, and whose methods of washing have ever been of the very crudest description. They work in winter, chiefly because of the binding power of frost on the friable soil, suffering great hardships and obtaining but a poor return for their labour. But the remoteness of Ladak and its extreme altitude still continue to bar the way to substantial progress, though its central position naturally entitles it to be the great trade mart.

The road to Leh from Srinagar lies up the lovely Sind valley to the sources of the river at the Zoji La pass

(11,300 feet) in the Zaskar range. This is the range which, skirting the southern edge of the upland plains of Deosai in Baltistan, divides them from the valley of Kashmir, and then continues to Nanga Parbat (26,620 feet) and beyond that mountain, to the north of Swat and Bajaor. To the south-east it stretches in an unbroken chain till it merges into the line of snowy peaks which is seen from Simla and the plains of India—the snowy range which reaches past Chini to the famous peaks of Gangotri, Nandadevi, and Nampa. It is the most central and the best known range in the Himalaya. The Zoji La, which curves from the head of the Sind valley on to the bleak uplands of Dras (where lies the road to the trough of the Indus and Leh), is, in spite of its altitude, a pan in which but little snow lies; but for local accumulations, it would be open all the year round. It is cited by Oldham, of the Indian Geological Survey, as affording a typical instance of that cutting-back process by which a river-head may erode a channel through a watershed and cut into the plateau behind, there being no steep fall towards the Indus on the northern side of the range. From the Zoji La the road continues by easy gradients, following the line of the Dras drainage, to the Indus, when it turns up the valley to Leh. From Leh there are many routes into Tibet, the best known being that which comes from the Indus valley to the Tibetan plateau, by the Chang La, to Lake Pangkong and Rudok (14,000 feet). Rudok occupies a forward position on the western Tibetan border which is analogous to that of Leh in Kashmir. The chief trade route to Lhasa from Leh, however, follows the line offered by the valleys of the Indus and the Brahmaputra (or Tsanpo), crossing the divide between these rivers north of Lake Manasarowar. The development of trade through Ladak depends on the maintenance of this road, which is at present absolutely closed to Europeans.

The observatory at Leh is the most elevated observatory in Asia. According to Mr Blandford's work on the climate and weather of India, it is situated 4° farther north than Quetta, and 6,000 feet higher, and "in the leading characteristics of its climate represents that of western Tibet. . . . The atmosphere of the Indus valley is remarkably clear and transparent, and the heat of the sun is very great. There is generally a difference of more than 60° between the reading of the exposed sun thermometer *in vacuo* and the air temperature in the shade, and this difference has occasionally exceeded 90°. . . . The mean annual temperature at Leh is 40°, that of the coldest months (January and February) only 18° and 19°, but it rises rapidly from February to July, in which month it reaches 62° with a mean diurnal maximum of 80° both in that month and August, and an average difference of 29° or 30° between the early morning and afternoon. The mean highest temperature of the year is 90°, varying between 84° and 93° in the twelve years previous to 1893. On the other hand, in the winter the minimum thermometer falls occasionally below 0°, and in 1878 reached as low as 17° below zero. The extreme range of recorded temperature is therefore not less than 110°. The air is as dry as Quetta, and rather more uniformly so. . . . The amount of rain and snow is insignificant. The average rain (and snow) fall is only 2·7 inches in the year, and since that amount is the greatest ever recorded in any one year, and as rain is most frequent in July and August—but even then it only occurs on one day in ten—and the average fall of each rainy day is between one-tenth and two-tenths of an inch, agriculture is therefore almost entirely dependent on irrigation. The winds are generally light, and depend on the local direction of the valleys. At Leh, which stands at the entrance of the valley leading to the Khardong Pass, the most common directions are between south and west in the daytime and summer, and from north-east in the night, especially in the later months of the year. In January and February the air is generally calm, and April and May are the most windy months of the year."

Leh has been repeatedly visited since 1880 by travellers bound on Tibetan exploration, including Bower, Wellby, Littledale, Deasy, and others, who have recorded their general impressions, but left little description of districts on the Indian side of the Tibetan border.

The following should be consulted:—Godwin-Austen. "The Mountain Systems of the Himalaya," vol. vi. *Proc. R.G.S.*, 1884.—W. Lawrence. *The Valley of Kashmir.* London, 1895.—H. F. Blandford. *The Climate and Weather of India.* London, 1889. (T. H. H*.)

Ladrones, or Mariannes, an archipelago in the North Pacific, in about 15°–20° N. and 142° E. It consists of two groups—a northern of ten volcanic islands, of which only four (Agrigan, Anatahan, Alamagan, and Pagan) are inhabited, and a southern of five (Rota, Guam, Aguigan, Tinian, and Saypan) coralline limestone islands, all inhabited save one, Aguigan. The entire archipelago, except the island of Guam, together with the Caroline and Pelew Islands, was sold by Spain to Germany for £837,500 in 1899. The total area is about 220 square miles, and the population 1950, mostly descendants of Tagal immigrants from the Philippines. Cocoanut and areca palms, yams, sweet potatoes, manioc, coffee, cocoa, sugar, cotton, tobacco, and mother-of-pearl are the chief products, and copra the principal export. Administratively the archipelago forms part of the New Guinea Protectorate.

Lafayette, a city of Indiana, U.S.A., capital of Tippecanoe county, on the east bank of the Wabash river, at an altitude of 542 feet. It is well laid out, and is divided into seven wards. Its water-supply is pumped from the Wabash. It is on four railways: the Chicago, Indianapolis, and Louisville; the Cleveland, Cincinnati, Chicago, and St Louis; the Lake Erie and Western; and the Wabash. It is the seat of Purdue University, a technical school, founded in 1874, which had, in 1899, 64 professors and instructors and was attended by 749 students, 91 of whom were women. Population (1890), 16,243; (1900), 18,116, of whom 2266 were foreign-born and 344 negroes.

Laffitte, Pierre (1823– ——), French Positivist, was born 21st February 1823 at Béguey (Gironde). Residing in Paris as a teacher of mathematics, he became a disciple of Comte, and was one of his testamentary executors. On the schism of the Positivist body, which followed the master's death, he was recognized as head of the section which accepted the full Comtian doctrine; the other section adhering to Littré, who rejected the Religion of Humanity as inconsistent with the materialism of Comte's earlier period. In 1875 Laffitte published *Les grands types de l'humanité*, and *Cours de philosophie première* (1889). Owing to advanced years he afterwards resigned the active direction of Positivist affairs.

Lagarde, Paul Anton de (1827–1891), German theologian and orientalist, was born at Berlin on the 2nd of November 1827, and educated there. At Berlin, and afterwards at Halle, he studied theology and philosophy, as well as Oriental languages. In 1852 his studies took him to London and Paris. On his return to Germany in 1854 he obtained the post of teacher at a Berlin public school, but at the same time carried on his Biblical studies. He edited the Syriac "Didascalia Apostolorum," and followed this up with other Syriac texts collected in the British Museum and in Paris. Lagarde kept this post till 1866, when he received three years' leave of absence with a view to collecting fresh materials for his labours. On his return in 1869 he was called to Göttingen to the professorship previously held by Ewald. Like him, Lagarde was an active worker in a great variety of subjects and languages; but his chief aim, the elucidation of the Bible, was almost always kept in view. He edited the Aramaic translation (known as "Targum") of the Prophets according to the Codex Reuchlinianus preserved in the library at Karlsruhe, the Hagiographa Chaldaica, an Arabic translation of the Gospels, a Syriac translation of the Old Testament Apocrypha, a Coptic translation of the Pentateuch, and a part of the Lucianic text of the Septuagint, which he was able to reconstruct from manuscripts for nearly half the Old Testament. Besides his Biblical studies, he devoted himself ardently to Oriental scholarship. In 1877 he engaged in Armenian investigations; in 1883 he took up Persian, and also published his "Ægyptiaca," which deals with Coptic studies. His minor articles were collected under the titles "Symmicta" and "Mitteilungen," as well as in volumes issued by the University of Göttingen. Lagarde also took some part in politics. He belonged to the Prussian Conservative party, and was a violent anti-Semite. The bitterness which he showed in this racial question also made itself felt in his other writings, and in his differences with other scholars he showed some of that polemic acrimony which prevails in learned circles in Germany. He died at Göttingen on the 22nd of December 1891. (A. Z.)

Lagos, a British colony in West Africa, bounded roughly on the N. by Ilorin, on the E. by Benin (both forming part of Nigeria), on the S. by the Bight of Benin, and on the W. by Dahomey. It was, by a charter dated 13th January 1886, separated from the Gold Coast Colony and erected into a separate colony, the government of which is conducted by a governor assisted by executive and legislative councils nominated by the Crown. In the legislative council there are four unofficial members, two of whom are natives of the country. The colony proper begins on the coast, on the west side, at the boundary of the French protectorate of Dahomey, on the meridian of Ajara Creek, at about 2° 45′ 50″ E., and extends on the east side to Ode, at about 4° 30′ E. Connected with the colony is an administrative protectorate, within which the courts of the colony have jurisdiction. The colony proper and this protectorate together make up an area of some 1500 square miles. The political protectorate connected with Lagos meets southern Nigeria at Ogbo on the coast, about 4° 49′ E. It includes the Idanre country, but excludes Ilorin. On the west it follows generally the meridian of the Ajara watercourse as far north as the neighbourhood of 9° N., in the vicinity of which it passes eastwards, so as to include all Yoruba settlements on the Lagos side of the boundary. The jurisdiction of the supreme court has not been extended to the political protectorate, but a general directing control is maintained there by the commissioners who preserve the public peace and influence and assist native authorities. The population of Lagos, the largest town on the African west coast, is about 33,000, of whom about 300 are Europeans. The largest towns in the protectorate are Abeokuta and Ibadan, estimated to have populations of about 150,000 and 200,000 respectively, but there has been no census. The population of the colony and protectorate may be altogether upwards of two millions. The total superficial area of the colony and all its dependencies is set down at 27,000 square miles. The supreme court has jurisdiction in the administrative protectorate as well as in the colony. The native authorities have, save in the case of some graver crimes, a concurrent jurisdiction which is exercised in this protectorate. In the political protectorate the laws are administered in the name of the native authorities. The great majority of the civil servants are natives of the country, some of whom have been educated in the colony, others in England and elsewhere. The European officers number generally about 112; the native officers about 259. Mails are received weekly from Europe, but with some irregularity, as there is no subsidized service. There is cable communication with Europe. The British and West African Bank was opened in Lagos on the 1st of April 1891. There is also a Government savings bank. The amount of the deposits is £16,553. The police establishment embraces a force of upwards of 350 men. The police is an armed and partially drilled body. There is a Hausa constabulary of about 800 men. These are trained as infantry and artillery by 18 European and 3 native commissioned officers. About 300 men are generally stationed at Lagos, 150 at Ibadan, 50 at Shaki, and others in small detachments elsewhere. The legal status of slavery is not recognized by the courts, and dealing in slaves is suppressed. As an institution slavery is steadily dying out, and will soon become extinct, unless in some veiled domestic form.

Lagos Town.—The principal buildings in the town of Lagos are a large and sumptuous government house; the Glover Memorial Hall, used for public meetings and entertainments; an elaborate club, provided from public funds; police quarters, and many substantial villas that serve as quarters for the officers of the civil service. There are many solidly-built, handsome private buildings. Regular streets are laid out over about half the town only. Owing to the complete absence of stone, the streets are not macadamized. The chief stores and depots for goods are all on the banks of the lagoon. Merchandise is generally transported by water. An electric tramway is projected, to traverse the town and connect with the railway on the mainland. A considerable portion of the town is supplied with the electric light, which is being extended. Only surface drainage has been attempted. Underground draining is difficult, on account of the low and level nature of the ground. There still exists a large acreage of swamp land in and near the town of Lagos, and costly and persevering efforts are being made to reclaim these swamps. Till this is done it is not likely that Lagos can become even tolerably healthy. The water-supply is derived in many cases from rain-water collected from the iron roofs of houses and stored in tanks, but more generally from wells sunk in the sandy soil on which the town is built. The number of houses covered by galvanized iron is steadily increasing, and now exceeds 5000. There is a dry-earth system of sewerage. No form of municipality has been established. Its inhabitants have always regarded any proposal in that direction with disfavour. The commodious public hospital, of the cottage type, on a good site, with proper accommodation for 10 European and 46 native patients, has European nurses in charge and a resident medical officer. The number of resident patients treated in 1899 was—Europeans 77, others 694; out-patients 4294. There is a good racecourse, which also serves as a general public recreation ground. The port is accessible only to vessels drawing about 10 feet of water, on account of shifting banks of sand that form a bar at the sea entrance of the lagoon. Large ocean-going steamers anchor outside the bar, not less than a couple of miles from land, and goods and passengers are there transhipped into smaller branch steamers for Lagos. Heavy cargo is taken on by the large steamers to Forcados and transhipped there into the branch boats for Lagos. It has been estimated that it would cost a million sterling to open the harbour permanently to large steamers.

Communications.—A solidly constructed railway on a 3-feet gauge starts from Iddo Island, and extends past Abeokuta, which is some 60 miles from Lagos, to Ibadan, a total distance of 122 miles. The railway (opened in 1901) crosses from Ebute Metta on the mainland to Iddo Island by the Denton Bridge, a handsome structure of iron 917 feet long. The Carter Bridge, also of iron, 2111 feet long, connects Iddo Island with the town of Lagos. The railway was built by the Government, and cost nearly a million sterling. The lagoon, which lies in a direction generally parallel to the sea, and only a very few miles from it, is entirely free of coral, and contains hardly any rocks of any kind, though it is often shallow and has many mud-banks in its bed. It, however, offers very convenient channels for numerous small craft, which, with the exception of steam-launches, are almost entirely native-built canoes. Branch steamers run between Lagos and Porto Novo.

During the last few years some miles of road have been made by the Government at an expense of nearly £40,000.

Industry.—No minerals are known with certainty to exist in the colony. The inhabitants are chiefly engaged in agriculture and trading. The principal articles of cultivation are yams, cassava, maize, sweet potatoes, sesame, millet, beans, sugar-cane, and cotton, all original products of the country. To these are being added coffee, cocoa, rubber trees, &c. Model farms are being established for the purposes of experimental culture and for the tuition of the natives. The soil is generally fertile, though as a rule containing a considerable proportion of sand. A few land concessions have been taken up by Europeans on long leases. The native owners profess to be unable to alienate land in perpetuity, but native custom does not preclude leasing. Some of the concessions are only for cutting and removing timber, others permit of cultivation.

Climate.—The rainfall has not been ascertained in the interior. In the northern districts it is probably considerably less than at Lagos, where it is about 70 inches a year. The mean temperature at Lagos is 82°·5 F. At certain seasons sudden heavy squalls of wind and rain that last for a few hours are common. The hurricane and typhoon are unknown. The climate is not a healthy one, especially for Europeans. The sanitary condition of all towns, including Lagos itself, is bad. The principal diseases are malarial fever, smallpox, rheumatism, peripheral neuritis, dysentery, chest diseases, and guinea-worm. Fever not unfrequently assumes the dangerous form known as "black-water fever." The frequency of smallpox is being much diminished outside of the larger towns in the interior, in which, owing to the absence of an organized government, vaccination is neglected. The number of persons vaccinated by the medical department in 1899 was 65,073. A contagious diseases hospital is used for the reception of patients suffering from smallpox, &c. There is a leper asylum, lunatic asylum, and a laboratory for chemical and pathological study. The absence of plague, yellow fever, cholera, typhoid fever, and scarlatina is noteworthy. Yaws of a mild form is endemic.

Education.—The Government expends directly about £6000 on education annually. Grants are made on examination results as determined by the inspector of schools to seventeen Church of England schools, ten Wesleyan, and ten Roman Catholic schools. Grants are also given to schools for the elementary education of Mahommedans in the form of payment for their teachers (seven in number). Contributions are also made to technical education. Lagos is a centre for the examinations for degrees in arts and laws of the University of London.

Religion.—The different Christian denominations claim 6700 members, namely: Church of England 2700, Wesleyans 1800, Roman Catholics 1800, Baptists 400. The Mahommedans number about 21,000, which leaves some 50,000 pagans. In some parts of the country Mahommedanism is gaining ground, but it is not of a rigid type.

Finance.—The revenue is chiefly derived from customs, which yield nearly eleven-twelfths of the whole. Over three-fourths of the duties is paid on spirits. The revenue for 1890 was £56,340; for 1895, £142,049; for 1900–01, £211,467; and the expenditure for 1890 was £63,600; for 1895, £144,483; for 1900–01, £187,125.

Trade.—The import and export trade is chiefly in the hands of British and German merchants. In 1899 imports by British merchants amounted in round numbers to £878,892; by German merchants to £78,623. Exports by British merchants were valued at £577,902; by German merchants at £338,032. In 1890 the imports were valued at £464,260, and the exports at £457,649; in 1895 these were £815,815 and £985,595; in 1899 £957,515 and £915,934; and in 1900–01, £806,529 and £831,258.

The principal articles of export for the years 1889 and 1899 were as follows:—

Articles.	1889.	1899.
Palm oil and kernels	£373,710	£581,275
Timber	...	34,738
Rubber	...	160,313
Coffee	...	139
Cocoa	70	3,411
Copra	3	296
Gum	1,135	507
Ivory	4,093	870
Shea—butter	1,393	5,323
Other articles	77,245	129,062
	£457,649	£915,934

(W. M'G.)

Laguna, a town of the Canary Islands (Spanish), on the island of Tenerife. The population in 1897 was 11,987. It is the seat of a coadjutor bishop of Seville. The soil of the surrounding country is fertile, and yields wheat, wine, oranges, raisins, tobacco, and other products of agriculture. The town has two large squares, regular and broad streets, a fine modern town hall, hospitals, a public library of 20,000 volumes, an institute, and several schools. There are three churches besides the cathedral, and several handsome residences of the nobility.

Lahn, a river of Prussia, in the Rhine province and province of Hesse-Nassau, rising in the extreme south of the province of Westphalia east of Siegen, at an altitude of 2210 feet. It flows at first east as far as Kölbe, then south past Marburg to Giessen, where it turns to the west-south-west, and continues past Wetzlar, Limburg, Ems, and Niederlahnstein, and enters the Rhine from the right after a course of 135 miles. Its valley is in parts very narrow, and full of picturesque charm.

Lahore, a city of British India, the capital of the Punjab, giving its name to a district and a division. It is situated near the left bank of the river Ravi, 1706 feet above the sea; 1160 miles by rail north-west of Calcutta, and 290 miles south-east of Peshawar. Population (1881), 149,369; (1891), 176,854; (1901), 120,058. The municipal income in 1897–98 was Rs.4,52,652; death-rate (1897), 29 per 1000. The native town is still surrounded by a brick wall 16 feet high, with thirteen gates and a citadel. To the south lies the suburb of Anarkalli, and eastward of this stretches the European quarter known as Donald Town (after Sir Donald Macleod), with Government House and the Lawrence Gardens. Still farther east, separated by a branch of the Bari Doab canal, is the cantonment of Mian Mir, which has accommodation for all arms. It is an important junction on the North-Western railway system, but without much trade or manufacture. The chief industries are silk goods, gold and silver lace, and metal work. A cotton-mill was opened in 1897. There are a flour-mill, an ice factory, and several factories for mineral waters. It is the headquarters of the Punjab University, which not only conducts examinations, but also manages the Oriental College, with 70 students in 1896–97. In addition, there are four arts colleges: one maintained by Government, with 246 students; the Dayanand Anglo-Vedic College, with 383 students; the Forman Christian College, with 270 students; and the Islamiya College, with 48 students. The other educational institutions include the Medical College, with 238 students; the Law School, with 433 students; the Veterinary College, with 82 students; the Mayo School of Art—perhaps the most successful of its kind in India—with 196 students; the Central Training College, with 82 students; the Aitchison College, for the training of the sons of native noblemen, on the model of an English public school, with 60 boys; 11 high schools, including one for European boys; and a railway technical school, with 183 boys. There are 67 printing-presses, issuing 34 newspapers, of which the best known is *The Civil and Military Gazette.* The public library and reading-room receives Rs.2666 from Government; and there are numerous religious institutions, Hindu, Sikh, and Mahommedan, which are active in diffusing education and literature.

The district of LAHORE has an area of 3678 miles; population (1881), 924,106; (1891), 1,075,379, showing an increase of 16 per cent., due to the extension of irrigation; average density, 292 persons per square mile. In 1901 the population was 1,156,548, showing a further increase of 8 per cent. The land revenue and rates were in 1897–98 Rs.10,14,852, the incidence of assessment being Rs.0:8:5 per acre; cultivated area, 802,853 acres, of which 696,141 were irrigated, including 403,000 from Government canals; number of police, 1404; number of schools (1896–97), 267, attended by 13,123 boys, being 14 per cent. of the boys of school-going age; death-rate (1897), 26·8 per thousand. The principal crops are wheat, pulse, millet, maize, oil-seeds, and cotton. There are about 20 factories for ginning and pressing cotton. Irrigation is provided by the main line of the Bari Doab canal and its branches, and also by inundation-cuts from the Sutlej. The district is crossed in several directions by lines of the North-Western railway, 127 miles. Some local distress was caused by drought in 1896–97.

The division of LAHORE extends along the right bank of the Sutlej, from the Himalaya to Mooltan. It comprises the six districts of Mooltan, Jhang, Montgomery, Lahore, Amritsar, and Gurdaspur. Total area, 24,872 square miles; population (1891), 4,579,794.

Laibach, the capital of the Austrian Duchy of Carniola, on the Laibach, 40 miles south by east of Klagenfurt. The garrison, comprising infantry and artillery, numbers 2592 men. Since the severe earthquake of April 1895, which destroyed part of the town, the old castle, which was used as a prison, is only inhabited by a caretaker. The municipal administration is purely Slovenian, and the Slovenian language is in general official use. A subsidized Slovene theatre is maintained, and there are also societies for the promotion of science and literature in the native tongue. The industries now include manufactures of pottery, bricks, lucifer matches, &c. Population (1890), 31,663; (1900), 36,547.

Laing, Samuel (1810–1897), British author and railway administrator, was born at Edinburgh, 12th December 1810. He was the nephew of Malcolm Laing (*Ency. Brit.* xiv. 216), the historian of Scotland, and his father, Samuel Laing (1780–1868), was also a well-known author, whose books on Norway and Sweden attracted much attention in the 'forties and 'fifties. Samuel Laing the younger entered St John's College, Cambridge, in 1827, and after graduating as second wrangler and Smith's prizeman, was elected a fellow, and remained at Cambridge temporarily as a coach. He was called to the bar in 1837, and became private secretary to Mr Labouchere (afterwards Lord Taunton) the President of the Board of Trade. In 1842 he was made secretary to the railway department, and retained this post till 1847. He had by then become an authority on railway working, and had been a member of the Dalhousie Railway Commission; it was at his suggestion that the "parliamentary" rate of a penny a mile was instituted. In 1848 he was appointed chairman and managing director of the London, Brighton, and South Coast railway, and his business faculty soon showed itself in the largely increased prosperity of the line. He also became chairman (1852) of the Crystal Palace Company, but retired from both posts in 1855. In 1852 he entered Parliament as a Liberal for Wick, and after losing his seat in 1857, was re-elected in 1859, in which year he was appointed financial secretary to the Treasury; in 1860 he was made Finance Minister in India. On returning from India, he was re-elected to Parliament for Wick in 1865. He was defeated in 1868, but in 1873 he was returned for Orkney and Shetland, and retained his seat till 1885. Meanwhile he had been reappointed chairman of the Brighton line in 1867, and continued in that post till 1894, being generally recognized as an admirable administrator. He was also chairman of the Railway Debenture Trust and the Railway Share Trust. In later life he became well known as an author, his *Modern Science and Modern Thought* (1885), *Problems of the Future* (1889), and *Human Origins* (1892) being widely read, not only by reason of the writer's influential position, experience of affairs, and clear style, but also through their popular and at the same time well-informed treatment of the latest scientific problems of the day. Laing died at Sydenham, 6th August 1897.

Lake Charles, a city of Louisiana, U.S.A., capital of Calcasieu, on the Calcasieu river and on the Port Arthur route and the Kansas City, Watkins and Gulf and the Southern Pacific railways. The manufacture of lumber is the principal industry. Population (1880), 838; (1890), 3442; (1900), 6680, of whom 409 were foreign-born and 2407 negroes.

Lake District, a characteristic region of England, in the counties of Cumberland, Westmorland, and Lancashire, celebrated for the beauty, and even in some degree for the grandeur, of its mountain scenery, and for the loveliness of its lakes. In outline the district is roughly circular, the valleys radiating outwards, each about 15 miles, from an imaginary centre near Langdale Pikes. Most of these valleys contain lakes, long and narrow; and upon the mountains there are frequent tarns. The valley lakes are of two types, one shallow, the other deep. Those of the first group, embracing only Derwentwater and Bassenthwaite, have an average depth of 18 feet. The rest, all belonging to the second group, average 40 to 135 feet in depth, and as a rule have steeply sloping sides and flat bottoms, the lake bed in two of them—Windermere and Ullswater—being divided into basins. Three of the lakes—Windermere, Coniston, and Wastwater—go down in depth below the level of the sea. The district as a whole is grooved by a main depression, running from north to south along the valleys of St John, Thirlmere, Grasmere, and Windermere, and by a secondary depression, in the same direction, along Derwentwater, Borrowdale, and Wastwater.[1] The subjoined table gives the names and other particulars of the larger lakes:—

Names.	Altitude above Sea Level.	Area in Square Miles.	Length.	Maximum Breadth.	Maximum Depth.	Average Depth.
	Feet.		Miles.	Yards.	Feet.	Feet.
Windermere . .	130	5·7	10½	1610	219	78½
Coniston . . .	143	1·9	5½	870	184	79
Wastwater . .	200	1·1	3	880	258	134½
Ennerdale . .	368	1·1	2½	1000	148	62
Crummock . .	321	1·0	2½	1000	144	87½
Derwentwater .	244	2·1	2¾	2130	72	18
Bassenthwaite	223	2·1	3¾	1300	70	18
Thirlmere . . .	533	0·5	2½	...	...	...
Ullswater . . .	476	3·4	7¼	1100	205	83
Grasmere . . .	208	...	1	...	180	...
Rydal . . .	181	...	¾	...	55	...
Hawes . . .	694	0·5	2¼	600	103	39½
Buttermere	329	0·4	1¼	670	94	54½

Windermere (or, more correctly, Winandermere), Coniston, Derwentwater, and Ullswater all contain small islands, amongst them being the Floating Island of Derwentwater, a mass of consolidated vegetation which periodically sinks to the bottom of the lake and reascends to its surface.[2] Fish—perch, pike, char, and trout—exist in Windermere, Ennerdale, Crummock, Derwentwater, and Bassenthwaite, and the gwyniad or "fresh-water herring" in Ullswater. In 1890–94 Thirlmere was dammed at its lower (northern) end, in order to convert the lake into a reservoir for supplying Manchester, 95 miles distant, with water, the dam being 800 feet long and 100 feet in height. The effect has been to raise the level of the lake permanently to 554 feet and increase its surface area from 330 acres to 565 acres; and its level can be raised another 30 feet, which would give an area of 793 acres. The present drainage area of 7400 acres would also be enlarged to 11,000 acres. At the same time a new road was made by the Manchester Corporation along the west side of the lake. Grasmere, Rydal, and Coniston abound in literary associations (see below). The district derives variety and picturesqueness from several small waterfalls, *e.g.*, Scale Force (Dano-Norwegian, *fors*, *foss*), beside Crummock; Lodore, near Derwentwater, made famous by Southey; Dungeon Gill, or Ghyll, beside Langdale; Dalegarth Force or Stanley Gill, in Eskdale; Aira, near Ullswater, sung by Wordsworth; Stock Gill, near Ambleside; and Rydal Falls. The higher mountains range from 2000 to over 3000 feet in altitude. The highest peaks are Scafell Pike (3210 feet), and its sister Scafell (3162 feet); of the others the best known are Helvellyn (3118 feet), Skiddaw (3054 feet), Bowfell (2960 feet), Great Gable (2949 feet), Pillar (2927 feet), the Old Man of Coniston (2633 feet), and Langdale Pikes (2401 and 2323 feet). Some of these, such as Scafell, Great Gable, Helvellyn, Langdale Pikes, Old Man, and Pillar, furnish ascents which experienced mountaineers do not disdain.[1] The district is drained by the Derwent, Leven, Duddon, Esk, Irt, Ehen, and other small streams. Lead and zinc are still mined in the mountains around Keswick (see CUMBERLAND and WESTMORLAND).

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[1] See Dr H. R. Mill, in *Geog. Journal*, 1895, pp. 237–246.

[2] See Symons, *The Floating Island in Derwentwater* (1888).

Climate.—The district records an unusually heavy rainfall. At Grasmere the annual average is 80 to 82 inches; on the mountains west of that village as much as 140 inches; and on Styhead pass, at the north foot of Scafell Pike, even as much as 243·98 inches was measured in 1872. At Keswick the annual mean is 59 to 60½ inches (55·4 inches in 1899); at Derwentwater 54¾ inches. Taking the summer months (the tourist season), May to October inclusive, an annual average of 27·5 inches fell at Windermere during the eight years 1892–99 inclusive. During the same period, and at the same place, an average of 255 hours of sunshine was recorded for the same summer months.

Literary Associations.—Setting aside London and Edinburgh, there is no locality in the British Isles which is so intimately associated with the history of English literature as the Lake District. In point of time the poet whose name is first connected with the region is Gray, who wrote a journal of his tour in 1769. But it was Wordsworth, a native of Cumberland, born on the outskirts of the Lake District itself, who really made it a Mecca for lovers of English poetry. Out of his long life of eighty years, no less than sixty were spent amid its lakes and mountains, first as a schoolboy at Hawkshead, and afterwards as a resident at Grasmere (1799–1813) and Rydal Mount (1813–50). In the churchyard of Grasmere the poet and his wife lie buried; and very near to them are the remains of Hartley Coleridge (son of the poet), who himself lived many years at Keswick, Ambleside, and Grasmere. Southey, the friend of Wordsworth, was a resident of Keswick for exactly forty years (1803–43), and was buried in Crosthwaite churchyard. Samuel Taylor Coleridge lived some time at Keswick, and also with the Wordsworths at Grasmere. From 1807 to 1815 Christopher North (John Wilson) was settled at Windermere. De Quincey spent the greater part of the years 1809 to 1828 at Grasmere, in the first cottage which Wordsworth had inhabited. Ambleside, or its environs, was also the place of residence of Dr Arnold (of Rugby), who spent there the vacations of the last ten years of his life; and of Harriet Martineau, who built herself a house there in 1845. At Keswick Mrs Lynn Linton was born in 1822. Brantwood, a house beside Coniston Lake, was the home of Ruskin during the last years of his life. In addition to these residents or natives of the locality, Shelley, Scott, Nathaniel Hawthorne, Clough, Crabb Robinson, Carlyle, Keats, Tennyson, Matthew Arnold, Mrs Hemans, Gerald Massey, and others of less reputation made longer or shorter visits, or were bound by ties of friendship with the poets already mentioned. The Vale of St John, near Keswick, recalls Scott's *Bridal of Triermain.* But there is a deeper connexion than this between the Lake District and English letters. German literature tells of several literary schools, or groups of writers animated by the same ideas, and working in the spirit of the same principles and by the same poetic methods. The most notable instance—indeed it is almost the only instance—of the kind in English literature is the Lake School of Poets. Of this school the acknowledged head and founder was Wordsworth, and the tenets it professed are those laid down by the poet himself in the famous preface to the edition of *The Lyrical Ballads* which he published in 1800. Wordsworth's theories of poetry—the objects best suited for poetic treatment, the characteristics of such treatment, and the choice of diction suitable for the purpose—may be said to have grown out of the soil and substance of the lakes and mountains, and out of the homely lives of the people, of Cumberland and Westmorland. Wordsworth is the poet of Nature, as he was the worshipper and priest of the Divine in Nature, and preacher of the beauty and sublimity of the moral law. But the Nature which he worshipped, the Nature which he sang, was nature as he saw her in the green dales, and beside the peaceful lakes and green or craggy fells, of his native Cumberland; just as the people, whose sincere and simple lives supplied themes for so many of his poems, were the sturdy natives of the same beautiful region. Thus it were hardly an exaggeration to say that the poetic principles of the Lake School are to a certain extent a reflection of the spirit of the Lake District itself. At any rate, not only did its beauties entwine themselves amongst the most cherished recollections of Wordsworth's boyhood, but they also awakened his poetic consciousness, and quickened and ripened his poetic faculty, so that he was enabled to enter into the most intimate sympathy with Nature, and bring the Divine which is immanent in her into close, practical relation with the thoughts and feelings of ordinary men. For a fuller discussion of the poet's poetic creed, see the late Professor Minto's admirable article on WORDSWORTH in the earlier volumes (ninth edition) of this Encyclopædia.

Dalton, the chemist, whose name is inseparably linked with the Atomic Theory, was born near Cockermouth, and Sir John Richardson, the Arctic explorer, and Romney, the painter, both lived for some time in the district. The chief mansion in the Lake District is Lowther Castle, partly in the Gothic, partly in the Baronial style, built in 1726 from designs by Sir Robert Smirke; it contains a good collection of pictures by Dutch and other old masters. At Eden Hall, the seat of the Musgrave family, is kept the glass goblet called "the Luck of Eden Hall," to which a well-known legend is attached. Brougham Hall, in the same neighbourhood, near Penrith, was the ancestral inheritance, and frequently the residence, of Lord Brougham. Muncaster Castle, near the old Roman port of Ravenglass at the mouth of the Esk, has many vestiges of the Roman occupation in its neighbourhood. The antiquarian objects include the Roman encampment known as Hardknott Castle, in Eskdale, with remains of a shrine and of a house with a bath; the remains of a supposed Roman encampment at Brougham Castle, near Penrith; the circular area, with fosse and mound, known as King Arthur's Round Table, also near the same place; and the ruins of Shap Abbey, of Egremont Castle, belonging to Lord Leconfield, of Calder Abbey, four miles south-east from Egremont, and of Furness Abbey, though these, like most of the preceding, lie on the outer fringe of the district rather than actually within its confines.

See also HARRIET MARTINEAU. *The English Lakes.* Windermere, 1858.—MRS LYNN LINTON. *The Lake Country.* London, 1864.—E. WAUGH. *Rambles in the Lake Country* (1861) and *In the Lake Country* (1880).—W. KNIGHT. *Through the Wordsworth Country.* London, 1890.—H. D. RAWNSLEY. *Literary Associations of the English Lakes*, 2 vols. (Glasgow, 1894), and *Life and Nature of the English Lakes* (Glasgow, 1899).—STOPFORD BROOKE. *Dove Cottage, Wordsworth's Home from 1800 to 1808.*—A. G. BRADLEY. *The Lake District, its Highways and Byeways.* London, 1901.—SIR JOHN HARWOOD. *History of the Thirlmere Water Scheme.* 1895.—Also, for mountain-climbing, Col. J. BROWN. *Mountain Ascents in Westmorland and Cumberland.* London, 1888.

Lakewood, a village of Ocean county, New Jersey, U.S.A., 8 miles from the coast, and 44 miles nearly south of New York City, on the Central of New Jersey railroad, in a region of pine-woods and ponds. Owing to its temperate, salubrious climate it has become a noted winter resort, with large hotels and many cottages. Population of the township, including the village (1895), 2201; (1900), 3094.

Lakhimpur, a district of British India, in the Brahmaputra Valley division of Assam. The deputy-commissioner in charge exercises political control over numerous tribes beyond the inner surveyed border. The most important of these tribes are the Miris, Abors, Mishmis, Khamtis, Singphos, and Nagas. The civil headquarters are at Dibrugarh; the military frontier post is at Sadiya, the limit of navigation on the Brahmaputra. Area, 3724 square miles; population (1881), 179,893; (1891), 254,043, showing an increase of 41 per cent., mainly due to the immigration of tea-coolies; average density, 68 persons per square mile, the lowest in the Brahmaputra valley. Classified according to religion, Hindus numbered 227,350; Mahommedans, 8086; Buddhists, 4462; Christians, 1606, of whom 305 were Europeans; hill tribes, 12,536; "others," 3. In 1901 the population was 371,784, showing a further increase of 46 per cent. The land revenue is Rs.5,40,367, the incidence of assessment being Rs.2 : 8 : 11 per acre; number of police, 1018; number of boys at school (1896–97), 3859, being 18·96 per cent. of the male population of school-going age; registered death-rate (1897), 41·58 per thousand. Lakhimpur was the first district into which tea cultivation was introduced by the Government, and the Assam Company commenced operations here in 1840. In 1897 the number of gardens was 149, with 55,560 acres under tea, employing 121,460 persons, of whom 46,428 had been imported under contract, and producing an out-turn of just 19,000,000℔, or at the rate of 400℔ per acre. Lakhimpur is also the scene of operations of the Assam railways and Trading Company, which owns a railway, coal mines, and petroleum wells. The railway, known as the Dibru–Sadiya line, runs from Dibrugarh to Makum, with two branches to Talap and Margherita; total length, 77½ miles. It will ultimately be connected across the hills with the Assam–Bengal railway. The capital outlay is Rs.74,22,050. In 1897 the gross receipts were Rs.7,87,359, and the net profits Rs.2,46,749. The company has five coal mines, of which the total output in 1897 was 184,271 tons, yielding to Government a rent and royalty of Rs.33,000. The coal is of excellent quality, and is exported by river as far as Calcutta. The Assam Company works another mine, yielding 1000 tons. The chief oil-wells are at Digboi, where a depth of 1680 feet has been reached. In 1897 the output was 219,780 gallons, yielding to Government a royalty of Rs.5500. The oil is refined at Margherita, producing a good quality of kerosene oil and first-class paraffin, with wax and other by-products. The wells at Makum are disappointing. In 1897 they produced 2297 gallons. The oil is entirely without kerosene or paraffin, but is valuable as a lubricant. The company also manufactures bricks and pipes of various kinds. In 1897 the out-turn of their railway workshops was valued at Rs.1,55,782. Yet another industry is timber-mills, for the manufacture of tea-chests, &c. There are five of these, employing 800 persons, with an out-turn valued at Rs.3,75,000.

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[1] See Haskett-Smith, *Climbing in the British Isles*, Part I.; and Owen G. Jones, *Rock-Climbing in the English Lake District*, 2nd ed. by W. M. Crook (Keswick, 1900).

Lalin, a township in the north-east of Spain, in the province of Pontevedra. The population in 1897 was 16,441. It is a centre of the trade in agricultural products of the fertile district around it. The local industries are supplied by paper-mills and tanneries. Lalin is situated in the neighbourhood of the ruins of the historic abbey of Carboeiro, a noble Gothic pile.

Lalitpur, formerly a district of British India, in the Allahabad division of the North-West Provinces, incorporated with Jhansi. Area, 1948 square miles. Population (1881), 249,088; (1891), 274,200, showing an increase of 10 per cent.; average density, 141 persons per square mile, being far the lowest in the province except in the Himalayan tracts; number of vernacular schools (1896–97), 45, with 1450 pupils. The district is traversed by the line of the Indian Midland railway from Bhopal to Jhansi. The town of LALITPUR has a population (1891) of 11,348; municipal income (1897–98), Rs.16,468, the incidence of taxation being just over R.1 per head; death-rate (1897), 76·84 per thousand. It is a railway station, 56 miles south of Jhansi.

Lalo, Edouard (1823–1892), French composer, was born at Lille, 27th January 1823. He began his musical studies at the conservatoire at Lille, and subsequently went to Paris, where he attended the violin classes of Habeneck, and also worked at composition. For several years Lalo led a modest and retired existence, playing the viola in the quartet party organized by Armingaud and Jacquard, and in composing chamber music. His early works include two trios, a quartet, and several pieces for violin and pianoforte. Discouragement seems to have taken possession of Lalo, for he remained some years without bringing forward anything new. In 1867, however, he took part in an operatic competition, an opera from his pen, entitled *Fiesque,* obtaining the third place out of forty-three. This work was actually accepted for production at the Paris Opéra, but delays occurred, and nothing was done. *Fiesque* was next offered to the Théâtre de la Monnaie, Brussels, and was definitely to be produced there when the manager became bankrupt. Thus, when nearly fifty years of age, Lalo found himself again stranded. *Fiesque* was never performed, but the composer published the pianoforte score, and eventually employed some of the music in other works. After the Franco-German war French composers found their opportunity in the concert-room. Lalo was one of these, and during the succeeding ten years several interesting works from his pen were produced, among them a sonata for violoncello, a "divertissement" for orchestra, a violin concerto, and the *Symphonie Espagnole* for violin and orchestra, one of his best-known compositions. In the meanwhile he had written a second opera, *Le Roi d'Ys,* which he fondly hoped would be produced at the Opéra. The administration offered him the "scenario" of a ballet instead. Lalo was perforce obliged to be content with this, and set to work with so much energy that he fell ill while engaged upon the music of this ballet, the last scenes of which were orchestrated by Gounod. *Namouna,* the ballet in question, was produced at the Opéra in 1882. Six years later, on 7th May 1888, *Le Roi d'Ys* was brought out at the Opéra Comique, and Lalo was at last enabled to taste the sweets of success. Unfortunately, fame came to him too late in life. A pianoforte concerto and the music to *Néron,* a pantomimic piece played at the Hippodrome in 1891, were his last two works. He had begun a new opera, but had only written the first act when, on 23rd April 1892, he was carried off by an attack of paralysis. This opera, *La Jacquerie,* was finished by M. Arthur Coquard, and was produced in 1895, three years after the death of Lalo, at Monte Carlo, Aix-les-Bains, and finally in Paris. Lalo had distinct originality, discernible in his employment of curious rhythmic devices. His music is ever ingenious and brilliantly effective. (A. HE.)

La Marmora, Alfonso (1804–1878), Italian general and statesman, was born at Turin on 18th November 1804. He entered the army as lieutenant of artillery in 1823, but was only captain in March 1848, when he gained distinction and the rank of major at the battle of Pastrengo. On 5th August 1848 he liberated Carlo Alberto from the Milan revolutionaries, and in October was promoted general and appointed Minister of War. After suppressing the revolt of Genoa in 1849, he again assumed (November 1849) the portfolio of war, which, save during the period of his command of the Crimean expedition, he retained until 1859. Having reconstructed the Piedmontese army, he took part in the war of 1859; but in July of that year succeeded Cavour in the premiership. In 1860 he was sent to Berlin and St Petersburg to prepare the recognition of the kingdom of Italy, and subsequently held the offices of governor of Milan and royal lieutenant at Naples, until, in September 1864, he succeeded Minghetti as premier. In this capacity he modified the scope of the September Convention by a note in which he claimed for Italy full freedom of action in respect of national aspirations to the possession of Rome, a document of which Viscontí Venosta afterwards took advantage when justifying the Italian occupation of Rome in 1870. In April 1866 La Marmora concluded the Italo-Prussian alliance against Austria, and, on the outbreak of war in June, took command of an army corps, but was defeated at Custozza on 23rd June. Accused of treason by his fellow-countrymen, and of duplicity by the Prussians, he eventually published in defence of his tactics (1873) a series of documents entitled "More Light on the Events of 1866," a step which caused irritation in Germany, and exposed him at home to the charge of having violated State secrets. Meanwhile he had been sent to Paris in 1867 to oppose the French expedition to Rome, and in 1870, after the occupation of Rome by the Italians, had been appointed lieutenant-royal of the new capital. He died at Florence on 5th January 1878. (H. W. S.)

Lambayeque, a department of northern Peru, is divided into three provinces—Lambayeque, Chiclayo, and Pacasmayu, of which the principal towns are Lambayeque (population, 6000), Chiclayo (14,000), and Ferriñafe (8000). The area of the department is 17,939 square miles. Population (1896), 124,091.

Lambeth Conferences.—The Lambeth Conferences, or "Pan-Anglican Synods," were an outcome of that fellowship amongst the churches of the Anglican Communion which has shown so remarkable a development in recent years. There had been a growing sense that this fellowship could only be maintained by mutual knowledge and common counsel, and in 1851 Bishop Hopkins of Vermont, in a letter to the archbishop of Canterbury, expressed his desire that "in a time of controversy and division there should be a council of all the bishops in Communion with your Grace." But the immediate impulse came from the colonial Church in Canada. In 1865 the synod of that province, in an urgent letter to the archbishop of Canterbury (Dr Longley), represented the unsettlement of members of the Canadian Church caused by recent legal decisions of the Privy Council, and their alarm lest the revived action of Convocation "should leave us governed by canons different from those in force in England and Ireland, and thus cause us to drift into the status of an independent branch of the Catholic Church." They therefore requested him to call a "national synod of the bishops of the Anglican Church at home and abroad," to meet together under his leadership for the purpose of taking combined counsel and action. After consulting both Houses of the Convocation of Canterbury, Archbishop Longley assented, and convened all the bishops of the Anglican Communion (then 144 in number) to meet at Lambeth in 1867. Many Anglican bishops (amongst them the archbishop of York and most of his suffragans) felt so doubtful as to the wisdom of such an assembly that they refused to attend it, and Dean Stanley declined to allow Westminster Abbey to be used for the closing service, giving as his reasons the partial character of the assembly, uncertainty as to the effect of its measures, and "the presence of prelates not belonging to our Church." Archbishop Longley said in his opening address, however, that they had no desire to assume "the functions of a general synod of all the churches in full communion with the Church of England," but merely to "discuss matters of practical interest, and pronounce what we deem expedient in resolutions which may serve as safe guides to future action." Experience has shown how valuable and wise this course was. The resolutions of the Lambeth Conferences have never been regarded as synodical decrees, but their weight has increased with each conference; and in particular the "Lambeth Quadrilateral" of 1888 has already had a great effect as a plan of reunion. Apprehensions such as those which possessed the mind of Dean Stanley have long passed away.

Seventy-six bishops accepted the Primate's invitation to the first Conference, which met at Lambeth on 24th September 1867, and sat for four days, the sessions being in private. The archbishop opened the Conference with an address: deliberation followed (but the appointed subjects were not strictly adhered to); committees were appointed to report on special questions; resolutions were adopted, and an encyclical letter was drawn up and addressed to the faithful of the Anglican Communion. Each of the subsequent Conferences has been first received in Canterbury Cathedral and addressed by the archbishop from the chair of St Augustine. It has then met at Lambeth, and after sitting for five days for deliberation upon the fixed subjects and appointment of committees, has adjourned, to meet again at the end of a fortnight and sit for five days more, to receive reports, adopt resolutions, and to put forth the encyclical letter.

I. *First Conference* (September 24–28, 1867), convened and presided over by Archbishop Longley. The proposed order of subjects was entirely altered in view of the Colenso case, for which urgency was claimed; and most of the time was spent in discussing it. Of the thirteen resolutions adopted by the Conference, two have direct reference to this case; the rest have to do with the creation of new sees and missionary jurisdictions, commendatory letters, and a "voluntary spiritual tribunal" in cases of doctrine, and the due subordination of synods. The reports of the committees were not ready, and were carried forward to the Conference of 1878.

II. *Second Conference* (July 2–27, 1878), convened and presided over by Archbishop Tait. On this occasion no hesitation appears to have been felt; 100 bishops were present, and the opening sermon was preached by the archbishop of York. In this instance the reports of the five special committees (based in part upon those of the committee of 1867) were embodied in the encyclical letter, viz., on the best mode of maintaining union, voluntary boards of arbitration, missionary bishops and missionaries, Continental chaplains, and the report of a committee on difficulties submitted to the Conference.

III. *Third Conference* (July 3–27, 1888), convened and presided over by Archbishop Benson; 145 bishops present; the chief subject of consideration being the position of communities which do not possess the Historic Episcopate. In addition to the encyclical letter, nineteen resolutions were put forth, and the reports of twelve special committees are appended upon which they are based, the subjects being Intemperance, Purity, Divorce, Polygamy, Observance of Sunday, Socialism, Care of Emigrants, Mutual Relations of Dioceses of the Anglican Communion, Home Reunion, Scandinavian Church, Old Catholics, &c., Eastern Churches, Standards of Doctrine and Worship. Perhaps the most important of these is the famous "Lambeth Quadrilateral," which laid down a fourfold basis for home reunion—the Holy Scriptures, the Apostles' and Nicene Creeds, the two Sacraments ordained by Christ Himself, and the Historic Episcopate.

IV. *Fourth Conference* (July 5–31, 1897), convened by Archbishop Benson, presided over by Archbishop Temple; 194 bishops present. One of the chief subjects for consideration was the creation of a "tribunal of reference"; but the resolutions on this subject were withdrawn, owing, it is said, to the opposition of the American bishops, and a more general resolution in favour of a "consultative body" was substituted. The encyclical letter is accompanied by sixty-three resolutions (which include careful provision for provincial organization and the extension of the title "archbishop" to all metropolitans, a "thankful recognition of the revival of brotherhoods and sisterhoods, and of the office of Deaconess," and a desire to promote friendly relations with the Eastern Churches and the various Old Catholic bodies), and the reports of the eleven committees are subjoined.

See Bishop R. T. Davidson, *The Lambeth Conferences of 1867, 1878, and 1888*, London, 1896. *Conference of Bishops of the Anglican Communion, Encyclical Letter*, &c., London, 1897. (M. B. S.)

Lamego, a town and episcopal see of Portugal, district Vizeu, 4 miles south of the Douro and 42 east of Oporto. It is famous for its fine fruit and hams.

Vineyards in 1892 covered 3650 acres, and yielded 755,250 gallons of wine, valued at £48,450. Population (1900), 9179.

Lamoureux, Charles (1834–1899), French conductor and violinist, was born at Bordeaux, 28th September 1834. He studied at the Pau Conservatoire, was engaged as violinist at the Opéra, and in 1864 organized a series of concerts devoted to chamber music. Having journeyed to England and assisted at a Handel festival, he thought he would attempt something similar in Paris. At his own expense he founded the "Société de l'Harmonie Sacrée," and in 1873 conducted the first performance in Paris of Handel's *Messiah*. He also gave performances of Bach's *St Matthew Passion*, Handel's *Judas Maccabœus*, Gounod's *Gallia*, and Massenet's *Eve*. In 1875 he conducted the festival given at Rouen to celebrate the centenary of Boïeldieu. The following year he became *chef d'orchestre* at the Opéra Comique. In 1881 he founded the famous concerts associated with his name, which contributed so much to popularize Wagner's music in Paris. The performances of detached pieces taken from the German master's works did not, however, satisfy him, and he matured the project to produce *Lohengrin*, which at that time had not been heard in Paris. For this purpose he took the Eden Theatre, and on 3rd May 1887 he conducted the first performance of Wagner's opera in the French capital. Owing to the opposition of the Chauvinists of the press and streets, the performance was not repeated; but it doubtless prepared the way for the production of the same masterpiece at the Paris Opéra a few years later. Lamoureux was successively second *chef d'orchestre* at the Conservatoire, first *chef d'orchestre* at the Opéra Comique, and twice first *chef d'orchestre* at the Opéra. He visited London on several occasions, and gave successful concerts at the Queen's Hall. Lamoureux, whose death occurred at Paris in December 1899, may be said to have died in harness. *Tristan und Isolde* had been at last heard in Paris, owing to his initiative and under his direction. After conducting one of the performances of this masterpiece, he was taken ill, and succumbed in a few days, having had the consolation before his death of witnessing the triumph of the cause he had so courageously championed. (A. HE.)

Lampedusa, an island of Italy, belonging to the province of Girgenti, commune Licata, but situated halfway between Malta and the African coast. Area, 11½ square miles. In 1897 its port was cleared by 170 vessels of 27,621 tons. Population, about 1200. The small island of LINOSA, 11 miles in circumference, with about 200 inhabitants, lies 31 miles to the north-north-east, and likewise belongs to the commune of Licata. In 1897 its port was cleared by 121 vessels of 25,286 tons.

Lampeter, a municipal borough (1884), market town, and railway station of Cardiganshire, Wales, on the Teify, 23 miles north-north-east of Carmarthen. A parliamentary borough until 1885, its representation is now merged in that of the county. St David's College, founded in 1827, has power to grant certain degrees, and is affiliated to the Universities of Oxford and Cambridge. A college school for boys has been opened, and also a secondary school for girls. There is a town hall. Area, 1754 acres. Population (1881), 1443; (1891), 1569; (1901), 1722.

Lanark, a royal and parliamentary burgh (Falkirk group) and the county town of Lanarkshire, half a mile from the Clyde, 31 miles south-east of Glasgow by rail. A new water scheme has been carried out and the drainage system renewed. A fountain in commemoration of Queen Victoria's Jubilee has been erected; also, a convalescent home. Cattle and sheep dealing is the most important industry, and a large retail trade is done with the surrounding country. Population (1881), 5874; (1891), 5537; (1901), 6440. Cotton mills founded by Robert Owen at NEW LANARK have been doubled in size since 1881.

Lanarkshire, an inland county of Scotland, bounded on the N. by Dumbarton and Stirling, on the E. by Stirling, Linlithgow, Mid-Lothian, and Peebles, on the S. by Dumfries, and on the W. by Ayr, Renfrew, and Dumbarton.

Area and Population.—In 1891 the parishes of Kirkpatrick-Juxta and Moffat were placed wholly in Dumfriesshire; the Peebles part of Culter parish was added to another Peebles parish. In 1892 Cathcart parish was placed wholly in Renfrew, and the Renfrew parts of East Kilbride and Govan wholly in Lanark. In 1893 the city of Glasgow, a large part of which was included in Lanarkshire, was made a county of a city. The area of the county is 567,027 acres, or about 886 square miles. It is much the most populous county in Scotland. In 1881 the population was 904,412; in 1891, 1,046,040; in 1891 on the above area, 1,105,899; in 1901, 1,339,289, of whom 674,136 were males and 665,153 females. On the old area, taking land only (564,284 acres or 881·7 square miles), the number of persons to the square mile in 1891 was 1186, and the number of acres to the person 0·5. In the registration county the population increased between 1881 and 1891 by 15·8 per cent. Between 1881 and 1891 the excess of births over deaths was 149,761, and the increase of the resident population 141,628. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899:—

Year.	Deaths.	Marriages.	Births.	Per cent. of Illegitimate.
1880	22,466	7241	35,227	6·7
1890	23,526	9221	38,069	6·09
1899	25,846	11,402	43,774	5·4

The following table gives the birth-rate, death-rate and marriage-rate per thousand of the population for a series of years:—

	1880.	1881–90.	1890.	1891–98.	1899.
Birth-rate . .	37·98	36·85	35·25	35·48	35·65
Death-rate . .	24·17	22·12	21·78	20·88	21·04
Marriage-rate .	7·79	8·02	8·53	8·30	9·28

In 1891 the number of Gaelic-speaking persons in the county was 25,208, and of foreigners 2982. Valuation in 1889–90, £2,226,352; 1899–1900, £2,502,345.

Administration.—The county is divided into six parliamentary divisions—North-east, North-west, Mid, and South Lanark, Govan, and Partick. The royal burghs, in addition to Glasgow, are Lanark (6440) and Rutherglen (18,280), of which the former belongs to the Falkirk group and the latter to the Kilmarnock group of parliamentary burghs. Airdrie (22,288) and Hamilton (32,775) are parliamentary burghs of the Falkirk group, and Coatbridge (36,981) is a municipal burgh included in the North-west parliamentary division. Other towns are Govan (76,351); Kinning Park (13,851); Motherwell (30,243); Partick (54,274), and Wishaw (20,869)—all police burghs. Fifteen other towns had more than 2000 inhabitants in 1891. There are 39 civil parishes, and including the two for Glasgow parish, there are eight poorhouses; the number of paupers and dependants (Glasgow included) in September 1899 was 27,156. There are lunatic asylums for the county at Hartwood in the parish of Shotts, and at Bothwell, and one of the Glasgow asylums is at Gartloch in the parish of Cadder. Lanark is a sheriffdom, whose sheriff-principal is confined to his judicial duties in the county, and he has eight substitutes, five of whom sit constantly in Glasgow, and one each at Airdrie, Hamilton, and Lanark.

Education.—Fifty school boards manage 274 schools, which had an average attendance of 145,703 in 1898–99, while 74 voluntary schools, of which 56 were Roman Catholic and one Episcopal, had 39,388. There are six high schools in Glasgow and one at Hamilton, a technical school at Coatbridge, and two secondary and technical schools (one Roman Catholic) at Wishaw, in addition to the Glasgow and West of Scotland Technical College. Thirteen other schools under the Glasgow board, 10 under the Govan board, and 62 in other parts of the county, earned grants in 1898 for giving higher education. The county council expends the "residue" grant in supporting lectures and classes in agriculture and agricultural chemistry, mining, dairying, cooking, laundry work, nursing, and poultry-keeping, and in paying fees and railway fares and providing bursaries for technical students, and in subsidizing science and art and technical classes in day and evening schools. A director of technical education is maintained by the council. Lanark, Motherwell, and Biggar entrust their shares of the grant to the county council, and Coatbridge and Airdrie themselves subsidize science and art and evening classes and continuation schools.

Agriculture.—The proportion of the acreage cultivated in 1898 was 45·2, the county ranking eleventh in Scotland in this regard. In the Lower Ward market-gardening continues to increase, and there have been large additions in recent years to the quantity of glass. There were 717 acres under orchards in 1898 and 1899 under small fruit, strawberries being grown on a very large scale in the parishes of Lesmahagow, Dalserf, Lanark, Carluke, and Cambusnethan. In the whole county there were 21,499 acres under wood in 1895, of which 957 had been planted since 1881. Oats preponderate in the corn crops, covering 37,691 acres out of 41,406 in 1898. The following table gives the principal acreages at intervals of five years from 1880:—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	247,053	50,321	19,584	61,137	115,048	934
1885	256,083	47,975	16,859	88,296	102,285	666
1890	258,637	42,563	16,403	115,783	81,741	426
1895	256,737	41,510	16,225	108,043	88,567	327
1899	255,841	41,110	16,600	102,006	93,734	376

The following table gives particulars of the live stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or Calf.	Sheep.	Pigs.
1880	7795	65,192	33,272	217,563	6110
1885	7418	72,082	37,215	214,936	8671
1890	7988	75,775	38,604	236,930	7957
1895	8631	71,367	38,222	232,673	8560
1899	8074	75,408	39,574	252,199	7213

Of the 3102 holdings in 1895 the average size was 83 acres. The percentage under 5 acres was 11·99, between 5 and 50 acres 33·53, and over 50 acres 54·48. The number of farms between 50 and 100 acres was 698, between 100 and 300, 918, between 300 and 500, 65, and over 500 acres 9. At the census of 1891, 8896 men and 1813 women were returned as being engaged in agriculture.

Industries and Trade.—The following table gives the output of the principal minerals in 1890 and 1899:—

Year.	Coal.		Ironstone.		Fireclay.		Sandstone.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
		£		£		£		£
1890	13,584,770	4,584,860	113,501	58,525	294,925	55,744	. .	. .
1899	16,416,754	6,123,364	189,528	97,358	427,590	61.943	334,282	74,240

Forty blast furnaces produced 496,218 tons of pig-iron in 1890; 85 furnaces produced 1,170,830 tons in 1899. In 1899 were also obtained 56,335 tons of limestone valued at £13,560, and 76,246 tons of oil-shale valued at £19,066.

The industries of the county are for the most part the same as those of Glasgow, and reference may be made to the articles on that city and on other towns of Lanarkshire for details. The number of persons connected with industrial pursuits in 1891 was 260,461 men and 86,468 women, of whom machines and implements engaged the labour of 24,549 men; ships, 9488; textiles, 14,194 men and 28,212 women; minerals, 94,473 men and 2713 women. About a score of new short branches and extensions have been opened in the county during the past twenty-five years by the three leading Scottish railway companies, the addition to the mileage being between 70 and 80 miles.

Authorities.—J. Maidment. *Topographical Collections.* Glasgow, Mitchell Library.—W. Hamilton. *Description of the Sheriffdoms of Lanark and Renfrew.* Maitland Club, 1831.—C. V. Irving and A. Murray. *The Upper Ward of Lanarkshire.* Glasgow, 1864.—Thomson. *Martyr Graves of Scotland.* Edinburgh, 1875 and 1877.—R. W. Cochran-Patrick. *Early Records relating to Mining in Scotland.* Edinburgh, 1878.—P. Dudgeon. *Historical Notes on the Occurrence of Gold in the South of Scotland.* Edinburgh, 1876.—Dr John Brown. *Horæ Subsecivæ* (The Enterkin). London, 1897.—*The Clydesdale Stud Book.* Glasgow, 1878 and 1880.—W. A. Cowan. *History of Lanark.* Lanark, 1867.—*Extracts from the Records of the Burgh of Lanark.* Glasgow, 1893.—A. M'Michael. *Notes by the Way.* Ayr, 1887.—W. Hunter. *Biggar and the House of Fleming.* Edinburgh, 1867.—J. Wallace. *The Parish of Govan.* Glasgow, 1877. See also Glasgow bibliography. (W. Wa.)

Lancashire, a north-western maritime county of England, bounded on the N. by Westmorland, on the E. by Yorkshire, on the S. by Cheshire and the estuary of the Mersey, and on the W. by the Irish Sea. The Furness district to the north, having as its southern boundary the Irish Sea, is detached from the rest of the county and interpolated between Cumberland and Westmorland.

Area and Population.—The area of the ancient county is 1,207,311 acres, or 1887 square miles, with a population in 1881 of 3,454,438 and in 1891 of 3,926,760, of whom 1,889,926 were males and 2,036,834 females, the number of persons per square mile being 2081, and of acres to a person 0·31. In 1901 the population numbered 4,406,787. The area of the administrative county in 1891 was 1,124,450 acres with a population of 1,768,273, or, including the county boroughs, of 1,202,726 acres, with a population of 3,906,721. Since 1891, however, various changes have been made in the administrative area; in 1895 the county borough of Liverpool was extended, and the parish of Dalton in Lancashire was transferred to Westmorland; in 1896 part of the townships of Appleton-with-Hull, Latchford Without, and Walton Inferior were transferred from Cheshire to Lancashire and added to the municipal borough of Warrington; and in 1898 part of the township of Ashton-under-Lyne was transferred to Cheshire. The population of the administrative county, without the county boroughs, in 1901 was 1,827,390; and with the boroughs, 4,386,961. The area of the registration county is 1,306,777 acres, with a population in 1891 of 3,957,906, of which 3,646,314 were urban and only 311,592 rural. Within the registration area the percentage of increase between 1881 and 1891 was 13·54. The excess of births over deaths between 1881 and 1891 was 448,538, but this was exceeded by the actual increase of the population, which was 472,807. In 1901 the population of the registration county numbered 4,437,398, of whom 2,131,162 were males and 2,306,236 were females.

The following table gives the number of marriages, births, and deaths, with the number of illegitimate births for 1880, 1890, and 1898:—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				Males.	Females.
1880	28,111	126,842	81,812	2918	2855
1890	32,480	125,787	91,739	2840	2563
1898	37,060	132,491	83,831	2631	2524

In 1891 the number of marriages was 37,854, of births 131,945, and of deaths 92,239.

The following table gives the marriage-, birth-, and death-rates, with the percentage of illegitimate births, for a series of years:—

	1870–79.	1880.	1880–89.	1890.	1888–97.	1898.
Marriage-rate . .	18·6	16·3	16·2	16·6	16·2	17·1
Birth-rate . .	38·8	36·8	35·1	32·1	32·2	30·6
Death-rate . .	25·7	23·8	24·5	23·4	21·6	19·4
Percentage of illegitimate births . .	4·7	4·6	4·5	4.3	4·1	3·9

The marriage-, birth-, and death-rates are all considerably above the average, but the percentage of illegitimate births is below it. In 1891 the number of Scots in the county was 56,405, of Irish, 164,489, and of foreigners, 25,109.

Constitution and Government.—For parliamentary purposes the four divisions of the ancient county—North Lancashire, North-east Lancashire, South-east Lancashire, and South-west Lancashire—are subdivided into twenty-three divisions; and the county also includes the parliamentary boroughs of Liverpool with nine parliamentary divisions, Manchester with six, and Salford with three, while the following boroughs return two members: Blackburn, Bolton, Oldham, and Preston; and the following return one each: Barrow-in-Furness, Burnley, Bury, Rochdale, St Helens, Salford, and Wigan, in addition to which parts of Ashton-under-Lyne, Stalybridge, Stockport, and Warrington are included in the county. The administrative county contains the following municipal boroughs: Accrington (43,095), part of Ashton-under-Lyne (43,890), Bacup (22,505), Barrow-in-Furness (57,584), Blackburn (127,527), Blackpool (47,346), Bolton (168,205), Bootle (58,558), Burnley (97,044), Bury (58,028), Chorley (26,850), Clitheroe (11,414), Colne (23,000), Darwen (38,211), Eccles (34,369), Haslingden (18,543), Heywood (25,461), Lancaster (40,329), Leigh (40,001), the city of Liverpool (684,947), the city of Manchester (543,969), Middleton (25,178), Mossley (13,452), Nelson (32,816), Oldham (137,238), Preston (112,982), Rawtenstall (31,052), Rochdale (83,112), St Helens (84,410), Salford (220,956), Southport (48,087), Warrington (64,241), Widnes (28,580), and Wigan (60,770). Barrow-in-Furness, Blackburn, Bolton, Bootle, Burnley, Bury, Liverpool, Manchester, Oldham, Preston, Rochdale, St Helens, Salford, and Wigan are county boroughs. The urban districts are too numerous for mention. The following have populations of over 10,000: Ashton-in-Makerfield (18,695), Atherton (16,211), Birkdale (14,197), Chadderton (24,892), Crompton (13,427), Dalton-in-Furness (13,020), Denton (14,934), Droylsden (11,087), Failsworth (14,152), Farnworth (25,927), Fleetwood (12,093), Garston (17,288), Gorton (26,564), Great Harwood (12,014), Hindley (23,504), Horwich (15,083), Ince-in-Makerfield (21,270), Levenshulme (11,485), Litherland (10,593), Littleborough (11,166), Morecambe (11,798), Moss-side (26,677), Newton-in-Makerfield (16,699), Oswaldtwistle (14,200), Padiham (12,205), Pemberton (21,664), Prestwich (12,837), Radcliffe (25,368), Ramsbottom (15,920), Royton (14,881), Stretford (30,346), Swinton-and-Pendlebury (27,001), Turton (12,353), Tyldesley-with-Shakerley (14,843), Ulverston (10,064), Walton-le-Dale (11,271), Waterloo-with-Seaforth (23,101), West Houghton (14,377), Withington (30,201), and Worsley (12,448). The county is in the northern circuit, and assizes are held for North Lancashire at Lancaster, and for South Lancashire at Liverpool and Manchester. Twenty-five of the boroughs have separate commissions of the peace, and the boroughs of Blackburn, Bolton, Liverpool, Manchester, Oldham, Salford, and Wigan have also separate courts of quarter sessions. The county is still attached to the duchy of Lancaster, and retains the chancery court for the county palatine. The ancient county is chiefly in the diocese of Manchester, but a small part is in Liverpool, the northern portion of Furness is in Carlisle, and a few parishes adjoining Yorkshire are in Ripon or in Wakefield. There are 730 entire ecclesiastical parishes or districts and parts of 10 others.

Education.—Manchester and Liverpool are each seats of a university and of other important educational institutions. Within the bounds of the county there are many denominational colleges, and at Ashton, near Whalley, is the famous Catholic college of Stonyhurst. There is a day training college for schoolmasters in connexion with University College, Liverpool, and a day training college for both schoolmasters and schoolmistresses in connexion with Owens College, Manchester. At Edgehill, near Manchester, there is a residential training college for schoolmistresses which takes day pupils, at Liverpool a residential Roman Catholic training college for schoolmasters, and at Warrington a residential training college (Chester, Manchester, and Liverpool diocesan) for schoolmistresses. At Burnley there are a board blind school and a board deaf school; at Liverpool a Catholic blind asylum, a home for blind children, a school for deaf and dumb, and a school for the indigent blind; at Oldham, a board deaf school and a board blind school; at Preston, the Royal Cross School for the deaf; at Fulwood, an industrial institute for the blind; and at Stretford a blind asylum and the Manchester schools for the deaf. The total number of elementary schools in the county, including the county boroughs, on 31st August 1898 was 1796, of which 254 were board and 1542 voluntary schools, the latter including 884 National Church of England schools, 139 Wesleyan, 299 Roman Catholic, and 220 "British and other." The average attendance at voluntary schools was 446,224, and at board schools 144,203. The total school board receipts of the county boroughs for the year ended 29th September 1899 were over £775,037. The income under the Technical Instruction Act was over £7631, and that under the Agricultural Rates Act was over £269. The total school board receipts of the administrative county, apart from the boroughs, were over £127,631. The income under the Technical Instruction Act was over £150, and that under the Agricultural Rates Act was over £1098.

Communications.—By the opening of the Manchester Ship Canal, on 1st June 1894, a populous inland district has obtained the advantages of immediate sea transport. The canal, which is in great part formed by deepening the bed of the Mersey, stretches by Warrington and Runcorn towards Liverpool, the total length being 35½ miles, and the cost £11,750,000. The port of Liverpool is now second in importance only to that of London.

Agriculture.—About three-fourths of the county is under cultivation, and of this nearly three-fourths is in permanent pasture, cows being largely kept for the supply of milk to the towns, while in the uplands many sheep are reared. In addition to the cultivated area, about 92,000 acres are under hill pasturage and over 40,000 acres are under woods. Since 1880 the acreage under corn crops has been gradually increasing, the increase being chiefly in the acreage under oats, which has increased about one-sixth, and is now about seven-tenths of the whole; but the acreage under wheat, now about one-fifth of the whole, has also increased, while there has been a great decrease in the acreage under barley. More than three-fourths of the acreage under green crops is occupied by potatoes, and less than one-sixth is usually occupied by turnips and swedes. The following table gives the acreage of the larger main divisions of the cultivated area at intervals from 1885:—

Year.	Total Acreage under Cultivation.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	783,065	100,189	56,894	63,161	559,976	2836
1885	809,927	102,005	56,573	75,380	574,016	1953
1890	824,846	103,688	53,324	86,221	578,044	1773
1895	823,676	103,320	54,087	76,363	585,996	1383
1900	822,866	104,024	51,820	81,374	576,616	1161

The following table gives the numbers of the principal live stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows.	Sheep.	Pigs.
1880	38,316	221,018	121,113	318,368	34,712
1885	35,625	238,158	130,662	296,425	43,880
1890	38,939	233,055	132,746	330,333	56,802
1895	44,775	226,234	130,041	306,954	60,421
1900	44,451	239,507	137,678	334,859	60,617

Industries and Trade.—According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 896,333, as compared with 896,848 in 1896. Of these 434,609 were employed in textile factories, there being a decrease of 1·1 per cent. both between 1895 and 1896 and between 1896 and 1897. The staple textile industry is cotton, which employed 411,808 persons, the centre of the trade being Manchester, Oldham, and the neighbouring towns. The woollen, worsted, and silk manufactures, though of less importance, employ considerable numbers, there being 13,805 employed in the woollen industry and 3009 in that of silk; 4439 were employed in connexion with the flax, hemp, or jute industries. In non-textile factories 384,352 persons were employed, there being an increase between 1895 and 1896 of 9·0 per cent., and between 1896 and 1897 of 0·4 per cent. The manufacture of machines, appliances, conveyances, tools, &c., occupied 112,596 persons, much of it being carried on on a large scale to supply the needs of the immense weaving and spinning industries. For the same purpose large quantities of bobbins are made from the wood grown in the northern districts of the county, wood industries employing 16,804 persons. At Barrow-in-Furness the manufacture of iron and steel has continued to develop; and in the county 24,089 persons were employed in the founding and conversion, 3580 in the extraction, and 2321 in the galvanizing, &c., of metals. In print, bleach, and dye works 52,672 persons were employed; in the manufacture of paper, &c., 28,092; in clothing industries, 25,222; in the manufacture of chemicals, 18,962; in food industries, 15,592; in those of drink, 8914; in glass-making, 9846; in india-rubber and gutta-percha industries, 6338; and in those of tobacco, snuff, and cigars, 5803. Workshops employed 77,372 persons, of which 40,450 were employed in clothing industries, 6546 in the manufacture of machines, &c., 5711 in furniture making, and 5725 in food industries. The total number of persons employed in connexion with mines and quarries in 1899 was 90,679. In the same year 1,356,492 tons of clay were raised, 600,480 tons of limestone, 820,232 tons of sandstone, 20,156 tons of slate, and 99,405 tons of salt, in addition to which 197,610 tons of salt were obtained from brine. In the production of coal Lancashire vies with Yorkshire, but each is about one-third below Durham. The red hæmatitic iron obtained in the Furness district is also very valuable. In 1885 the amount of pig-iron made in the county was 695,919 tons, in 1890 it was 716,748 tons, in 1895 it was 540,295 tons, and in 1899 it was 744,065 tons. The following table gives the tonnage and value of the fireclay, coal, and iron production in 1890 and 1899:—

Year.	Fireclay.		Coal.		Ironstone.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
1890	104,030	£14,731	21,707,867	£6,997,566	1,021,990	£447,083
1899	186,503	£23,885	24,387,475	£9,177,416	670,924	£419,909

The fish landed in 1899 at all the Lancashire stations mentioned in the sea fisheries return (Fleetwood and Liverpool are the chief ports) was 217,092 cwt., valued at £153,411.

AUTHORITIES.—Among later works are: ROBY. *Traditions of Lancashire.* London, 1882, 2nd ed., 1892.—ANON. *Lancashire Gleanings.* Manchester, 1883.—WATKIN. *Roman Lancashire.* Liverpool, 1883.—CROSTON. *Historic Sites of Lancashire.* Manchester, 1883; *County Families of Lancashire.* Manchester, 1887.

—Taylor. *Old Halls of Lancashire.* Manchester, 1884.—Mitchell. *Birds of Lancashire.* London, 1885, 2nd ed. 1892.—E. Baines. *History.* Manchester, 1886.—Anon. *Bygone Lancashire.* London, 1899.—Ellwood. *Landnama Book of Iceland as it illustrates the Dialect and Antiquities of North-east Lancashire.* London, 1892.—Philips. *Views of Old Halls in Lancashire, 1822–26.* London, 1893.—Thornley. *Monumental Brasses of Lancashire.* Hull, 1893.—Sutton. *Lancastriensis Bibliotheca.* Manchester, 1898.—W. A. Shaw. *Old and New Manchester.* 3 vols., London, 1898. See also various publications of the Chetham Society and of the Manchester Record Society, as well as the *Transactions of the Lancashire Antiquarian Society.*

(T. F. H.)

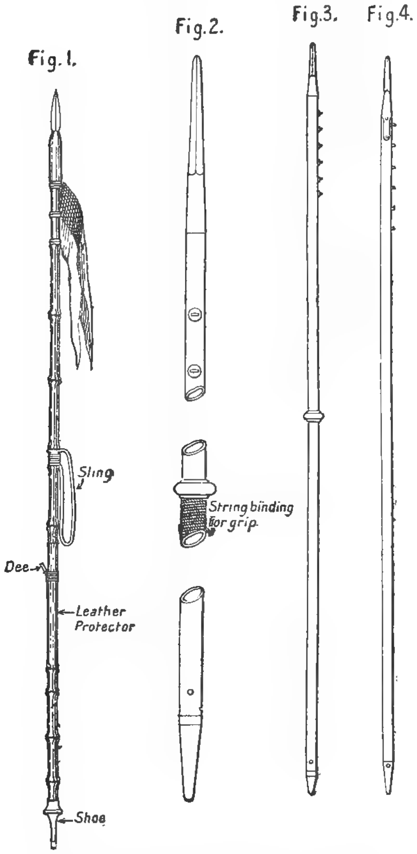
Lancaster, a parish, municipal borough (extended 1900), seaport, market town, and county town of Lancashire, England, in the Lancaster parliamentary division of the county, on the Lune, 230 miles north-north-west of London by rail. The grammar-school (rebuilt in 1853), the public baths, the county lunatic asylum, and the Ripley Hospital have been enlarged. A Palatine Hall has been established; the Storey Institute and Art Gallery were made over to the corporation in 1893. Recent erections are new buildings for the Royal Lancaster Infirmary, a sanatorium, and an observatory in the Williamson Park of 40 acres (1881). Glasson dock, on the south side of the Lune estuary, is accessible to vessels of 600 tons, that is, to vessels drawing 12 to 20 feet, and has a graving-dock attached. The port was in 1900 entered and cleared by an aggregate of 1732 vessels of 254,842 tons, the total trade, however, being valued at only £24,500. Area of borough (1891), 1680 acres; population (1881), 20,663; (1891), 31,034. In 1900 the area was extended so as to embrace 3610 acres; population, 40,329.

Lancaster, a city of Ohio, U.S.A., capital of Fairfield county, on the Hocking river, at an altitude of 841 feet. It is on the Cincinnati and Muskingum Valley and the Hocking Valley railways. It is in a natural-gas region, and has varied manufactures, principally of flour and agricultural implements. Population (1890), 7555; (1900), 8991, of whom 442 were foreign-born and 212 were negroes.

Lancaster, a city of Pennsylvania, U.S.A., capital of Lancaster county, on the Conestoga river, at an altitude of 357 feet. It is on four railways, the Cornwall, the Lancaster and Reading, the Pennsylvania, and the Philadelphia and Reading. Its manufacturing interests are large. In 1900 there were 738 manufacturing establishments with a capital of $10,803,464. They employed 9349 hands, and produced goods valued at $16,370,281. These consisted in great part of cotton goods, foundry and machine-shop products, clothing, and leather. Franklin and Marshall College, situated here, had in 1899 a faculty of 26 and was attended by 332 students. The assessed valuation of property, real and personal, on a basis of about 75 per cent. of the full value, was, in 1900, $16,685,148, the net debt of the city was $764,480, and the rate of taxation was $17.50 per $1000. Population (1890), 32,011; (1900), 41,459, of whom 3492 were foreign-born and 777 were negroes.

Lance (Military).—The lance has been used in war in all ages. It was the chosen weapon in the so-called ages of chivalry, and, though somewhat in disfavour in the 17th century, the renown of the Polish Lancers and Cossack cavalry in the 18th and 19th centuries again brought it into fashion. Now many nations, besides having regular Lancer regiments, arm the front ranks at least of all their cavalry regiments with lances.

The lances used in the British service are of two kinds, those with ash and those with bamboo staves. The latter are much preferred and are generally used, the "male" bamboo being peculiarly tough and elastic. The lance (Fig. 1) is provided with a sling, through which the trooper passes his right arm when the lance is carried slung, the point of the steel shoe fitting into a bucket attached to the right stirrup. A small "dee" loop is also provided, by which the lance can be attached to the saddle when the trooper dismounts. The small flag is removed on service. The head is of the best steel. The Germans, doubtless owing to difficulty in obtaining bamboos, or ash in large quantity straight enough in the grain over a considerable length, for lance staves, have adopted a stave of steel tubing as well as one of pine (Figs. 2, 3, and 4).



Types of British and German Lances.

		Length.	Weight about.
Fig. 1	British lance, bamboo stave	9 ft.	4 lbs. 8 ozs.
Figs. 2 and 3	German lance, tubular steel stave	10 ft. 5 ins.	4 lbs.
Fig. 4	,, ,, pine stave	10 ft. 2 ins.	4 lbs. 4 ozs.

Both German lances have a loop, attached by string binding, to take the sling. This loop is attached to the grip, shown in Fig. 2, in the case of the tubular lance.

The question of the relative efficiency of the lance and the sword as the principal arm for cavalry (*q.v.*) has been much discussed. Thus it is alleged that the former is heavy and fatiguing to carry, conspicuous, and much in the way when reconnoitring in close country, working through woods and the like; that, when unslung ready for the charge, it is awkward to handle, and may be positively dangerous if a horse becomes restive and the rider has to use both hands on the reins; that unless the thrust be delivered at full speed, it is easily parried; and, lastly, that in the *mêlée*, when the trooper has not room to use his lance, he will be helpless until he either throws it away, or slings it, and can draw his sword. On the other hand, while admitting the last-mentioned objection, those who favour the lance contend that success in the first shock of contact is all-important, and that this success the lancer will certainly obtain, owing to his long reach enabling him to deliver a blow before the swordsman can retaliate, while, when the *mêlée* commences, the rear rank will come to the assistance of the front rank. Further, it is claimed that the power of delivering the first blow gives confidence to the young soldier; that the appearance of a lancer regiment, preceded as it were by a hedge of steel, has an immense moral effect; that in single combat a lancer, with room to turn, can always defeat an opponent armed with a sword; and, lastly, that in pursuit a lancer is terrible to an enemy, whether the latter be mounted or on foot. As in the case of the perennial argument whether a sword should be designed mainly for cutting or thrusting, it is unlikely that the dispute as to the merits of the lance over the sword will ever be definitely settled, since so many other factors—horsemanship, the training of the horse, the skill and courage of the adversary—determine the trooper's success quite as much as the weapon he happens to wield. The following passage from *Cavalry: its History and Tactics* (London, 1853), by Captain Nolan, explains how the lance gained popularity in Austria:—"In the last Hungarian war (1848–49) the Hungarian Hussars were . . . generally successful against the Austrian heavy cavalry—cuirassiers and dragoons; but when they met the Polish Lancers, the finest regiments of light horse in the Austrian service, distinguished for their discipline, good riding, and, above all, for their *esprit de corps* and gallantry in action, against those the Hungarians were not successful, and at once attributed this to the lances of their opponents. The Austrians then extolled the lance above the sword, and armed all their light cavalry regiments with it." (H. W. B.)

Landau, a town of Bavaria, Germany, in the Palatinate, on the east side of the Haardt Mountains, 32 miles by rail south-west of Mannheim. There are manufactures of cigars, beer, horsehair goods, tanning, dyeing, gardening, &c., and trade in wine, cereals, tobacco, and groceries. Population (1885), 9395; (1900), 15,823.

Landeck, a town and watering-place of Prussia, province of Silesia, 73 miles by rail south of Breslau (16 miles south-east from Glatz), and close to the Austrian frontier, at an altitude of 1477 feet. It is visited by over 10,000 persons annually for its warm sulphur baths (68°–84·2° F.), which have been known since the 13th century. There are also mud-baths and hydropathics. Population (1900), 3526.

Landes, a department in the south-west of France, bordering on the Atlantic Ocean, traversed by the Adour river.

Area, 3615 square miles. The population has decreased from 302,266 in 1886 to 291,657. There were in 1896, 661 schools, with 38,000 pupils, and 10 per cent. of the population was illiterate. Births in 1899, 6459, of which 401 were illegitimate; deaths, 4929; marriages, 2350. The area under cultivation in 1896 was counted at 1,848,044 acres, but of this surface more than 1,161,000 acres were occupied by the Landes, and only 434,900 acres were plough-land and 44,480 acres vineyards. The land in wheat produced in 1899 the value of £330,000; rye, £288,000; vines, £440,000. The natural pastures yielded a revenue of £322,000. Landes owned in 1899, 32,000 horses, 126,440 cattle, 415,250 sheep, 114,000 pigs, and 23,000 goats. Mining in 1898 produced 750 metric tons of turf and 6900 tons of salt. The industry in metals is, on the other hand, a source of considerable wealth, the department having in 1898 produced 73,500 metric tons of cast iron, 4000 tons of iron, and 50,000 tons of steel, of a total value of £640,000. Of note are also the exportation of resin and the manufacture of alcohol—60,000 gallons in 1899. Mont-de-Marsan, the capital, had a population of 11,604 in 1900.

Landlord and Tenant.—The law of landlord and tenant has been altered and expanded in such a variety of directions since the article in the earlier volumes (ninth edition) of the *Encyclopædia Britannica* appeared, that it seems advisable to take a fresh survey of the field which it covers, assigning special prominence to matters which have arisen subsequently to, or were not emphasized in, the original article. The relationship of landlord and tenant is constituted by a lease, or an agreement for a lease, by assignment, by attornment, and by estoppel. And first of a lease and an agreement for a lease. All kinds of interests and property, whether corporeal, such as lands or buildings, or incorporeal, such as rights of common or of way, may be let. The Benefices Act, 1898, however, now prohibits the grant of a lease of an advowson. Titles of honour, offices of trust or relating to the administration of justice, and pensions granted by the Crown for military services are also inalienable. Generally speaking, any person may grant or take a lease. But to this rule there are a number of common-law and statutory qualifications and exceptions. A lease by or to an infant is voidable at his option. But extensive powers of leasing the property of infants have been created by the Settled Estates Act, 1877, and the Settled Land Act, 1882. A person of unsound mind can grant or take a lease if he is capable of contracting (see Insanity, *Legal*). Leases may be made on behalf of lunatics who are subject to the jurisdiction in lunacy under the provisions of the Lunacy Act, 1890, and the Settled Land Act, 1882. A married woman can lease her "separate property" apart from or under the Married Women's Property Acts, as if she were a single woman (*femme sole*). As regards other property, the concurrence of her husband is generally necessary. An alien was at common law incapable of being either a lessor or a lessee. But this disqualification is removed by the Naturalization Act, 1870. The right to deal with the property of a convict while he is undergoing sentence (but not while he is out of prison on leave) is, by the Forfeiture Act, 1870, vested in his administrator. Leases by or to corporations must be by deed under their common seal, and the leasing powers of ecclesiastical corporations in particular are subject to complicated statutory restrictions which cannot here be examined. Powers of granting building and other leases have been conferred by modern legislation on municipal corporations and other local authorities. There are also special rules of law with reference to leases by persons having only a limited interest in the property leased, *e.g.*, a tenant for life under the Settled Land Acts (see the article Settlements in *Encyclopædia Britannica* [ninth edition], vol. xxi.), or a mortgagor or mortgagee. In order to constitute the relationship of landlord and tenant in the mode under consideration, it is necessary not only that there should be parties capable of entering into the contract, but that there should be a letting, as distinct from a mere agreement to let, and that the right conveyed should be a right to the exclusive possession of the subject of the letting and not a simple licence to use it. Whether a particular instrument is a lease, or an agreement for a lease, or a bare licence, is a question the answer to which depends to a large extent on the circumstances of individual cases; and the only general rule that can be laid down is that in a lease there must be an expression of intention on the part of the lessor to convey, and of the lessee to accept, the exclusive possession of the thing let for the prescribed term and on the prescribed conditions. It is scarcely necessary to add that the landlord must not part with the whole of his interest, since, if he does so, the instrument is not a lease but an assignment. Where a tenant enters under an agreement for a lease and pays rent, the agreement will be regarded as a lease from year to year; and if the agreement is one of which specific performance would be decreed (*i.e.*, if it contains a complete contract between the parties and satisfies the provisions—to be noted immediately—of the Statute of Frauds, and if, in all the circumstances, its enforcement is just and equitable), the lessee is treated as having a lease for the term fixed in the agreement from the time that he took possession under it, just as if a valid lease had been executed. At common law a lease for a term of years (other than a lease by a corporation) might be made by parol. But under the Statute of Frauds leases, except those the term of which does not exceed three years, and in which the reserved rent if equal to two-thirds at least of the improved value of the premises, were required to be in writing signed by the parties or their lawfully authorized agents; and now, under the Real Property Act, 1845, a lease required by law to be in writing is void unless made by deed. The Statute of Frauds also prohibits an action from being brought upon any agreement for a lease, for any term, unless such agreement is in writing and signed by the party to be charged therewith or by some agent lawfully authorized by him.

The following are the principal forms of tenancy:—(i.)

Forms of tenancy.

Tenancy for Life.—A lease for life must be made by deed, and the term may be the life of the lessee, the life or lives of some other person or persons, &c. (As to the position of a tenant for life under the Settled Land Acts, see the article SETTLEMENTS in vol. xxi. [ninth edition] of this Encyclopædia.) (ii.) *Tenancy for Years, i.e.*, for a term of years.—This tenancy is created by an express contract between the parties and never by implication, as in the case of tenancy from year to year and tenancy at will. (iii.) *Tenancy from Year to Year.*—This tenancy may be created by express agreement between the parties, or by implication as, *e.g.*, where a person enters and pays rent under a lease for years, void either by law or by statute, or without any actual lease or agreement, or holds over after the determination of a lease whether for years or otherwise. In the absence of express agreement or custom or statutory provision (such as is made by the Agricultural Holdings Act, 1883), a tenancy from year to year is determinable on half a year's notice expiring at the end of some current year of the tenancy. Closely associated with tenancies from year to year are various other tenancies for shorter periods than a year—weekly, monthly, or quarterly, as the case may be. Questions of considerable importance frequently arise as to the notice necessary to terminate tenancies of this character. The issue is one of fact; the date at which the rent is payable is a material circumstance, but it may be said generally that a week's notice should be given to determine a weekly tenancy, a month's to determine a monthly tenancy, and a quarter's to determine a quarterly tenancy.

It is chiefly in connexion with the letting of lodgings, flats, &c., that tenancies of this class arise, and it may therefore be convenient to notice here a few special incidents attaching to them. Where *furnished* apartments are let for immediate use, the law implies an undertaking on the part of the landlord that they are fit for habitation, and if this condition is broken, the tenant may refuse to occupy the premises or pay any rent. But there is no implied contract that the apartments shall continue fit for habitation during the term of the tenancy, and the rule has no application in the case of a letting of *unfurnished* lodgings. In the absence of express agreement to the contrary, a lodger has the right to the use of everything necessary to his enjoyment of the premises, such as the door-bell and knocker, and the skylight of the staircase. Whether the rent of furnished apartments can be distrained for where the landlord resides on the premises and supplies attendance, is a question the answer to which is involved in some uncertainty. But a *lodger's goods* are protected from distress for rent due by an immediate to a superior landlord by the Lodgers' Goods Protection Act, 1871, if the lodger serves the distraining landlord or his bailiff with a written declaration claiming the goods as his property. Where the tenant "holds over" after himself giving notice to quit, the landlord has a statutory right of action for double the rent. *Overcrowding* lodging-houses may be dealt with as a nuisance under the Public Health Acts, 1875 and 1891. (As to the lodger franchise, see article REGISTRATION OF VOTERS.) A lodger is rateable where he is in exclusive occupation of the apartments let to him and the landlord does not retain the control and dominion of the whole structure. There is a considerable body of special law with regard to *flats*. Thus the occupier of an upper flat has a right to the support of a lower one, although not to the extent of imposing upon the tenant of the latter the duty of actively maintaining such support by repairs. Again, where the only mode of access to a number of residential flats is a common staircase, the landlord is bound to maintain it so as to be a reasonably safe entrance and exit to the tenants and persons doing business with them.

(iv.) *Tenancy at Will.*—A tenancy at will is one which endures at the will of the parties only, *i.e.*, at the will of both, for if a demise be made to hold at the will of the lessor, the law implies that it is at the will of the lessee also and *vice versâ.* This form of tenancy, like tenancy from year to year, may be created either by express contract or by implication, as where premises are occupied with the consent of the owner, but without any express or implied agreement as to the duration of the tenancy, or where a house is lent rent free by one person to another.

(v.) *Tenancy at Sufferance.*—A tenant who comes into possession by a lawful demise, but "holds over" or continues in possession after his estate is ended, is said to be a "tenant at sufferance." Properly speaking, tenancy at sufferance is not a tenancy at all, inasmuch as if the landlord acquiesces in it, it becomes a tenancy at will; and it is to be regarded merely as a legal fiction which prevented the rightful owner from treating the tenant as a trespasser until he had himself made an actual entry on or had brought an action to recover the land. The Distress for Rent Act, 1737, however, enables a landlord to recover double rent from a tenant who holds over after having himself given notice to quit; while another statute in the reign of George II. makes a tenant who holds over after receiving notice from his landlord liable to the extent of double the value of the premises. There is no tenancy by sufferance against the Crown.

Form of a lease.

The component parts of a lease are the parties, the recitals (when necessary) setting out such matters as the title of the lessor; the demise or actual letting (the word "demise" is ordinarily used, but any term indicating an express intention to make a present letting is sufficient); the parcels in which the extent of the premises demised is stated; the *habendum* (which defines the commencement and the term of the lease), the *reddendum* or reservation of rent, and the covenants and conditions. The Conveyancing Act, 1881, provides that, as regards conveyances subsequent to 1881, unless a contrary intention is expressed, a lease of "land" is to be deemed to include all buildings, fixtures, easements, &c., appertaining to it; and, if there are houses or other buildings on the land demised, all out-houses, erections, &c., are to pass with the lease of the land. Covenants in leases may be roughly divided into four groups.

(i.) *Implied Covenants.*—A covenant is said to be implied when it is raised by implication of law without any express provision being made for it in the lease. Thus a lessee is under an implied obligation to treat the premises demised in a tenant-like or "husband-like" manner, and again, where in a lease by deed the word "demise" is used, the lessor probably covenants impliedly for his own title and for the quiet enjoyment of the premises by the lessee.

(ii.) "*Usual*" *Covenants.*—The term "usual" has a restricted meaning in this connexion, and includes a covenant by the lessor, limited to his own acts and those of persons claiming under or through him, for the "quiet enjoyment" by the lessee of the demised premises, and covenants by the lessee to pay rent, to pay taxes, except such as fall upon the landlord, to keep the premises in repair, and to allow the landlord to enter and view the condition of the premises.

(iii.) *The Covenants running with the Land.*—A covenant is said to "run with the land" when the rights and duties which it creates are not merely personal to the immediate parties (in which case a covenant is said to be "collateral"), but pass also to their assignees. A covenant "runs with the land" if it relates either to a thing *in esse*, which is part and parcel of the demise, *e.g.*, the payment of rent, the repair of houses or fixtures or machinery already built or set up, or to a thing not *in esse* at the time of the demise, but touching the land, provided that the word "assigns" is used in the covenant. As instances of "collateral" covenants, we may take a covenant by a lessor to give the lessee a right of pre-emption over a piece of land adjoining the subject of the demise, or in the case of a lease of a beer-shop, not to keep any similar shop within a prescribed distance from the premises demised, or a covenant by a lessee to pay rates on premises not demised.

(iv.) *Restrictive Covenants.*—These may be subdivided into two classes—covenants not to assign or underlet without the lessor's consent (it may be noted in passing that such consent must be applied for even if, under the covenant, it cannot be withheld); and covenants in restraint of trade, *e.g.*, not to use the demised premises for certain trading purposes, and in the case of "tied houses" a covenant by the lessees to purchase all beer required from the lessors.

In addition to those above noted, a lease frequently contains covenants for removal of the lease at the option of the lessee, and for repairs or insurance against damage by fire by the lessee. Leases frequently contain a covenant by the lessee to bear and pay rates, taxes, assessments, and other "impositions" or "charges," or "duties" or "outgoings," or "burdens" (except property tax) imposed upon the demised premises during the term. Considerable difficulty has arisen in recent years as to the scope of the terms "impositions," "charges," "duties," "outgoings," "burdens." The words "rates, taxes, assessments" point to payments of a periodical or recurring character. Are the latter words in such covenants limited to payments of this kind, or do they include single and definite payments demanded, for example, by a local authority, acting under statutory powers, for improvements of a permanent kind affecting the premises demised? The decisions on the point are numerous and difficult to reconcile, but the main test is whether, on the true construction of the particular covenant, the lessee has undertaken to indemnify the landlord against payments of all kinds.

Rent.

There are several special points in connexion with rent that deserve to be noted. The amount of rent must be ascertained or ascertainable. There must also be certainty as to the time of payment. If a tenant pays his rent before the day on which it is due, he runs the risk of being called upon, in certain circumstances, to pay it over again. Such a payment is an advance to the landlord subject to an agreement that when the rent becomes due the advance shall be treated as a fulfilment of the tenant's obligation to pay rent. The payment is therefore, generally speaking, a defence to an action by the landlord or his heirs. But if the landlord mortgages his reversion, either before or after the advance, the assignee will, by giving notice to the tenant before the proper rent day to pay rent to him, become entitled to the rent then falling due. A tenant is not in arrears with his rent until after midnight on the day on which it is due. Payment by cheque is conditional payment only, and if the cheque is dishonoured, the original obligation revives. Where a cheque in payment of rent is lost in the course of transmission through the post, the loss falls on the tenant unless the landlord has expressly or impliedly authorized it to be forwarded in that way; and the landlord's consent to take the risk of such transmission will not be inferred from the fact that payments were ordinarily made in this manner in the dealings between the parties. A tenant may deduct from his rent (i.) "landlord's taxes," *e.g.*, property-tax paid by the tenant, if, as is usual, the statute imposing the tax authorizes the deduction; the deduction should be made from the rent next due after the payment. (ii.) Taxes or rates which the landlord had undertaken to pay, but had not paid—payment having thereupon been made by the tenant. (iii.) Payments made by the tenant which ought to have been made by the landlord, *e.g.*, rent due to a superior landlord. (As to the opportionment of rent, see APPORTIONMENT.) A right of distress is incident to rent. The latest statutory development of the law on this subject is the Law of Distress Amendment Act, 1888. This statute confers absolute privilege from distress upon the wearing apparel and "bedding"—a term which includes "bedstead"—of the tenant or his family, and the tools and implements of his trade to the value of £5. The Act does not apply to cases where the interest of the tenant has expired, and where possession of the premises has been demanded, and where distress is made not earlier than seven days after such demand. Under this Act also, distress, unless made by the landlord in person, must be made by a bailiff duly certificated (see the Distress for Rent Rules, 1888 and 1895). The Law of Distress Amendment Act, 1895, supplements the Act of 1888, and in particular gives county court judges wider powers of dealing with the certificates of bailiffs. Rent is also recoverable by action, which must be brought within twenty years after the cause of action has arisen, or after an acknowledgment by the party liable, or his agent, or part payment if the rent is reserved by a lease under seal, and in other cases within six years.

Termination.

The relationship of landlord and tenant may be altered either voluntarily, by the act of the parties, or involuntarily, by the operation of law, and may also be dissolved. The principal mode of voluntary alteration is an assignment either by the tenant of his term or by the landlord of his reversion. An assignment which creates, it will be observed, the relationship of landlord and tenant between the lessor or lessee and the assignee, must be by deed, but the acceptance by a landlord of rent from a tenant under an invalid assignment may create an implied tenancy from year to year; and similarly payment of rent by a tenant may amount to an acknowledgment of his landlord's title. This is one form of tenancy by estoppel. The principle of all tenancies of this kind is that something has been done by the party estopped, amounting to an admission which he cannot be allowed to contradict. "Attornment," or the agreement by a tenant to become tenant to a new landlord, is a term now often used to indicate an acknowledgment of the existence of the relationship of landlord and tenant. It may be noted here that it is still common to insert in mortgage deeds what is called an "attornment clause," by which the mortgagor "attorns" tenant to the mortgagee, and the latter thereupon acquires a power of distress as an additional security. If the lands assigned are situated in Middlesex or Yorkshire, the assignment should be registered under the Middlesex Registry or Yorkshire Registries Acts, as the case may be; and similar provision is now made for the registration by an assignee of his title under the Lands Transfer Acts, 1875 and 1897. Another form of alteration in a contract of tenancy is an under-lease, which differs from assignment in this—that the lessor parts with a portion of his estate instead of, as in assignment, with the whole of it. There is no privity of contract between an under-lessee and the superior landlord, but the latter can enforce against the former restrictive covenants (*v. sup.*) of which he had notice. The contract of tenancy may also be altered by operation of law. If a tenant becomes bankrupt, his interest passes to his trustee in bankruptcy—unless, as is frequently the case, the lease makes the occurrence of that contingency determine the lease. So on the death of a tenant his interest passes to his legal representatives. Tenancy is dissolved by the expiry of the term for which it was created—a subject which has already been sufficiently touched upon in considering the various kinds of tenancy—or by forfeiture of the tenant's interest on the ground of the breach of some condition by the tenant and re-entry by the landlord. A breach of condition may, however, be waived by the landlord, and the legislature has made provision for the relief of the tenant from the consequences of such breaches in certain cases. Relief from forfeiture and rights of re-entry are now regulated chiefly by the Conveyancing Acts, 1881 and

1892. Under these Acts a right of re-entry or forfeiture is not to be enforceable unless and until the lessor has served on the lessee a written notice specifying the breach of covenant or condition complained of, and requiring him to remedy it or make compensation, and this demand has not within a reasonable time been complied with; and when a lessor is proceeding to enforce such a right the court may, if it think fit, grant relief to the lessee.

Reference may be made, in conclusion, to a few modern statutes which have affected the law of landlord and tenant. The Agricultural Holdings Acts, 1883 (which repeals the Agricultural Holdings Act, 1875) and 1900, give to the agricultural tenant a right to compensation for (i.) certain specified improvements made by him with the landlord's previous consent in writing; and (ii.) certain other classes of improvements although the landlord's consent has not been obtained. As examples of class (i.) may be mentioned—erection or enlargement of buildings, laying down of permanent pasture, making of gardens or fences, planting of hops, embankments, and sluices; as examples of (ii.)—chalking of land, clay burning, application to land of purchased artificial or purchased manure. In the case of proposed drainage improvements, however, notice in writing must be given to the landlord, who may then execute the improvements himself and charge the tenant with interest not exceeding 5 per cent. per annum on the outlay, or such annual instalments, payable for a period of twenty-five years, and recoverable as rent, as will repay the outlay, with interest at the rate of 3 per cent. a year. An agricultural tenant may not contract himself out of his statutory right to compensation, but "contracting out" is apparently not prohibited with regard to the right given him by the Acts of 1883 and 1900 to remove fixtures which he has erected and for which he is not otherwise entitled to compensation, after reasonable notice to the landlord, unless the latter elects to purchase such fixtures at a valuation. The Allotments and Cottage Gardens (Compensation) Act, 1887, deals, on terms similar to those of the Agricultural Holdings Acts, 1883 and 1900, with allotments (*i.e.*, parcels of land of not more than two acres, cultivated as gardens or farms, or partly as gardens and partly as farms) and cottage gardens (*i.e.*, allotments attached to cottages); and where a tenant is entitled to "compensation" under the Act of 1887 he is not to be so entitled under the Act of 1883 (Tenants' Compensation Act, 1890). Compensation is given to market gardeners for unexhausted improvements by the Market Gardeners' Compensation Act, 1895. The Agricultural Holdings Act, 1883, the Tenants' Compensation Act, 1890, the Market Gardeners' Compensation Act, 1895, and the Agricultural Holdings Act, 1900, may now (by § 14 (2) of the last-named statute) be cited together as the Agricultural Holdings (England) Acts, 1883 to 1900.

Scotland.—The following statutes relating to the law of landlord and tenant in Scotland must be noted. The Agricultural Holdings (Scotland) Acts, 1883 and 1900, contain provisions—similar to those of the English Acts—as to a tenant's right to compensation for unexhausted improvements, removal for non-payment of rent, notice to quit at the termination of a tenancy, and a tenant's property in fixtures. The Crofters' Holdings (Scotland) Acts, 1886, 1887, and 1888, confer on "crofters" special rights. A crofter is defined as "a tenant of a holding"—being arable or pasture land, or partly arable and partly pasture land—"from year to year who resides on his holding, the annual rent of which does not exceed £30 in money, and which is situated in a 'crofting parish.'" Nearly all the parishes in Argyll, Inverness, Ross, Cromarty, Sutherland, Caithness, and Orkney and Shetland answer to this description. The crofter enjoys a perpetual tenure subject to the fulfilment of certain conditions as to payment of rent, non-assignment of tenancy, &c., and to defeasance at his own option on giving one year's notice to the landlord. A Crofters' Commission constituted under the Acts has power to fix fair rents, and the crofter on renunciation of his tenancy or removal from his holding is entitled to compensation for permanent improvements. The Small Holdings Act, 1892, applies to Scotland.

Ireland.—The history and condition of the law of landlord and tenant in Ireland down to and including the year 1881 will be found stated in the article IRELAND in vol. xiii. (ninth edition) of the *Encyclopædia Britannica.* The first important statute after that date was the Land Purchase Act of 1885 (Lord Ashbourne's Act). It enabled the Land Commission, established under the Land Act, 1881, to advance to tenants out of a grant of £5,000,000, which it made to the Land Commission for the purpose, the whole money required for the purchase of their holdings (under the Land Act, 1881, the limit of an advance was three-fourths of the purchase money), if provision were made for the lodgment or retention of a guarantee deposit; and the sale might be carried out by a vesting order of the Land Commission in lieu of a conveyance. The advance was made repayable by an annuity in favour of the Land Commission of £4 for every £100, and so in proportion for any less sum. Amending Acts were passed in 1887, 1888, 1891, and 1896. The Land Act, 1887, enabled all leaseholders to obtain a judicial revision of their rents; all middlemen, *i.e.*, leaseholders who had sublet their lands, were allowed, if the courts reduced the rents of their tenants, to throw up their leases; power was given to the landlord who had obtained judgment of eviction to make his tenant a caretaker without first evicting him. An equitable jurisdiction was vested in the county court to hear complaints from tenants, to give them time for the payment of their rents, when that should be necessary, and when they were honestly insolvent to relieve them—in like manner as under the bankruptcy law—from all or part of their debts, including rent, and in proper cases to reinstate them in their holdings at a fair rent. The Land Act, 1888, increased the grant placed at the disposal of the Land Commission by Lord Ashbourne's Act from £5,000,000 to £10,000,000. The Land Purchase Act, 1891, besides providing for the relief of "congested districts" (which were also the subject of legislation in 1893 and 1894) and the allocation of the money to be lent for land purchase, created ingenious machinery for enabling British credit to be applied in the extension of the system of land purchase. When a landlord and tenant agree on the sale of a holding—the measure is entirely permissive in character—and when the Land Commission has sanctioned the advance, the advance is made to the landlord not in cash but in the issue of guaranteed land stock of the nominal amount of the advance, producing dividends at the rate of 2¾ per cent. In order to provide for the payment of these dividends and for the redemption of the whole amount in forty-nine years, the tenant pays a purchase annuity for that period, the normal rate of which is 4 per cent. for the advance, but which is fixed at a higher rate during the earlier years of the term so as to provide a tenants' insurance fund. The purchase annuities are paid into a land purchase account, and any deficiency in the payment either of interest or of capital is temporarily advanced out of the Consolidated Fund, which is in turn recouped for these temporary advances out of a guarantee fund, consisting of (i.) a cash portion—the Irish Probate Duty Grant, the annual exchequer contribution, and (a provision abolished by the Land Act, 1896) the county percentage—and (ii.)

a contingent portion including the Irish share of the local taxation (Customs and Excise) duties and various local grants. The Land Act, 1896, required the court in fixing a fair rent for a holding to ascertain and record in the form of a schedule, *inter alia*, the condition as to deterioration, cultivation, or otherwise of the holding and any buildings on it, the improvements made at the cost of the tenant and those made at the cost of the landlord, defined the tenures excluded from its provisions as to fair rents, altered to some extent the mode of calculating the annuity payable by the tenant, amended the law as to the guarantee deposit, and provided that where an order had been made for a sale of an estate or it had been placed in the hands of a receiver the land judge might, after reference to the Land Commission, offer it for sale to the tenants, but the offer was not to be accepted until all parties had been fully heard and all the circumstances had been considered.

The law of landlord and tenant in the United States is in its principles similar to those of English law. The relationship of landlord and tenant is created, altered, and dissolved in the same way, and the rights and duties of parties are similar. An excellent summary of the law will be found in Bouvier's *Law Dictionary* (ed. Rawle, 1897), *s.v.* "Landlord and Tenant." As to India, see INDIA in vol. xii. (ninth edition) of the *Encyclopædia Britannica.* The laws of the various colonies on the subject are too numerous and too different to be dealt with here. But there has been a general tendency in recent years to copy modern English statutory developments, as in limiting the right of distress (see No. 1388 of 1895—Victoria—and cp. C. 17 of 1895, and C. 18 of 1896—British Columbia), securing the protection of lodgers' goods (No. 2 of 1898—West Australia, and No. 5 of 1898—Grenada), and in securing compensation to tenants (see No. 11 of 1897—Barbados).

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Land Registration in its two forms—registration of deeds and registration of title—may be best described as a species of machinery for assisting a purchaser or mortgagee in his inquiries as to his vendor's or mortgagor's title previously to completing his dealing, and for securing his own position afterwards. The expediency of making some inquiry into the vendor's title before completing a purchase of land (and the case of a mortgage is precisely similar) is so obvious as hardly to need demonstration. Goods, it is true, are ordinarily bought and sold without any inquiry of this nature, but there is very little analogy between the two cases. In the case of goods, possession may ordinarily be relied on as proof of full ownership; in the case of land, the person in ostensible possession is very seldom the owner, being usually only a tenant, paying rent to some one else. Even the person to whom the rent is paid is in many cases—probably, in England, in most cases—not the full owner, but only a life owner, or a trustee, whose powers of disposing of the property are of a strictly limited nature. Again, goods are very seldom the subject of a mortgage, whereas land has from time immemorial been the frequent subject of this class of transaction. Evidently, therefore, some sort of inquiry is necessary to enable a purchaser to obtain certainty that the land for which he pays full price is not subject to an unknown mortgage or charge, which, if left undiscovered, might afterwards deprive him of a large part or even the whole of its value. Again: the probability of serious consequences to the purchaser ensuing from a mistake as to title is infinitely greater in the case of land than in the case of goods. Before the rightful owner can recover misappropriated goods, he has to find out where they are. This is usually a matter of considerable difficulty. By the time they have reached the hands of a *bonâ fide* purchaser all chance of their recovery by the true owner is practically at an end. But with land the case is far otherwise. A dispossessed rightful owner never has any difficulty in tracing his property, for it is immovable. All he has to do is to bring an action for ejectment against the person in possession. For these reasons, among others, it may safely be said that any attempt to deal with land on the simple and unsuspecting principles which obtain in regard to goods would be fraught with grave risks.

Apart from very early and primitive social conditions, when everybody's affairs were more or less within the common knowledge of everybody else, there appear to be only two ways in which the required certainty as to title to land can be obtained. Either the purchaser must satisfy himself, by an exhaustive scrutiny and review of all the deeds, wills, marriages, heirships, and other documents and events by which the property has been conveyed, mortgaged, leased, devised, or transmitted during a considerable period of time, that no loophole exists whereby an adverse claim can enter or be made good—this is called the system of private investigation of title—or the Government must keep an authoritative list, or register, of the properties within its jurisdiction, together with the names of the owners and particulars of the encumbrances in each case, and must protect purchasers and others dealing with land, on the faith of this register, from all adverse claims. This second system is called Registration of Title. To these two alternatives may perhaps be added a third, of very recent growth—Insurance of Title. This is largely used in the United States. But it is in reality only a phase of the system of private investigation. The insurance company investigates the title according to a method of its own, and charges the purchaser a premium to cover the expense and the risk of error. Registration of deeds is an adjunct of the system of private investigation, and, except in England, is a practically invariable feature of it. It consists in the establishment of public offices, in which all documents affecting land are to be recorded—partly in order to preserve them in a readily accessible place, partly in order to prevent the possibility of any material deed or document being dishonestly concealed by a vendor from the scrutiny of the intending purchaser. Where registration is effected by depositing a full copy of the deed, it also renders the subsequent falsification of the original document dangerous. Registration of deeds does not (except perhaps to a certain extent indirectly) cheapen or simplify the process of investigation—the formalities at the registry add something to the trouble and cost incurred—but it prevents the particular classes of fraud above mentioned.

The history of land registration follows, as a general rule, a fairly uniform course of development. In very early times, and in small and simple communities, the difficulty which is afterwards found in establishing title to land does not arise, owing to the primitive habit of attaching a certain amount of ceremony and publicity to all dealings. The parties meet on the land, with witnesses; symbolical acts (such as handing over a piece of earth, or the bough of a tree) are performed; and a set form of words is spoken, expressive of the intention to convey. By this means the ownership of each estate in the community becomes to a certain extent a matter of common knowledge, rendering fraud and mistake difficult.

But this method leaves a good deal to be desired in point of security. Witnesses die, and memory is uncertain; and one of the earliest improvements consists in the establishment of a sort of public record kept by the magistrate, lord, or other local authority, containing a series of contemporary notes of the effect of the various transactions that take place. This book becomes the general title-deed of the whole community, and as long as transactions remain simple, and not too numerous, the results appear to be satisfactory. Of this character are the Manorial Court Rolls, which were in the Middle Ages the great authorities on title, both in England and on the Continent. The entries in them in early times were made in a very few words. The date, the names of the parties, the name or short verbal description of the land, the nature of the transaction, are all that appear. In the land registry at Vienna there is a continuous series of registers of this kind going back to 1368, in Prague to 1377, in Munich to 1440. No doubt there are extant (though in a less easily accessible form) manorial records in England of equal or greater antiquity. This may be considered the first stage in the history of Land Registration. It can hardly be said to be in active operation at the present day in any civilized country—in the sense in which that term is usually understood. Where dealings become more numerous and complicated, written instruments are required to express the intentions of the parties, and perform the further function afterwards of supplying evidence of the landowner's title. It appears, too, that as a general rule the public books already described continue to be used, notwithstanding this change; only (as would be expected) the entries in them, once plain and simple, either grow into full copies of the long and intricate deeds, or consist of mere notes stating that such and such deeds have been executed, leaving the persons interested to inquire for the originals, in whose custody soever they may be found. This system, which may be regarded as the second stage in the history of land registration, is called Registration of Deeds. It prevails in France, Belgium, parts of Switzerland, in Italy, Spain, India, in almost all the British colonies (except Australasia and Canada), in most of the states of the American Union, in the South American republics, in Scotland and Ireland, and in the English counties of Yorkshire and Middlesex. Where it exists, there is generally a law to the effect that in case of dispute a registered deed shall prevail over an unregistered one. The practical effect of this is that a purchaser can, by searching the register, find out exactly what deeds he ought to inquire for, and receives an assurance that if, after completion, he registers his own conveyance, no other deeds—even if they exist—will prevail against him.

The expenses and delays, not to mention the occasional actual losses of property through fraud or mistake, attendant on the system of making every purchaser responsible for the due examination of his vendor's title—whether or not assisted by registration of deeds—have ultimately induced several Governments to establish the more perfect system of Registration of Title, which consists in collecting the transactions affecting each separate estate under a separate head, in keeping an accurate account of the parcels of which each such estate is composed, and summarizing authoritatively, as each fresh transaction occurs, the subsisting rights of all parties in relation to the land itself. This system prevails in Germany, Austria, Hungary, parts of Switzerland, the Australasian colonies, nearly the whole of Canada, some of the states of the American Union, to a certain extent in Ireland, and is in course of establishment in England and Wales. The Register consists of three portions:—(1) The description of the land, now always accompanied by a reference to a map; (2) the ownership, giving the name and address of the person who can sell and dispose of the land; and (3) the encumbrances, in their order of priority, and the names of the persons for the time being entitled to them. When any fresh transaction takes place the instrument effecting it is produced, and the proper alterations in, or additions to, the register are made: if it be a sale, the name of the vendor is cancelled from the register, and that of the purchaser is entered instead; if it be a mortgage, it is added to the list of encumbrances; if a discharge, the encumbrance discharged is cancelled; if it is a sale of part of the land, the original plan is marked to show the piece conveyed, while a new plan is made and a new register is opened for the detached parcel. In the English and Australian registries a "land certificate" is also issued to the landowner containing copies of the register and of the plan. This certificate takes the place more or less of the old documents of title. On a sale, the process is as follows. The vendor first of all produces to the purchaser his land certificate, or gives him the number of his title and an authority to inspect the register. In Austria and in some colonial registries this is not necessary, the register being open to public inspection, which in England is not the case. The purchaser, on inspecting this, can easily see for himself whether the land he wishes to buy is comprised in the registered plan, whether the vendor's name appears on the register as the owner of the land, and whether there are any encumbrances or other burdens registered as affecting it. If there are encumbrances, the register states their amount and who are entitled to them. The purchaser then usually[1] prepares a conveyance or transfer of the land (generally in a short printed form issued by the registry), and the vendor executes it in exchange for the purchase money. If there are mortgages, he pays them off to the persons named in the register as their owners, and they concur in a discharge. He then presents the executed instruments at the registry, and is entered as owner of the land instead of the vendor, the mortgages, if any, being cancelled. Where "land certificates" are used (as in England and Australia), a new land certificate is issued to the purchaser showing the existing state of the register and containing a copy of the registered plan of the land. The above is of course only a brief outline of the processes employed. For further information as to practical details reference may be made to the treatises mentioned at the end of this article. The following particulars indicating the history and distinctive features of different systems prevailing in Great Britain and various other countries may, however, prove interesting:—

England and Wales.—In England and Wales land registration is as yet (1902) only partially established. Since the time of Queen Anne deed registries have existed in Middlesex and Yorkshire, and under Lord Halsbury's Land Transfer Act of 1897 considerable progress has been made in compiling a register of title in the county of London, but it will probably be some years before this measure will have attained its full effect. The Act of 1897, § 20, provides the means of gradually extending the system throughout the country on the initiative of the County Councils. The first attempt to introduce general registration of conveyances appears to have been made by the Statute of Enrolments, passed in the 27th year of Henry VIII. But this was soon found to be capable of evasion, and it became a dead letter. A Registration Act applying to the counties of Lancaster, Chester, and Durham was passed in Queen Elizabeth's reign, but failed for want of providing the necessary machinery for its own observance. The subject reappeared in several Bills during the Commonwealth, but these failed to pass, owing, it would seem, to the objection of landowners to publicity. In 1669 a committee of the House of Lords reported that one cause of the depreciation of landed property was the uncertainty of titles, and proposed registration of deeds as a remedy, but nothing was done.

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[1] In Prussia all conveyances are verbal, made in person or by attorney before the registrar, who forthwith notes them in his books.

During the next thirty years numerous pamphlets for and against a general registry were published. In 1704 the first Deed Registry Act was passed, applying to the West Riding of Yorkshire. In 1707 the system was extended to the East Riding, and in 1708 to Middlesex. These Middlesex and Yorkshire registries remain in operation to the present day, and are greatly valued by the smaller proprietors and mortgagees, owing to the security against fraud which they provide at a trifling cost. The selection of these counties seems capricious: its probable explanation is that in them trade was flourishing, and the fortunes made were frequently invested inland, and a protection against secret encumbrances was most in demand. In 1728 and 1732 Surrey and Derby petitioned, unsuccessfully, for local registries. In 1735 the North Riding Deed Registry Act was passed. In 1739 a General Registry Bill passed the Commons, but did not reach the Lords. Next year the Lords passed a similar Bill, but it did not reach the Commons. In 1759 a General Registry Bill was thrown out by a majority of one. In 1785 Northumberland unsuccessfully petitioned for a local registry. After this the subject went almost out of sight till the Real Property Commission of 1828. They reported in 1830 in favour of a general register of deeds, but though several Bills were introduced, none were passed. In 1846 a committee of the House of Lords reported that the marketable value of real property was seriously diminished by the tedious and expensive process of the transfer of land, and that a registry of title to all real property was essential to the success of any attempt to simplify the system of conveyancing. In 1850 a Royal Commission reported in favour of a general register of deeds, and in 1851 Lord Campbell introduced a Bill accordingly, but it was opposed, and was dropped. In 1853 Lord Cranworth introduced a Bill, which passed the Lords but not the Commons. Hitherto only registration of deeds had been considered, but in 1854 a new Royal Commission was appointed, which reported in 1857 in favour of a register of title. The scheme they recommended was substantially embodied in a Bill introduced in 1859 by Lord Cairns—then Solicitor-General—but a dissolution stopped its progress. In 1862 Lord Westbury had the satisfaction of carrying the first Act for registration of title. This Act enabled any landowner to register an indefeasible title on production of strict proof. The proof required was to be such as the Court of Chancery would force an unwilling purchaser to accept. Only a few hundred titles were registered under this Act, and in 1868 a Royal Commission was appointed to inquire into the causes of its failure. They reported in 1870, making various suggestions of detail, and especially adverting to the great expense caused by the strictness of the official investigation of title before a property could be admitted to the register at all. In the same year Lord Hatherley introduced a Transfer of Land Bill, but it was not proceeded with. In 1873 Lord Selborne introduced a Land Titles and Transfer Bill, following more or less the recommendations of the report of 1870, proposing for the first time compulsory registration of title upon every next sale after a prescribed date. Lord Cairns again introduced this Bill (with some modifications) in 1874, but it had to be dropped. In 1875 Lord Cairn's Land Transfer Act of that year was passed, which was much the same as the former Bill, but without compulsion. This Act had no better success than the Act of 1862, but as its adoption has since been made compulsory, its provisions are important. Its most noticeable feature from a practical point of view is the additional prominence given to an expedient called "Possessory" registration (which also existed under another name in Lord Westbury's Act), whereby is removed the great initial difficulty of placing titles on the register in the first instance. Two sorts of registration were established, "Absolute" and "Possessory." The effect of an absolute registration was immediately to destroy all claims adverse to the registered title. But this was only to be granted on a regular investigation of title, which, though not so strict as under the former Act, yet necessarily involved a certain amount of time and cost. Possessory registration, on the other hand, was to be granted to any one who could show a *primâ facie* title—a quick and cheap process. But the effect of such registration would not be immediately felt. It would not destroy existing claims. It would only prevent new difficulties from arising. In course of time such a title would be practically as good as an absolute one. In 1885 the Duke of Marlborough introduced a Bill for a registry of titles, and in the following vacation Lord Davey wrote three letters to *The Times* advocating the same thing on the general lines afterwards adopted.[1] In 1887 Lord Halsbury, by introducing his Land Transfer Bill, commenced a struggle with the opponents of reform, which, after ten years of almost continuous effort, resulted in the passing of his Act of 1897, establishing compulsory registration of title. Without going into the details of this protracted campaign, suffice it to say that Lord Halsbury introduced Bills in 1887, 1888, and 1889. Lord Herschell, who succeeded him after the change of Government, introduced Bills in 1893, 1894, and 1895, these last three being unanimously passed by the House of Lords on every occasion. The Bill of 1895 reached committee in the Commons, but was stopped by the dissolution of Parliament. In 1897 Lord Halsbury (who had meanwhile returned to the Woolsack) again introduced the same Bill with certain modifications which caused the Incorporated Law Society to withdraw its opposition in the House of Commons, and the Act was finally passed on the last day of the session. Under it the Privy Council has power to issue orders from time to time declaring that on a certain date registration of title is to be compulsory on sale in a given district. The effect of such an order is to oblige every purchaser of land in the district after that date to register a "possessory title," as above described, immediately after his purchase. The compulsory provisions of the Act extend to freeholds and (by a rule afterwards made) to leaseholds having forty years to run. No order except the first can be made, save on the request of a county council. The first order was made in July 1898. It embraces the whole administrative county of London (including the City of London), proceeding gradually by groups of parishes. Under this order upwards of 32,000 titles have already been registered, representing a value exceeding thirty millions sterling. The cost of originally registering a possessory title, or a subsequent transfer or charge of registered land, is regulated according to the value of the land or charge, and is as follows:—

Value.	Fee.
Up to £1000 . . .	1s. 6d. per £25 value.
Thence to £3000 . .	£3 for the first £1000, and then 1s. per £25.
Thence to £10,000 . .	£7 for the first £3000, and then 1s. per £50.
Over £10,000 . . .	£14 for the first £10,000, and then 1s. per £100, up to a maximum of £25 for £32,000 value and over.

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[1] This summary is an abridgment (with permission) of pp. 7 to 26 of Mr R. Burnet Morris's book referred to at the end of this article.

Under the operation of this Act, at the expense of a somewhat increased cost on all transactions during a few years, persons dealing with land in the county will ultimately experience great relief in the matter both of cost and of delay. Mortgagees will also be protected from risks of fraud, which at present are very appreciable, and of which the Redgrave case is a recent example.

Scotland.—In Scotland registration of *deeds* was established by an Act of 1617, which remained unaltered till 1845. There are also Acts of 1868 and 1874. The registry is in Edinburgh. Deeds are registered almost invariably by full copy. The deeds are indexed according to properties—each property having a separate number and folio called a "search sheet," on which all deeds affecting it are referred to. In 1893, 34,767 deeds were registered and 2000 official searches were made. The consequence of the existence of this register is to render fraud in title absolutely unknown. Forty years is the usual period investigated. The investigation can, if desired, be made from the records in the registry alone. The fees are trifling, but suffice to pay the expenses of the office, which in 1893 employed no less than seventy-five permanent clerks in addition to temporary assistants. The total costs of conveyancing amount, roughly speaking, to between 1 and 2 per cent. on the purchase money, and are equally shared between vendor and purchaser.

Australia and New Zealand.—These colonies now furnish the most conspicuous examples in the British Empire of the success of registration of *title.* But prior to the year 1857 they had only registration of *deeds,* and the expense, delay, and confusion resulting from the frequent dealings appear to have been a crying evil. The late Sir Robert Torrens, then registrar of deeds in South Australia, drew up and carried an Act establishing a register of title similar to the shipping register. The Act rapidly became popular, and was adopted (with variations) in all the other Australasian colonies in the years 1861, 1862, 1870, and 1874. Consolidating and amending Acts have since been passed in most of these colonies. Only absolute title is registered. All land granted by Government, after the passing of the several Acts, is placed on the register compulsorily. But voluntary applications are also made in very large numbers. It is said ordinary purchasers will not buy land unless the vendor first registers the title. The fees are very low—£1 to £3 is a usual maximum—though in some colonies, *e.g.*, Victoria, the fees rise indefinitely, *ad valorem,* at a rate of about 10s. per £1000. Insurance funds are established to provide compensation for errors. At a recent date they amounted to over £400,000, while only £14,600 odd had been paid in claims. All the registries pay their own expenses. Bankers and men of business generally are warm in their appreciation of the Acts, which are popularly called Torrens Acts, after their originator, who, though not a lawyer, originated and carried through this important and difficult legal work.

Canada.—Registration of *title* was introduced in Vancouver Island in 1861, was extended to the rest of British Columbia in 1870, and was in 1885 adopted by Ontario, Manitoba, and the North-West Territories. Only Quebec, Nova Scotia, New Brunswick, and Prince Edward Island (all in the extreme east) retain the old English system, plus registration of deeds. The three provinces which have adopted registration of title have adopted it in somewhat different forms. In British Columbia it is similar to Lord Westbury's Act of 1862. The North-West Territories follows closely the Torrens Acts. The Ontario Act is almost a transcript of Lord Cairns's Act of 1875. The fees again are very low, seldom exceeding a few shillings, but all expenses of the office are paid from this source. The Ontario registry has five district offices, as well as the central one at Toronto. This is apparently the only colonial registry which is not open to public inspection.

Other British Colonies.—In the other British colonies private investigation of title, plus registration of deeds, is the prevailing system, but registration of title has been introduced in one or two instances.

Germany and Austria-Hungary.—By far the most important examples of registration of *title* at present existing —because they show how the system works when applied to large European communities, with all the intricacies and complications of modern civilized life—are to be found in Germany and Austria-Hungary. In some parts of these countries Registration of Title has been established for several centuries—notably in Bohemia; in most parts it has existed for the greater part of the 19th century; in some districts, again, notably Tirol and the Rhine Provinces, it is still in course of introduction. In all cases it appears to have been preceded by a system of deed registration, which materially facilitated its introduction. In some cases, Prussia, for instance, the former registers were kept in such a way as to amount in themselves to little short of a registry of title. Very low scales of fees suffice to pay all official expenses. In Prussia, for instance, the fees for registering sales begin at 5d. for a value of £1; at £20 the fee is 2s. 7d.; at £100 it is 7s. 3d.; at £1000 it is £1, 10s.; at £5000, £4, 5s., and so on. In case of error, the officials are personally liable; failing these, the state. Other states are very similar. In 1894, 1,159,995 transactions were registered in Prussia. In 1893, 938,708 were registered in Austria. Some idea of the extent to which small holdings prevail in these countries may be gathered from the fact that 36 per cent. of the sales and mortgages in Austria were for under £8, 6s. 8d. value—74 per cent. were for under £50. Owing to the ease and simplicity of the registers, it is not always necessary to employ professional help. When such help is required, the fees are low. In Vienna £1 is a very usual fee for the purchaser's lawyer. £10 is seldom reached. In Germany the register is private. In Austria it is open to public inspection. In these registers may be found examples of large estates in the country with numerous charges and encumbrances and dealings therewith; peasants' properties, in numerous scattered parcels, acquired and disposed of at different times, and variously mortgaged; town and suburban properties, flats, small farms, rights to light and air, rights of way, family settlements, and dealings of all sorts—inheritances and wills, partitions, bankruptcies, mortgages, and a great variety of dealings therewith. The Continental systems are usually administered locally in districts, about 20 to 30 miles across, attached to the local law courts. In Baden and Würtemberg every parish (commune) has its own registry. All ordinary dealings are transacted with the greatest expedition. Security is absolute.[1]

The United States.—Up to a late date the ordinary English system, with registration of *deeds,* was universal in the United States. The registries appear to go back practically to the original settlement of the country. Registration is by full copy. It is said that in the large towns the name indexes were often much overgrown owing to the want of subdivision into smaller areas corresponding to the parishes into which the Middlesex and Yorkshire indexes are divided. In the New York registry not many years ago 25,000 deeds were registered annually. At the same time 35,000 were registered in Middlesex. Complaints are made by American lawyers of want of accuracy in the indexes also. In 1890 an Act was passed in New York for splitting the indexes into "blocks," which is expected to give much relief in a few years' time. The average time and cost of an examination of title, as estimated by a committee of the Bar Association of New York in 1887, was about thirty days and 150 dollars (about £30). A later State Commission in Illinois estimates the law costs of a sale there at about 25 dollars (£5); the time may run into many months. Allusion has already been made to the insurance of title companies. The rates of insurance are substantial, *e.g.*, 65 dollars (£13) on the first 3000 dollars (£600), and 5 dollars (£1) on each additional 1000 dollars (£200). This would amount to £20 on £2000 value, £110 on £20,000, £510 on £100,000. The guarantee given is very ample, and may be renewed to subsequent owners at one-third of the fee. Registration of title has lately been introduced into Illinois, but the practical results have hardly as yet had time to declare themselves.

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[1] Full information as to the German and Austrian systems is to be found in a Parliamentary Report of 1896 (C.—8139) on the subject.

France.—In France registration of *deeds* is universal. Sales, mortgages, gifts, and successions; easements, leases of over eighteen years, and transactions affecting the land to the extent of three years' rent, may lose priority if not registered. Wills need not be registered. Mortgages must be registered every ten years. Purchase deeds are registered by filing full copies. Registries are established in all the considerable towns. The duty on sales amounts to the high figure of about 6½ per cent. on the value. Part of this is allocated to registration, in addition to which a fixed fee of 1 franc, and stationers' charges averaging 6 francs, are also chargeable. The title can usually be fully investigated from the documents in the registry. Official searches for mortgages are commonly resorted to, at a cost of about 5 francs. Under the monarchy the land system was practically copyhold tenure, but greater validity was attached to the Court Rolls than was the case in England. The present system was established by a law of 1790 after the abolition of seigniorial institutions in 1789. This was modified by the Code Napoleon, and further perfected by a law of 1855. The average value of transactions in France is very small. Probably at the present time four-fifths of the properties are of under £25 value. The costs of a sale for 200 francs (£8) would be about as follows:—Duty 13 fr.; Notary (1 p.c.), 2 fr.; expenses, 12 fr.—total 27 fr. A sale for 1000 fr. (£40) would cost about 110 fr. Taking all values, the cost of conveyance and duty reaches the high figure of 10 per cent. in the general run of transactions. The vendor as a rule has no costs. Indefeasible title is not obtainable, but frauds are almost unknown. A day or two usually suffices for all formalities. On large sales a further process known as the "purge" is undergone, which requires a few weeks and more expense, in order to guard against possible claims against which the deed registries afford no protection, such as dowries of wives, claims under guardianships, &c. A commission (Commission Extraparlementaire du Cadastre), appointed in 1891 to consider the revision of the Government cadastral maps (which are in very serious arrear) and the establishment of registration of title, has collected, in seven volumes of Comptes Rendus, a great mass of most interesting particulars relating to land questions in France.

Authorities.—A very complete list of some 114 English publications from 1653 to 1895 will be found in R. Burnet Morris. *Land Registration.* Wm. Clowes, 1895.—Parliamentary Publications: *Second Report of the Real Property Commissioners*, 1831; *Report of the Registration and Conveyancing Commission*, 1850; *Report of the Registration of Title Commission*, 1857; *Report of the Land Transfer Commission*, 1870; *Reports on Registration of Title in Australasian Colonies*, 1871 and 1881; *Report on Registration of Title in Germany and Austria-Hungary*, 1896. General reviews of land registration in the British Isles, the Colonies, and in foreign countries: R. Burnet Morris, as above, and C. F. Brickdale. *Land Transfer in Various Countries.* Horace Cox, 1894. Books on practice:—England: Brickdale and Sheldon. *The Land Transfer Acts.* Stevens and Sons, 1898.—Cherry and Marigold. *The Land Transfer Acts*, 1898.—Hay. *Land Transfer*, &c. Waterlow Bros., 1901.—C. F. Brickdale. *Registration in Middlesex.* Waterlow and Sons, 1892. Australia: Duffy and Eagleson. Melbourne. Prussia: Oberneck. *Die Preussischen Grundbuchgezetze*, Berlin, Bahr. Austria: *Das allgemeine Grundbuchsgezetz*, &c. Vienna, Manzsche Buchhandlung.—Bartsch. *Das Oesterreichische Allgemeine Grundbuchsgezetz in seiner practischen Anwendung*, Vienna, K. Konegen. Saxony: Siegmann. *Sächsische Hypothekenrecht.* Leipzig, Breitkopf and Härtel. Statistics: *Oesterreichische Statistik* (*Grundbuchs-ämter*). Staatsdruckerei, Vienna, annually. (C. F. Br.)

Landsberg, a town of Bavaria, Germany, district of Upper Bavaria, on the river Lech, 38 miles by rail west by south of Munich. Its 15th-century church has fine stained glass. In the town house are a picture by Herkomer and frescoes by Piloty. Hubert von Herkomer was born (1849) at Waal, 7 miles to the south-west of Landsberg. Here also are a fine gateway, an agricultural school, and brewing, tanning, and manufacture of agricultural machinery, &c. Population (1900), 5977.

Landsberg-an-der-Warthe, a town of Prussia, on the navigable Warthe, 29 miles east-north-east of Küstrin by rail. The educational institutions include a gymnasium with *real* school, a burghers' school, a higher-grade girls' school, an industrial school, a drawing school, and a school for farriery. Population (1890), 28,065; (1900), 33,597.

Landshut, a town of Prussia, province of Silesia, at the north foot of the Riesengebirge and on the river Bober, 65 miles south-west of Breslau. It carries on flax-spinning and linen-weaving, and manufactures of cloth, shoes, beer, &c. The town dates from the 13th century. Here the Prussians were defeated by the Austrians in 1745, and again in 1760. Population (1900), 8241.

Landskron, chief town of a government district in north-eastern Bohemia, close to the Moravian frontier, in an extensive German-speaking enclave. It has manufactures of linen and cotton stuffs, tobacco, beer, and spirits. Population (1890), 5843; (1900), 6112, German.

Landskrona, a seaport town of Sweden, on the east side of the Sound, about half-way between Helsingborg and Malmö, 15 miles north-east of Copenhagen. The harbour is excellent, giving a depth of 35 feet, with 15 feet beside the quays. The staple industry is sugar manufacture and refining (from beetroot). In 1899 its port was cleared by 1914 vessels of 374,600 tons. On the little island of Hven, immediately opposite the town, Tycho Brahe built his famous subterranean observatory of Uranienborg in the second half of the 16th century. Population (1880), 9763; (1890), 12,253; (1900), 14,399.

Landsturm, the German equivalent of the *levée en masse*, or general levy of all men capable of bearing arms are not included in the other regularly organized forces, standing army or its second line formations, of Continental nations.

All men coming under the above category are liable to serve in it; in Germany from their eighteenth to their forty-fifth year, in Austria from their nineteenth to their forty-second, and in Russia (where it is known as the "Opolchenic") from their twentieth to their forty-third year of age. As a rule, the landsturm would not be called out except in the case of invasion of the country, but certain preparations are in most countries made for its equipment, armament, and formation. It usually consists of two portions—(*a*) those men who have passed through the army, or have otherwise trained before passing into the landsturm; and (*b*) those who have received no training whatever in consequence of exemption for family or other reasons. The first category has a certain value, and its men would probably be organized in units which might not receive uniforms, but by international law are compelled to wear a distinguishing badge. The second category can be of but little military value, and would probably be employed as working parties, tradesmen in depôts or military factories, or in other non-combatant duties. (J. M. GR.)

Landwehr, a German word meaning "defence of the country"; but the term as applied to an insurrectional militia is very ancient, and "lantveri" are mentioned in *Baluzii Capitularia,* as quoted in Hallam's *Middle Ages,* i. p. 262, 10th ed.

The landwehr in Prussia was first formed by a royal edict of 17th March 1813, which called up all men capable of bearing arms between the ages of eighteen and forty-five, and not serving in the regular army, for the defence of the country. After the peace of 1815 this force was made an integral part of the Prussian army, each brigade being composed of 1 line and 1 landwehr regiment. This, however, retarded the mobilization and diminished the value of the first line, and by the reorganization of 1859 the landwehr troops were relegated to the second line. The present conditions of landwehr service are given under ARMY (*Germany*). In Austria the landwehr is a totally different organization. It is in reality a *cadre* force existing alongside the regular army, and to it are handed over such recruits as, for want of vacancies, cannot be placed in the latter. These are trained for two years with the colours, and are afterwards passed for ten years into the non-active portion, but may be called up for training. There is a marked tendency to level up the landwehr to the standard of the army. In Switzerland the landwehr is simply a second line force, in which all citizens serve for twelve years, after passing twelve in the "Auszug" or field army. (J. M. GR.)

Lange, Friedrich Albert (1828–1875), German philosopher and sociologist, was born 28th September 1828, at Wald, near Solingen, the son of the celebrated theologian, J. P. Lange. He was educated at Duisburg, Zürich, and Bonn, where he distinguished himself by gymnastics as much as by study. In 1852 he became schoolmaster at Cologne; in 1855 *privat-docent* in philosophy at Bonn; in 1858 schoolmaster at Duisburg, resigning when the Government forbade schoolmasters to take part in political agitation. Lange then entered on a career of militant journalism in the cause of political and social reform. He was also prominent in the local affairs of his town, yet found leisure to write most of his best-known books, *Die Leibesübungen* (1863), *Die Arbeiterfrage* (1865), *Geschichte des Materialismus* and *J. S. Mill's Ansichten über die sociale Frage* (both 1866). In 1866, discouraged by affairs in Germany, he moved to Winterthur, near Zürich, to become connected with the democratic *Winterthurer Landbote* newspaper. In 1869 he was *privat-docent* at Zürich, and next year professor. The strong French sympathies of the Swiss in the Franco-German war led to his speedy resignation. Thenceforward he gave up politics. In 1872 he accepted a professorship at Marburg. Unhappily, his vigorous frame was already stricken with disease, and, after a lingering illness, he died at Marburg, 21st November 1875, diligent to the end. His *Logische Studien* was published in 1877. His main work, the *History of Materialism* (translated into English), which is brilliantly written, with wide scientific knowledge and more sympathy with English thought than is usual in Germany, is rather a didactic exposition of principles than a history in the proper sense. Adopting the Kantian standpoint that we can know nothing but phenomena, Lange maintains that neither materialism nor any other metaphysical system has a valid claim to ultimate truth. For empirical phenomenal knowledge, however, which is all that man can look for, materialism with its exact scientific methods has done most valuable service. Ideal metaphysics, though they fail of the inner truth of things, have a value as the embodiment of high aspirations, in the same way as poetry and religion. In Lange's *Logische Studien,* which attempts a reconstruction of formal logic, the leading idea is that reasoning has validity in so far as it can be represented in terms of space. His *Arbeiterfrage* advocates an ill-defined form of socialism. It protests strongly against contemporary industrial selfishness, and against the organization of industry on the Darwinian principle of struggle for existence. (H. ST.)

Langen, Joseph (1837–1901), German theologian, was born at Cologne, 3rd June 1837. He studied at Bonn, was ordained priest in 1859, was nominated professor extraordinary at the University of Bonn in 1864, and a professor in ordinary of the exegesis of the New Testament in 1867—an office which he held till his death. He was one of the able band of professors who in 1870 supported Döllinger in his resistance to the Vatican decrees, and was excommunicated, with Döllinger, Huber, Friedrich, Reusch, Reinkens, Knoodt, Hilgers, and others, for refusing to accept them. In 1878, in consequence of the permission given to priests to marry, he ceased to identify himself longer with the Old Catholic movement, although he did not return to the Roman Catholic Church. Langen was more celebrated as a writer than as a speaker. He did not address the various Old Catholic conferences which have been held between 1872 and 1897, but he rendered service to the cause by his numerous books and articles. His first work was an inquiry into the authorship of the Commentary on St Paul's Epistles, and the Treatise on Biblical Questions, ascribed to Ambrose and Augustine respectively. In 1868 he published an *Introduction to the New Testament,* a work of which a second edition was called for in 1873. He also published works on the *Last Days of the Life of Jesus,* on *Judaism in the Time of Christ,* on *John of Damascus* (1879), and an *Examination of the Vatican Dogma in the Light of Patristic Exegesis of the New Testament.* But he is chiefly famous for his *History of the Church of Rome to the Pontificate of Innocent III.,* a work of learning and research in four volumes, which appeared between 1881 and 1893. He also contributed largely to the *Internationale Theologische Zeitschrift,* a review started in 1893 by the Old Catholics to promote the union of National Churches on the basis of the councils of the Undivided Church, and admitting articles in German, French, and English. Langen's articles are on various topics. Among other subjects, he wrote on the School of Hierotheus, on Romish falsifications of the Greek Fathers, on Leo XIII., on Liberal Ultramontanism, on the Papal Teaching in regard to Morals, on Vincentius of Lerins, and he carried on a controversy with Professor Beyschlag, of the German Evangelical Church, on the respective merits of Protestantism and Old Catholicism regarded as a basis for teaching the Christian faith. An attack of apoplexy put an end to his activity as a teacher and hastened his death, which occurred in July 1901, at the age of sixty-four. (J. J. L*.)

Langenbeck, Bernhard Rudolf Konrad von (1810–1887), German surgeon, was born at Horneburg on 9th November 1810, and received his medical education at Göttingen, where he took his doctor's degree in 1835 with a thesis on the structure of the retina. After a visit to France and England, he returned to Göttingen as *privat-docent,* and in 1842 became professor of surgery and director of the Friedrichs Hospital at Kiel. Six years later he succeeded Dieffenbach as director of the Clinical Institute for Surgery and Ophthalmology at Berlin, and remained there till 1882, when failing health obliged him to retire. He died at Wiesbaden on 30th September 1887. Langenbeck was a bold and skilful operator, but at the same time belonged to the conservative school, and was disinclined to resort to operation while other means afforded a prospect of success. He devoted particular attention to military surgery, and was a great authority in the treatment of gunshot wounds. Besides acting as general field-surgeon of the army in the war with Denmark in 1848, he also saw active service in 1864, 1866, and again in the Franco-German campaign of 1870–71. During the last, he was in Orleans at the end of 1870, after the city had been taken by the Prussians, and was unwearied in his attentions, whether as operator or consultant, to the crowds of wounded men with whom every public building was packed. Nor did he forget to utilize the opportunities for instruction that thus arose, and the "Militär-Aerztliche Gesellschaft," which met twice a week for some months, and in the discussions of which every surgeon present in the city was invited to take part, irrespective of nationality, was mainly formed by his personal energy and enthusiasm. He was ennobled for his services in the Danish war of 1864.

Langholm, a market town, burgh of barony, and police burgh (1892) of Dumfriesshire, Scotland, on the river Esk, 21¾ miles north by west of Carlisle by rail. There are six tweed mills, two distilleries, and tan works. There are a town hall and a hospital for indigent aged people. The public school gives higher education as well as elementary. Population (1891), 3643; (1901), 3142.

Langiewicz, Maryan (1827–1887), Polish patriot, was born at Krotoschin, 5th August 1827, and educated at the district school. His philological studies were completed at Breslau, and all his energies seemed to be directed to professorial work. But in a letter written when he was only seventeen years old, he declared it his wish to devote himself to military service and to the study of artillery. This taste was fostered by a year's service in the Prussian artillery, and, after some years chiefly spent in foreign travel, he joined in 1860 the expedition of Garibaldi in the kingdom of Naples. When the campaign was over, Langiewicz became professor at Cuneo; but in 1863, on the outbreak of the Polish insurrection, he was summoned by the committee and appointed military chief of Sandomir. Within six weeks his courage, his military knowledge, and his victories combined to raise him to the rank of general and dictator. During February and the early part of March 1863, by adopting the tactics of guerilla warfare, he defeated the Russians in several sanguinary battles, which might have been turned to greater advantage but for the impatience of the Poles. On 10th March he issued a proclamation assuming the dictatorship. On the 19th he endeavoured to communicate in person with the Polish Committee in Galicia, but was arrested and interned by the Austrians at Tarnow. On 2nd April he was removed to Tischnowitz, and at the end of the month to the fortress of Josefstadt. Being released in February 1865, he proceeded to Switzerland, and subsequently entered the Turkish service, in which he remained, under the name of Langie Bey, until his death, which took place at Constantinople, 11th May 1887. (G. F. B.)

Langley, Samuel Pierpont (1834–——), American physicist and astronomer, was born at Roxbury, Boston, Mass., on 22nd August 1834. After acting for a short time as assistant in Harvard College Observatory, he was appointed assistant professor of mathematics in the U.S. Naval Academy in 1866, and in the following year became director of the Allegheny Observatory at Pittsburg, a position which he held until his selection in 1887 as secretary of the Smithsonian Institution at Washington. His name is especially associated with two main branches of investigation—aeronautics, and the exploration of the infra-red portions of the solar spectrum. The study of the latter he took up as a result of the publication in 1871 of Ladansky's energy-curve of the spectrum. The imperfections of the thermopile, with which he began his work, led him, about 1880, to the invention of the bolometer, an instrument of extraordinary delicacy, which in its most refined form is believed to be capable of detecting a change of temperature amounting to less than one-hundred-millionth of a degree centigrade. Depending on the fact that the electrical conductivity of a metallic conductor is decreased by heat, it consists of two strips of platinum, arranged so as to form the two arms of a Wheatstone bridge; one strip being exposed to a source of radiation from which the other is shielded, the heat causes a change in the resistance of one arm, the balance of the bridge is destroyed, and a deflection is marked on the galvanometer. The platinum strips are exceedingly minute, being in some cases only $\frac{1}{250}$ inch in width, and less than one-tenth of that amount in thickness. By the aid of this instrument, Langley, working on Mount Whitney, at an altitude of 12,000 feet above sea-level, had the good fortune in 1881 to discover an entirely unsuspected extension of the invisible infra-red rays, which he called the "new spectrum." The importance of his achievement may be judged from the fact that, while the visible spectrum includes rays having wave-lengths of from about 0·4 μ to 0·76 μ, and no invisible heat-rays were known before 1881 having a wave-length greater than 1·8 μ, he has detected rays having a wave-length of 5·3 μ. But, in addition, taking advantage of the accuracy with which the bolometer can determine the position of a source of heat by which it is affected, he has mapped out in this infra-red spectrum over 700 dark lines or bands resembling the Fraunhofer lines of the visible spectrum, with a probable accuracy equal to that of refined astronomical observations. In aeronautics he has succeeded in demonstrating the practicability of mechanical flight. He first undertook a preliminary inquiry into the principles upon which flight depends, and for this purpose established at Allegheny a huge "whirling table," the revolving arm of which could be driven by a steam-engine at any circumferential speed up to 70 miles an hour. The actual construction of a flying machine was next attempted. The first difficulty was to make it sufficiently light in relation to the power its machinery could develop; and in the effort to do this several machines were built in which trials were made of steam, compressed air, and carbonic acid gas as motive agents. About 1893 a satisfactory machine was ready, and a new series of troubles had to be faced, for it had to be launched at a certain initial speed, and in the face of any wind that might be blowing. To enable these conditions to be fulfilled, as well as to ensure that the machine, when it fell, should fall on water, the experiments were carried out on the Potomac river, some 30 miles below Washington. It was not till the autumn of 1894 that, after many failures, an efficient launching apparatus was devised, and then the wings were found not to be strong enough to bear the pressures to which they were subjected. Various other delays and mishaps followed, but ultimately, on the 6th May 1896, a successful flight was made. On that day an aerodrome, weighing about 30 ℔ and about 16 feet in length, with wings measuring between 12 and 13 feet from tip to tip, twice sustained itself in the air for 1½ minutes (the full time for which it was supplied with fuel and water), and traversed on each occasion a distance of over half a mile, falling gently into the water when the engines stopped. Later in the same year, on 28th November, a similar aerodrome flew about three-quarters of a mile, attaining a speed of 30 miles an hour. It is understood that these experiments in artificial flight have since been continued in connexion with the United States War Department, but details have not been published.

Langreo, a township of northern Spain, in the province of Oviedo, situated in a very hilly region watered by the river Nalon, that produces large quantities of wheat, hemp, fruit, and cider. In the neighbourhood are coal and iron mines, foundries, and factories for the manufacture of coarse stuffs for local use. Population (1887), 14,015; (1897), 15,709.

Lanier, Sidney (1842–1881), American poet, was born at Macon, Georgia, on 3rd February 1842. He was of Huguenot descent on his father's side, and of Scottish and Virginian on his mother's. From childhood he was passionately fond of music, and could play on any instrument. His subsequent mastery of the flute helped to support him and greatly increased his reputation. At the age of fourteen he entered Oglethorpe College, where, after graduating with distinction, he held a tutorship until the Civil War began. He enlisted in the Confederate army in April 1861, serving first in Virginia, and finding opportunities to continue his studies. After the seven days' battles around Richmond, he was transferred to the signal service. About this time the first symptoms of consumption appeared. He subsequently served in a blockade-runner, but his vessel was captured, and he was confined for five months in a Federal prison, his flute proving the best of companions. Exchanged early in 1865, he started home on foot, arriving in a state of exhaustion that led to a severe illness. On recovering, he became a clerk in Montgomery, Alabama. In the spring of 1867 he visited New York in connexion with his novel *Tiger Lilies*—an immature work, dealing in part with his war experiences, and now difficult to obtain. Later in the same year he took charge of a country school in Alabama, and was married to Miss Mary Day of his native town. The next year he returned to Macon in low health, and began to study and practise law with his father, poetry and music cheering him in his struggles with disease. Late in 1872 he went to Texas for his health, but was forced to return. Then he determined to use his remaining strength in the service of the arts he loved, and went north, securing an engagement as first flute in the Peabody concerts at Baltimore (December 1873). His means were still narrow, and he was much away from his family, travelling for his health, but he found time to write a guide-book to Florida (1876), and tales for boys from Froissart, Malory, the Mabinogion, and Percy's *Reliques* (1878–82). He now made congenial friends, such as Bayard Taylor, his reputation gradually increased, and he was enabled to study music and literature, especially Anglo-Saxon poetry. In 1876 he wrote his ambitious cantata for the Centennial Exposition, and brought his family north. A small volume of verse appeared in the next year. Travel south was still necessary, but he preserved his courage, and wrote and lectured and played the flute. In 1879 he was made lecturer on English literature at Johns Hopkins University. His lectures became the basis of his *Science of English Verse* (1880)—his most important prose work, and an admirable discussion of the relations of music and poetry—and also of his *English Novel* (1883), which, devoted largely to George Eliot, is suggestive, but one-sided. Work had to be abandoned on account of growing feebleness, and in the spring of 1881 he was carried to Lynn, North Carolina, to try camp life, and died there on 7th September. Since his death his fame has grown steadily and greatly, an enlarged and final edition of his poems, prepared by his wife, his *Letters*, 1866–81 (1899), and several volumes of miscellaneous prose having assisted in keeping his name before the public. Among his more noteworthy poems are "Corn," "The Revenge of Hamish," "Song of the Chattahoochee," and "The Marshes of Glynn." By some his genius is regarded as musical rather than poetic, and his style is considered hectic; by others he is held to be one of the most original and most talented of modern American poets. He is considered the leading writer of the New South, the greatest Southern poet since Poe, and a man of heroic and exquisite character. (W. P. T.)

Lansing, a city of Michigan, U.S.A., capital of Ingham county and the capital of the state, on the Grand river at the mouth of the Cedar, at an altitude of 847 feet. It is on four railways, the Père Marquette, the Grand Trunk, the Lake Shore and Michigan Southern, and the Michigan Central. Besides the state capitol and other state buildings and institutions, the city contains the State Agricultural College, which had in 1899 a faculty of 43 and was attended by 528 students. It had property and endowments of over a million dollars. The manufactures consist in great part of agricultural tools and machines, waggons, carriages, and flour. Population (1890), 13,102; (1900), 16,485, of whom 2397 were foreign-born and 323 were negroes.

Lansingburg, a village of Rensselaer county, New York, U.S.A., on the east bank of the Hudson river, opposite the mouth of the Mohawk, on the Fitchburg railroad, at an altitude of 113 feet. Its site is level and its plan regular. It has considerable river traffic, and manufactures of clothing, collars, shirts, &c. Population (1890), 10,550; (1900), 12,595, of whom 2139 were foreign-born and 90 were negroes.

Lanza, Giovanni (1810–1882), Italian patriot and statesman, was born at Casale in February 1810. While medical student at Turin he founded the journal *L'Opinione*, to urge Charles Albert to grant reforms and make war upon Austria. In 1848 he offered himself as volunteer, but, upon being elected deputy, returned to Turin, where he became a determined opponent of the Government, accusing the Piedmontese generals of treason and protesting against the conclusion of peace with Austria. In 1854, however, he defended Cavour's Crimean policy, in 1855 was appointed Minister for Education, and in 1858, Finance Minister. After the peace of Villafranca he resigned office, but in 1860 accepted the presidency of the Chamber. Entering the La Marmora Cabinet of 1864, he found himself in disagreement with his colleagues on the ecclesiastical question, and resigned. Again elected President of the Chamber, he left that position in 1869 to combat the tobacco monopoly scheme proposed by the Menabrea Cabinet, and, though the scheme was adopted, Lanza's subsequent re-election to the presidency caused a cabinet crisis which was only solved by the formation of a ministry in which Lanza assumed the premiership. The Lanza Cabinet held office from 1869 to 1873, and succeeded in preventing a Franco-Italian alliance against Prussia, in accomplishing the unity of Italy by the occupation of Rome, in re-establishing sound finance, in passing the Law of Guarantees, and in extending to the city and province of Rome the Ecclesiastical Law of 1868. A man of unimpeachable integrity and sound judgment, and a prudent rather than a brilliant statesman, Lanza embodied many of the best qualities of the Piedmontese character. He died at Rome on 19th March 1882. (H. W. S.)

Lao, or Loas, the name given to a branch of the widespread Tai or Shân race, which is found over the whole of

Indo-China from 28° N. and the sources of the Irrawaddy, as far as Cambodia, and 7° N. in the Malay peninsula.

The various families of the Tai now met with, owing to the different circumstances which have attended their migrations, differ considerably in the degree of civilization to which they have attained. The Lao, who descended from the mountain districts of Yunnan, Sechuan, and Kweichau to the pleasant highland plains of Upper Indo-China, and drove the wilder Ka peoples whom they found in possession into the hills, mostly adopted Buddhism, and formed small settled communities or states in which laws were easy, taxes light, and a very fair degree of comfort was attained. The Lao Pong Dam, so called from their habit of tattooing the body from the waist to the knee, descended by Chieng Sen and Chieng Mai, and now form the western branch of the Lao family, inhabiting the Siamese Lao states of Chieng Mai Lakawn, 'Turn Pre, and Nan, and reaching as far south as 17° N. Various influences have contributed to making the Lao the pleasant, easy-going, idle fellow that he is. The result is that practically all the trade of these states is in the hands of Bangkok Chinese firms, of a certain number of European houses and others, while most of the manual labour connected with the teak industry is done by Ka Mus, who migrate in large numbers from the left bank of the Mekong.

The Lao Pong Kao, or eastern branch, appear to have migrated southwards by the more easterly route of the Nam-u and the Mekong valley. In contradistinction to the Lao Pong Dam, who have derived their written language from the Burmese character, the eastern race has retained what appears to be the early form of the present Siamese writing, from which it differs but little. They formed important settlements at various points on the Mekong, notably Luang Prabang, Wieng Chan, Ubon, and Bassac; and, heading inland as far as Korat on the one side and the Annamite watershed in the east, they drove out the less civilized Ka peoples, and even the Cambodians, as the Lao Pong Dam did on the west. Wieng Chan during the 18th century was the most powerful of the Lao principalities, and was feared and respected throughout Indo-China. It was destroyed by the Siamese in 1828. The inhabitants, in accordance with the Indo-Chinese custom of the day, were transported to Lower Siam. The Lao Pong Kao below 18° N. are a less merry and less vivacious people, and are for the most part shorter and more thick-set than those of Luang Prabang and the north. If possible, they are as a race lazier than the western Lao, as they are certainly more musical. The "khen," or mouth organ, which is universal among them, is the sweetest-toned of Eastern instruments.

Closely allied with the Lao are a number of tribes who are found throughout the hill regions of the Upper Mekong, between Yunnan and Kwangsi in China and the upper waters of the Menam in Siam. They have all within recent times been partakers in the general movement which has been going on towards the south-west from the highland districts of southern China, which has produced so many recruits for the peopling of the Indo-Chinese peninsula. Of this group of people, among whom may be named the Yao, Yao Yin, Lanten, Meo, Musur (or Muhso), and Kaw, perhaps the best known and most like the Lao are the Lu—both names meaning originally "man"—who have in many cases adopted a form of Buddhism (flavoured strongly by their natural respect for local spirits as well as tattooing) and other relatively civilized customs, and have forsaken their wandering life among the hills for a more settled village existence. Hardy, simple, and industrious, fond of music, kind-hearted, and with a strangely artistic taste in dress, these people possess in a wonderful degree the secret of cheerful contentment.

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Laoag, the capital of the province of North Ilocos, Luzon, Philippine Islands, on the banks of the Laoag river, some three miles from the Pacific coast. It is noted for its fine climate, the name "Laoag" signifying "clear." It is an important centre for the shipment of agricultural products, among which may be mentioned rice, Indian corn, tobacco, and sugar. Cotton is grown in the vicinity, and is woven by the women into fabrics, which find a ready sale among the pagan tribes of the mountains. The language is Ilocano. Population, 37,000.

Laon, chief town of the department of Aisne, 87 miles north-east of Paris, on the railway from Paris to Belgium. It is a first-class military post, and, according to M. Ténot, "the strategic key of the whole region comprised between the Aisne and the northern frontier." Since the war of 1870–71 the citadel has been reorganized and two batteries have been erected, one at each of the other angles of the rock on which Laon stands. At distances varying from $3\frac{1}{2}$ to 5 miles from the town are other defences. The Porte des Chenizelles, one of the 13th-century gateways of the town, was restored in 1895. Population (1881), 9662; (1891), 9555; (1901), 15,434.

La Paz, a department of Bolivia, bounded on the N. by the Bolivian territories of Madre de Dios and Beni, on the S. by the departments of Oruro and Cochabamba, on the E. by Cochabamba and Beni, and on the W. by Peru. Its area is 171,130 square miles, and in 1893 it had a population of 593,779. The capital, LA PAZ, which is also the capital of the republic and the largest city in it, had a population of 62,320. The department is divided into nine provinces. It has 83 schools, attended by about 5000 pupils.

Lapland, although no longer a geographical term, is conveniently retained as an ethnographical conception to indicate the region inhabited by the Lapps; that is, in Norway, the county of Finmarken,[1] and the higher inland parts of counties Tromsö and Nordland; in Sweden, the inland and northern parts of the division of Norrland, sometimes known as Lappmark, and divided into five districts—Torne Lappmark, Lulę Lappmark, Pite Lappmark, Lycksele Lappmark, and Åsele Lappmark; and in Russia, the northern part of the Finnish county of Uleåborg, and the western part of the Russian government of Archangel as far as the White Sea. In Norway the total number of Lapps was 20,786 in 1891, and in Sweden in 1895 it was officially estimated that there were 4736. Add to these some 3000 for Russian Lapland, and the total Lapp population of northern Europe approximates to 30,000. In Sweden the Lapps are gradually abandoning their nomadic habits and becoming merged in the Swedish population. The view that the Lapps at one time occupied the whole of the Scandinavian peninsula, and have during the course of centuries been driven back by the Aryan Swedes and Norwegians, is disproved by the recent investigations of Yngvar Nielsen, K. B. Wiklund, and others. The fact is, the Lapps are increasing in numbers, as well as pushing their way farther and farther south. In the beginning of the 16th century their southern border line in Norway ran on the upper side of 64° N. In 1890 they forced their way to the head of the Hardanger Fjord in 60° N. In Sweden the presence of Lapps as far south as Jämtland (or Jemtland) is first mentioned in 1564. In 1881 they pushed on into the north of Dalecarlia, about 61° 45′ N. The majority of the Norwegian Lapps lead a semi-nomadic existence; but the number of inveterate nomads can scarcely reach 1500 at the present day. In Sweden there were about 3300 nomads in 1895.

Although the first attempt to convert the Lapps to Christianity seems to have been made in the 11th century, the worship of heathen idols was carried on openly in Swedish Lappmark as late as 1687, and secretly in Norway down to the first quarter of the 18th century, while the practices of heathen superstition survived on into the 19th century, if indeed they are extinct even yet. Lapp graves, prepared in the heathen manner, have been discovered in Upper Namdalen (Norway), belonging to the years 1820 and 1826. It may be interesting to mention that Lapps, armed with bows and arrows, were attached to certain regiments of Gustavus Adolphus in Germany during the Thirty Years' War. It was not until 1840 that the New Testament was translated into Norwegian Lappish, and not until the year 1895 that the entire Bible was printed in the same dialect. In the Russian dialect of Lappish there exist only a couple of versions of St Matthew's Gospel. Amongst the more recent works dealing with the Lapp language may be mentioned a dictionary (1887) by J. A. Friis; a reader, with German translations (1888), by J. Qvigstad; a dictionary (1890) and two grammars (1891 and 1897) of the Luleå dialect, and a chrestomathy of Norwegian Lappish (1894), by K. B. Wiklund; a dictionary of Russian Lappish, or the Kola dialect (1891), by A. Genetz; readers of different dialects (1885–96), by J. Halász; and a grammar of Norwegian Lappish (1882), by S. Nielsen; further, a comparative study of Lappish and Finnish, by Qvigstad in the *Acts of the Finnish Academy of Science*, vol. xii., 1883; the same author's *Nordische Lehnwörter im Lappischen* (1893); and Wiklund's *Entwurf einer urlappischen Lautlehre* (1896). The older literature on the Lapps has received a notable addition by the discovery in 1896, amongst the letters of Linnæus preserved in the British Museum, of a MS. diary of a journey made in 1695 to the north of Swedish Lappmark by Olof Rudbeck the younger.

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[1] The Norwegians call the Lapps Finns, and the Finns they call Kvæns or Qvæns, though the word "Lapper" (for Lapps) is coming into use.

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La Plata, a city of the Argentine Republic, capital of the province of Buenos Aires, 3 miles from the port of La Plata and about 35 miles south-east of the city of Buenos Aires by rail. In 1895 it had a population of 45,609, which was estimated to have increased in 1900 to 61,000. This large and handsome city was entirely the growth of the last twenty years of the 19th century, having been founded in 1882, two years after Buenos Aires, previously the capital of the province, had been formally declared the federal capital and a separate administrative unit. Laid out on the plan of Washington, the streets are wide and frequently broken by large squares. The principal public buildings are the government house, the provincial parliament, the town hall, the cathedral (in course of construction), the courts of justice, and the provincial museum. The museum, originally presented by Dr Moreno, has grown to be one of the most important in South America, its palæontological and anthropological collections being unique. There are also a university, a national college, a public library, an astronomical observatory, and numerous churches and theatres. Electricity is in general use for lighting, and tramways are laid down in the principal thoroughfares. A large public park is maintained. La Plata is a municipality, but the police are under the provincial government. The harbour of the port of La Plata, which has taken the place of the old port of Ensenada, has been artificially constructed, and is capable of accommodating the largest ship that can navigate the river Plate. Various canals, &c., give entrance to a large dock about 1450 yards long by 150 broad. The export of cattle and agricultural produce furnishes most of the trade. The port is the point of arrival of the Royal Mail and Messageries Maritimes steamers.

Laporte, a city of Indiana, U.S.A., capital of Laporte county, at an altitude of 810 feet. It has modern improvements, and some reputation as a summer resort. Three railways—the Chicago and West Michigan, the Lake Erie and Western, and the Lake Shore and Michigan Southern—pass through it. Population (1890), 7126; (1900), 7113, of whom 1403 were foreign-born and 59 were negroes.

Lappa, the name given to a station of the Chinese imperial Maritime Customs which collects duties on vessels trading between China and the colony of Macao. The arrangement is altogether abnormal, and was consented to by the Portuguese Government in 1887 to assist the Chinese authorities in the suppression of opium smuggling. A similar arrangement prevails at the British colony of Hong-Kong, where the Chinese customs station is termed Kowloon. In both cases the customs stations are on Chinese territory, just outside the colonial boundary, but in both their function is to levy duties on vessels entering and leaving the foreign port in lieu of levying them, as ought to be done, on entering or leaving a Chinese port. The value of the trade passing through the custom house in 1899 was H. taels 13,748,000 (£2,062,000).

Lappmark, the districts inhabited by the Lapps in Sweden. See LAPLAND.

Laprade, Pierre Marin Victor Richard de (1812–1883), known as VICTOR, French poet and critic, was born 15th January 1812, at Montbrison, in the department of the Loire. He came of a modest provincial family, and owed to the care of excellent parents a deep foundation of character and encouragement to enter upon a scholar's career. His life was singularly uneventful. After completing his studies at Lyons, he produced in 1839 a small volume of religious verse, *Les Parfums de Madeleine.* This was followed in 1840 by *La Colère de Jésus*, in 1841 by the religious fantasy of *Psyché*, and in 1844 by *Odes et Poèmes.* In 1845 Laprade visited Italy on a mission of literary research, and in 1847 he was appointed professor of French literature at Lyons. The French Academy, by a single vote, preferred Émile Augier at the election in 1857, but in the following year Laprade was chosen to fill the chair of Alfred de Musset. In 1861 he was removed from his post at Lyons owing to the publication of a political satire in verse (*Les Muses d'État*), and in 1871 took his seat in the National Assembly on the benches of the Right. He died 13th December 1883. A statue has been raised by his fellow-townsmen at Montbrison. Besides those named above, Laprade's poetical works include *Poèmes Evangéliques* (1852), *Idylles Héroiques* (1858), *Les Voix de Silence* (1864), *Pernette* (1868), *Poèmes Civiles* (1873), *Le Livre d'un Père* (1877), *Varia* and *Livre des Adieux* (1878–1879). In prose he published, in 1840, *Des Habitudes Intellectuelles de l'Avocat. Questions d'Art et de Morale* appeared in 1861, succeeded by *Le sentiment de la nature, avant le Christianisme* in 1866, and *chez les modernes* in 1868, *Education Libérale* in 1873. The material for these books had in some cases been printed earlier, after delivery as a lecture. He also contributed articles to the *Revue des Deux Mondes* and the *Revue de Paris.* There is no writer who represents more perfectly than Laprade the admirable genius of French provincial life, its homely simplicity, its culture, its piety, and its sober patriotism. As a poet he belongs to the school of Chateaubriand and Lamartine. Devoted to the best classical models, inspired by a sense of the ideal and by worship of nature as revealing the divine—gifted, too, with a full faculty of expression—he lacked only fire and passion in the equipment of a romantic poet. But the want of these, and the pressure of a certain chilly facility and of a too conscious philosophizing, have prevented him from reaching the first rank, or from even attaining the popularity due to his high place in the second. Only in his patriotic verse did he shake himself clear from these trammels. Speaking generally, he possessed some of the qualities, and many of the defects, of the English Lake School. Laprade's prose criticisms must be ranked high. Apart from his classical and metaphysical studies, he was widely read in the literatures of Europe, and built upon the groundwork of a naturally correct taste. His dislike of irony and scepticism probably led him to underrate the product of the 18th century, and there are signs of a too fastidious dread of Philistinism. But a constant love of the best, a joy in nature, and a lofty patriotism are not less evident than in his poetry. Few writers of any nation have fixed their minds so steadily on whatsoever things are pure, and lovely, and of good report. (c.)

Laraiche (*El Ardïsh*), a port at the mouth of the Kûs in northern Morocco, the nearest to Fez and Mequinez, adjoining the ruins of Shammîsh or Lixus. A small mercantile European colony, missions, and consular officers are situated here. Exports: 1896, £31,201; 1900, £47,033; average for 1896–1900, £49,760. Wool and bird-seeds are the largest items of export. Imports, chiefly cottons and sugar: 1896, £249,902; 1900, £114,693; average for 1896–1900, £187,630. Shipping: 1896, 63,646 tons; 1899, 78,765 tons. In 1895, with good crops, Laraiche imported £344,204 worth of foreign goods, the bulk of which were for Fez and Mequinez. Population, about 6500.

Laramie, a city of Wyoming, U.S.A., capital of Albany county, on the Laramie plains, on the east bank of the Laramie river, and on the Union Pacific railroad, at an altitude of 7153 feet. Its site is level, and the city is regular in plan. It is in a live-stock region, and has considerable trade in cattle. It contains the machine works of the Union Pacific railroad. The University of Wyoming, founded in 1887, is situated here. In 1899 it had a faculty of 14 and was attended by 142 students, nearly half of whom were women. The city was founded in 1868 and chartered in 1873. Population (1880), 2696; (1890), 6388; (1900), 8207, of whom 1280 were foreign-born and 90 were negroes.

Laredo, a coast town of Spain, in the province of Santander, 20 miles east by south of Santander. The mole and port are blocked by a sandbank, but the town began to recover during the last years of the 19th century from the decay into which it had fallen, and important works have been instituted with the object of restoring it to some of its past importance. There are old forts on the neighbouring heights. The town contains a fine parish church, several convents and chapels, and a large town hall. The principal local industries are connected with the fisheries and manufactures of rope, sails, casks, and tins for fish, great quantities of which are salted and exported. Population (1897), 5073.

Laredo, a city of Texas, U.S.A., capital of Webb county, on the east bank of the Rio Grande, opposite Nuevo Laredo, Mexico, with which it is connected by two bridges, at an altitude of 421 feet. It is on three railways—the International and Great Northern, the Mexico National, and the Rio Grande and Eagle Pass. It is essentially a railway town, with a large export and import trade with Mexico. Population (1880), 3521; (1890), 11,319; (1900), 13,429, of whom 6882 were foreign-born and 87 were negroes.

Largs, a police burgh on the coast of Ayrshire, Scotland, 43 miles west of Glasgow by rail. A good beach and a dry and bracing climate have attracted an exceptional number of wealthy residents. Skelmorlie Aisle, the remnant of an ancient parish church, was converted into a mausoleum in 1636. Near it a mound covers remains, possibly those of Norwegians slain in the famous battle of Largs (1263) between Alexander III. and Haco III. of Norway. The academy has been fitted up as a workmen's club and library; there are two convalescent homes. The harbour, affording 12 to 14 feet of water, is used mainly by Clyde passenger steamers and yachtsmen. A new parish church cost over £20,000, and a United Free church £30,000. Population (1881), 3079; (1901), 3243.

Larissa, a town in the province of Larissa, Thessaly, Greece, on the Peneios, about 35 miles north-west of Volo, with which it is connected by rail. Population (1889), 13,610; (1896), 15,373.

Larkhall, a mining and manufacturing town of Lanarkshire, Scotland, 14 miles south-east of Glasgow by rail. The highest bridge in Scotland has been thrown across the river Avon, which flows close by. Brick-making is carried on at several of the adjoining collieries. Other works are bleach works, a silk-weaving factory, fire-clay and enamelling works, and a sanitary appliances factory. The town has a public hall and baths. Population (1881), 6503; (1901), 12,034.

Larkhana, a town of British India, in the Shikarpur district of Sind, Bombay; on a canal not far from the right bank of the Indus; a station on the North-Western railway, 281 miles north of Karachi. A centre of trade, with manufactures of cotton, silk, leather, metalware, and paper. Population (1881), 13,188; (1891), 12,010.

Larnaca (LARNICA OR LARNECA; in Turkish *Tuzla*), a town of the island of Cyprus, situated at the head of a bay on the south coast, 23 miles south-south-east from Nicosia. It is the principal port of the island, exporting barley, wheat, cotton, raisins, oranges, lemons, and gypsum. There is an iron pier, 450 feet long, but vessels anchor in the bay, in from 16 to 70 feet of water. It occupies the site of the ancient *Citium*, but the citadel of the ancient city was used to fill up the ancient harbour in 1879. Mycenæan tombs and other antiquities have been found in the vicinity. Population (1901), 7964.

Lasalle, a city of Lasalle county, Illinois, U.S.A., on the north bank of the Illinois river, at an altitude of 461 feet. It is built on the face of steep banks, yet with a regular plan. It has three railways—the Chicago, Burlington, and Quincy, the Chicago, Rock Island, and Pacific, and the Illinois Central. It is in a region of mines of bituminous coal, of which it ships large quantities. It has also zinc smelting works and other manufactures. Population (1890), 9855; (1900), 10,446, of whom 3471 were foreign-born.

Lasker, Eduard (1829–1884), German publicist, was born on 14th October 1829, at Jaroczin, a village in the province of Posen, being the son of a Jewish tradesman. He attended the gymnasium, and afterwards the University of Breslau. In 1848, after the outbreak of the Revolution, he went to Vienna and entered the Students' Legion which took so prominent a part in the disturbances; he fought against the Imperial troops during the siege of the city in October, but was fortunate enough to be able to return to his home. He then continued his legal studies at Breslau and Berlin, and after a visit of three years to England, then the model state for German Liberals, entered the Prussian judicial service. He was occupied in various posts, chiefly in the Berlin city courts, but he never advanced far in his official career. In 1870 he left the Government service, and in 1873 was appointed to an administrative post in the service of the corporation of Berlin. He had been brought to the notice of the political world by some articles he wrote in 1861 to 1864, which were afterwards published under the title *Zur Verfassungsgeschichte Preussens*, and in 1865 he was elected member for one of the divisions of Berlin in the Prussian Parliament. He joined the Radical or *Fortschritt* party, and in 1867 was also elected to the German Parliament, but he joined in forming the National Liberal party, and in consequence lost his seat in Berlin, which remained faithful to the Radicals; after this he represented Magdeburg and Frankfort-on-Main in the Prussian, and Meiningen in the German, Parliament. He threw himself with great energy into his parliamentary duties, and quickly became one of the most popular and most influential members. An optimist and idealist, he joined to a fervent belief in liberty an equal enthusiasm for German unity and the idea of the German state. His motion that Baden should be included in the North German Confederation in January 1870 caused much embarrassment to Bismarck, but was not without effect in hastening the crisis of 1870. His great work, however, was the share he took in the judicial reform which was the great achievement of the parliament during the ten years 1867–77. To him more than to any other single individual is due the great codification of the law. He threw himself into this work with remarkable industry, and while he again and again was able to compel the Government to withdraw or amend proposals which seemed dangerous to liberty, he opposed those Liberals who, unable to obtain all the concessions they called for, refused to vote for the new laws as a whole. A speech made by Lasker on 7th February 1873, in which he attacked the management of the Pomeranian railway, caused a great sensation, and his exposure of the financial mismanagement brought about the fall of Wagener, one of Bismarck's most trusted assistants. By this action he caused, however, some embarrassment to his party. This is generally regarded as the beginning of the reaction against economic Liberalism by which he and his party were to be deprived of their influence. He refused to follow Bismarck in his financial and economic policy after 1878; always unsympathetic to the Chancellor, he was now selected for his most bitter attacks. Between the Radicals and Socialists on the one side and the Government on the other, like many of his friends, he was unable to maintain himself. In 1880 he lost his seat in the Prussian Parliament; he joined the *Secession*, but was ill at ease in his new position. Broken in health and spirits by the incessant labours of the time when he did "half the work of the Reichstag," he went in 1883 for a tour in America, and died in that country on the 5th of January 1884. He was unmarried.

Lasker's death was the occasion of a curious episode, which caused much discussion at the time. The American House of Representatives adopted a motion of regret, and added to it these words:—"That his loss is not alone to be mourned by the people of his native land, where his firm and constant exposition of, and devotion to, free and liberal ideas have materially advanced the social, political, and economic conditions of these people, but by the lovers of liberty throughout the world." This motion was sent through the American envoy at Berlin to the German Foreign Office, with a request that it might be communicated to the President of the Reichstag. It was to ask Bismarck officially to communicate a resolution in which a foreign parliament expressed an opinion in German affairs exactly opposed to that which the Emperor at his advice had always followed. Bismarck therefore refused to communicate the resolution, and returned it to the German envoy at Washington. He was much attacked for this; but the difficulty would have been avoided had the resolution been so framed as not to express an opinion on the merits of Lasker's opinions, which at that time were a matter of keen controversy, or had it been communicated directly to the President of the Reichstag, and not by the means of diplomatic agents, who are the agents of communication not between parliament and parliament, but between government and government. (J. W. HE.)

Las Palmas, a town on the east coast of the island of Grand Canary, residence of the bishop of Canarias and of the military governor. It is a well-built town, with a modern theatre, athenæum club, several hospitals, good schools, and an institute. Las Palmas is a free port and harbour of refuge. Its trade is important, especially as a port of call and a coaling station, and the greater part is in British hands, though the Germans have been trying hard to get a footing since 1896. The coal trade is entirely in British hands; 213,000 tons were imported in 1898. The total value of imports in 1898 was £438,411, of which £223,127 came from England. The exports were chiefly bananas (£174,900 in 1900), tomatoes, potatoes, and oranges, the greater part for Liverpool and London. The port had a total shipping movement in 1898 of 1816 steamers, of which 1073 were British, 301 Spanish, 174 German, 122 Italian, 78 French, and 1015 sailing vessels, of which three were British and 993 Spanish. The harbour works of the port of LA LUZ have been much improved since 1883, the Santa Catalina mole has been pushed into deep water, and road communication has been extended to the north and centre of the island and to Las Palmas itself. There are engineering works and shipbuilding yards, and a slipway which will take vessels up to 800 tons. The harbour has an area of nearly 160 acres, with a depth varying from 35 to 60 feet. Population (1887), 21,018; (1897), 34,770.

Latacunga (LLATACUNGA, or, according to local usage, TACUNGA), chief town of the province of Leon, Ecuador, Central America, on a high plateau of the Andes, over 9000 feet above sea-level, near the confluence of the Alagues and the Cutuchi to form the Patate, an affluent of the Pastaza, 52 miles south of Quito, and about 25 south-east of the volcano of Cotopaxi. Founded in 1534, it was four times destroyed by earthquakes between 1698 and 1798. It is substantially built, chiefly of pumice stone. A large proportion of the inhabitants are Indians, and the trade is mainly local. Nitrate of potash is obtained from the volcanic deposits in the neighbourhood. In the vicinity are the ruins of a palace of the Incas. Population, 10,000.

Latakia, or LADIKIYEH, the chief town of a sanjak of the Beirút viláyet, situated on the Syrian coast, opposite the island of Cyprus. The population comprises 12,000 Moslems, 10,000 Christians (Syrians, Armenians, Maronites, Roman Catholics, and Protestants). The people are chiefly employed in tobacco cultivation, silk culture, and the sponge fishery. In 1900 the exports amounted to £79,512, and the imports to £64,000.

Lauban, a town of Prussia, province of Silesia, 16 miles by rail east of Görlitz. It has potteries, tanneries, bleaching, oil mills, linen and cotton weaving and printing, and manufacture of machinery. There are monuments to the Emperor William I. (1895) and the war of 1870–71. Population (1885), 11,236; (1900), 13,792.

Lauenburg, a town of Prussia, province of Pomerania, 50 miles by rail north-west of Danzig. It has a deaf and dumb asylum, and a provincial lunatic asylum; and flax and woollen spinning, iron-works, and brick-works. Population (1885), 7214; (1900), 10,436.

Laun (Czech, *Louny*), the chief town of a government district in north-west Bohemia, Austria, on the right bank of the Eger. The boundary between the Czech and German districts lies between it and the neighbouring town of Postelberg to the west. It has machine and metal industries, sugar-refining, brewing, and corn-milling. Population (1890), 6346; (1900), 10,212.

Launceston (or DUNHEVED), a municipal borough and market town in the North-eastern or Launceston parliamentary division (since 1885) of Cornwall, England, on the Kensey, 13 miles by road and 19 miles by rail north-west by west of Tavistock. Recent structures are the town hall (1887), a temperance institute (1889), a Baptist chapel (1892), a Bible Christian chapel, water-works (1895), sewage disposal works (1898), and a public library (1899). There are tanneries and iron-foundries. Area, 2188 acres. Population (1881), 3808; (1891), 4345; (1901), 4053.

Launceston, the second city of Tasmania, on the river Tamar, in the county of Cornwall, about 40 miles from the north coast of the island by water. The river is navigable to the town for vessels of 4000 tons at full tide. There is a railway. The city is well laid out and has a good water-supply. The electric lighting has cost £90,000. The Albert Hall seats over 2000 people. The quantity of fruit grown in the district increases yearly. The scenery is very picturesque. The mean annual rainfall (3 years) is 31·97 inches. Population of city proper (1891), 17,208; (1901), 21,180.

La Union, a town of Spain, province of Murcia, 5 miles east of Cartagena and close to the Mediterranean. Population within municipal boundaries (1887), 20,966; (1897), 21,594, of whom a little more than half inhabit the place itself. The rest are scattered among thirty works or foundries, and mine iron, manganese, calamine, sulphur, and lead. It is quite a modern town, having sprung up in the second half of the 19th century. It has good modern municipal buildings, schools, hospital, town hall, large factories, regular streets, and a very animated aspect.

Laurier, Sir Wilfrid (1841——), British Colonial statesman, the first French-Canadian Premier of the Dominion, was born at St Lin, Quebec, 20th November 1841. He was educated at L'Assomption College, graduated in law at M'Gill University in 1864, and was admitted to the bar in the same year. His ability at once became manifest, and he rose rapidly in his profession. In 1871 he began his political career, when he was elected as a Liberal to the Quebec Provincial Assembly. His eloquence and grasp of public questions speedily gave him a conspicuous position. In 1874 he was elected to the Dominion Parliament, where by his high personal character and great oratorical gifts he soon became one of the leaders of the Liberal party. At one time he edited *Le Défricheur*. In 1877 Laurier was appointed Minister of Inland Revenue in the Mackenzie government, a position which he held until the resignation of the ministry in 1878. He was a consistent advocate of the policy of Free Trade, so far as the revenue requirements of the colony would allow. Although a Roman Catholic, his uncompromising resistance to the dictation of the Roman Catholic hierarchy on the Manitoba schools question demonstrated that he was independent of clerical influence in political affairs. On the retirement of Mr Blake from the leadership of the Liberal party in 1891, Laurier was chosen as his successor. When the Conservative Premier brought forward proposals for a reciprocity treaty with the United States, with certain restrictions, Laurier and the Liberals advocated unrestricted reciprocity. At the general election of 1896 Laurier's platform included fiscal reform in the direction of Free Trade, the extension of the franchise, the enlargement of the trade of Canada, and a policy of non-interference with provincial politics, especially with regard to Manitoba. The Liberals secured a striking victory—the numbers being, 118 Liberals, 86 Conservatives, and 8 Independents, who were general supporters of the Liberal party. Laurier became Prime Minister, and the session of 1897 was distinguished for its epoch-making financial measures, a preferential rate in the tariff being given to imports from the mother-country (see CANADA). The celebrations of 1897 in honour of Queen Victoria's Diamond Jubilee excited extraordinary enthusiasm throughout Canada. The colonial premiers visited London in order to attend the festivities, and on that occasion Laurier was appointed a privy councillor and created G.C.M.G. His personality at once made an impression in England. His facial resemblance to both Lord Beaconsfield and Sir John A. Macdonald, his vigorous patriotic speeches, in which, while acclaiming the Imperial tie with the mother country, he vindicated for Canada its title to be called a "nation," and his striking position as a colonial Liberal leader who was yet an Imperialist, made him everywhere a remarkable figure. When war broke out in South Africa in October 1899, the Laurier Cabinet at once decided to send a force of 1000 men to assist the Imperial Government. In March 1900 the Dominion Assembly, after an eloquent speech from Sir Wilfrid, approved the action of the Government. In November 1900 the general election took place throughout the Dominion, when a largely increased majority was returned for Laurier's Government. In the session of 1901 Sir Wilfrid Laurier introduced and carried a Bill decreeing that Queen Victoria's birthday should be made a perpetual holiday throughout the Dominion.

Laurium, a village in Houghton county, Michigan, U.S.A., formerly CALUMET. It is on the Upper Peninsula, in the copper region of Keweenaw Point. Population (1890), 1159; (1900), 5643, of whom 2286 were foreign-born.

Laurvik, or LARVIK, a seaport town of Norway, at the head of a bay on the south coast, 98 miles by rail south-south-west of Christiania. It has various industries, including saw and planing mills, shipbuilding, glass-works, and factories for wood-pulp, barrels, and potato flour; and an active trade in exporting timber, ice, wood-pulp, and granite, chiefly to Great Britain, and in importing from the same country coal and salt. The total trade amounts to about £330,000 annually. The port, which can receive the largest vessels, and has a depth of 18 to 24 feet beside the quays, is entered and cleared by close upon 100,000 tons annually. A much-frequented hydropathic was opened in 1880. Population (1891), 11,261; (1900), 10,664.

Lausanne, the capital of the canton of Vaud, in Switzerland, 38 miles by rail north-east of Geneva. It is 328 feet above the lake, or 1558½ feet above the level of the sea. The Grand Pont, 79 feet high and 590½ feet long, was widened in 1891. The academy was founded in 1537, immediately after the Bernese conquest of 1536, and in 1891 was raised to the rank of a university. In the winter of 1898–99 it was attended by 264 matriculated students. Gibbon's house, La Grotte, was only destroyed a few years ago. Population (1888), 33,340; (1900), 47,444. In 1888 the French-speaking inhabitants numbered 25,750; the German-speaking, 5704; the Italian-speaking, 852; other languages, 1034. In the same year the Protestants numbered 28,431; Roman Catholics, 4575; Jews, 184.

See vols. vi. and vii. (1846–47 and 1851) of the *Mémoires de la Société d'Histoire de la Suisse Romande*.—MEREDITH READ. *Historic Studies in Vaud, Berne, and Savoy*, 2 vols. London, 1897.—M. SCHMITT. *Mémoires Historiques sur le Diocese de Lausanne*, 2 vols. Fribourg, 1859.

Lavagna, a town of the province of Genoa, Liguria, Italy, 43 miles south-east of Genoa by rail, on the shore of the Mediterranean. The church of San Salvador has been proclaimed a national monument. Shipbuilding is carried on, slate and marble are quarried, and olive oil prepared. Population, about 7000.

Laval, chief town of the department of Mayenne, France, 187 miles west-south-west of Paris, on the railway from Paris to Brest. The chief industry is still nominally the same—the manufacture of *coutils* (tickings)—but "tickings" no longer adequately represents the character of the material produced. *Coutils* now include fabrics of different kinds, either wholly of linen or of cotton, or a mixture of both. The industry is carried on chiefly in large factories, of which there are several in the suburb of Avenières. Population (1881), 23,534; (1891), 24,495; (1901), 30,356.

Laveleye, Émile Louis Victor de (1822–1892), Belgian economist, was born at Bruges on 5th April 1822, and educated there and at the Collège Stanislas, Paris, a celebrated establishment in the hands of the Oratorians. Thence he returned to Belgium, and continued his studies at the Catholic University of Louvain and afterwards at Ghent, where he came under the influence of Huet, the philosopher and Christian Socialist. In 1844 he won a prize with an essay on the language and literature of Provence. In 1847 he published *L'Histoire des rois francs*, and in 1861 a French version of the *Nibelungen*, but though he never lost his interest in literature and history, his most important work was in the domain of economics. He was one of a group of young lawyers, doctors, and critics, all old pupils of Huet, who met once a week to discuss social and economic questions, and was thus led to publish his views on these subjects. In 1859 some articles published by Laveleye in the *Revue des Deux Mondes* laid the foundation of his reputation as an economist. In 1864 he was elected to the chair of political economy at the State University of Liège. Here he wrote his most important works: *La Russie et l'Autriche depuis Sadowa* (1870), *Essai sur les formes de gouvernement dans les sociétés modernes* (1872), *Des causes actuelles de guerre en Europe et de l'arbitrage*, and *De la propriété et de ses formes primitives* (1874), dedicated to the memory of John Stuart Mill and François Huet. He died at Doyon, near Liège, on 3rd January 1892. De Laveleye's name is particularly connected with bimetallism and primitive property, and he took a special interest in the revival and preservation of small nationalities. But these subjects by no means exhausted the range of his activity, which included the whole realm of political science, political economy, monetary questions, international law, foreign and Belgian politics, questions of education, religion, and morality, travel and literature. He had the art of popularizing even the most technical subjects, owing to the clearness of his view and his firm grasp of the matter in hand. He was a frequent contributor to the *Revue des Deux Mondes*, *Revue de Belgique*, the *Nineteenth Century*, the *Fortnightly*, and the *Contemporary* reviews. He was especially attracted by England, where he thought he saw realized many of his ideals of social, political, and religious progress. The most widely circulated of Laveleye's works was a pamphlet on *Le parti clérical en Belgique*, of which 2,000,000 copies were circulated in ten languages.

Lavigerie, Charles Martial Allemand (1825–1892), cardinal archbishop of Carthage and Algiers and primate of Africa, was born at Bayonne, 31st October 1825. The son of a custom-house officer, he chose an ecclesiastical career, and came to St Sulpice, Paris, in 1840. He was ordained priest in 1849, and was professor of ecclesiastical history at the Sorbonne from 1854 to 1856. His superiors, however, soon discovered that he was an administrator as well as a scholar, and at the end of 1856 he accepted the direction of the schools of the East. He started shortly afterwards for Syria, and was thus for the first time brought into contact with the Mahommedan world. "C'est là," he wrote, "que j'ai connu enfin ma vocation." Activity in directing missionary work, and especially in alleviating the distresses of the victims of the Druses, soon brought him prominently into notice; he was made a chevalier of the Legion of Honour, and in October 1861, shortly after his return to Europe, was appointed French auditor at Rome. Two years later he was raised to the see of Nancy, where he remained for four years, during which the diocese became one of the best organized and best administered in France. While bishop of Nancy he met Marshal MacMahon, then governor-general of Algeria, who in 1866, when the see of Algiers fell vacant, offered him the succession. It had already been raised to an archbishopric in July 1866, the transformation was authorized in August 1867, and Lavigerie landed in Africa on the 11th May following. The famine which was to decimate the native population was already making itself felt, and the archbishop began in November to collect the orphans into villages. This action, however, did not meet with the approval of MacMahon, who feared that the Arabs would resent the cessation of the religious peace, and thought that the Mahommedan Church, being a state institution in Algeria, ought to be protected from proselytism; so it was intimated to the prelate that his sole duty was to minister to the colonists. Lavigerie, however, continued his self-imposed task, refused the primacy of Lyons, which was offered to him by the emperor, and won his point. Contact with the natives during the famine caused Lavigerie to entertain exaggerated hopes for their general conversion, and his enthusiasm was such that he offered to resign his archbishopric in order to devote himself entirely to the missions. Pius IX. refused this, but granted him a coadjutor, and placed the whole of equatorial Africa under his missions. In 1870 Lavigerie warmly supported Papal infallibility. In 1871 he was twice a candidate for the National Assembly, but was defeated. In 1874 he founded the Sahara and Sudan Mission, and sent missionaries to Tunis, Tripoli, East Africa, and the Congo. The order of African missionaries thus founded, for which Lavigerie himself drew up the rule, has since become famous as the "Pères Blancs." From 1881 to 1884 his activity in Tunisia so raised the prestige of France that it drew from Gambetta the celebrated declaration, "L'Anticléricalisme n'est pas un article d'exportation," and led to the exemption of Algeria from the application of the decrees concerning the religious orders. On 27th March 1882 the dignity of cardinal was conferred upon Lavigerie, but the great object of his ambition was to restore the see of St Cyprian; and in that also he was successful, for by a bull of 10th November 1884 the primacy of Carthage was re-erected, and Lavigerie received the pallium on the 25th of January following. The later years of his life were spent in ardent anti-slavery propaganda, and his eloquence moved large audiences in London, as well as in Paris, Brussels, and other parts of the Continent. He hoped, by organizing a fraternity of armed laymen as pioneers, to restore fertility to the Sahara; but this community did not succeed, and was dissolved before his death. In 1890 Lavigerie appeared in the new character of a politician, and arranged with Pope Leo XIII. to make an attempt to reconcile the Church with the Republic. He then invited the officers of the Mediterranean Squadron to lunch at Algiers, and, practically renouncing his monarchical sympathies, to which he clung as long as the comte de Chambord was alive, expressed his support of the Republic, and emphasized it by hiring a band to play the "Marseillaise." The further steps in this evolution emanated from the Pope, and Lavigerie, whose health now began to fail, receded comparatively into the background. He died at Algiers on the 26th November 1892, and by his death France lost one of her most popular prelates and the anti-slavery cause one of its most zealous champions. (G. F. B.)

Lavos, a town of Portugal, district Coimbra, 4 miles south of Figueira da Foz, and on the south side of the estuary of the Mondego. Here the greater part of the British forces landed in 1808. In 1900 it had a population of 7967.

LAW.

I. UNITED KINGDOM.

THE last thirty years of the reign of Queen Victoria were rich in legal changes affecting as well the political constitution of the government and the social rights and obligations of the citizens of the United Kingdom as the machinery for the administration of the law. It is with the latter class of reforms, so far as they relate to England, that this article will chiefly deal. By far the most important legal reform, as regards both the magnitude of the interests concerned and the character of the changes made, was that effected by the passing of the Judicature Act, 1873 (36 and 37 Vict. c. 66). Any person who desires to know in a general way the constitution, jurisdiction, and practice of the Courts of Common Law and Equity, at the commencement of Queen Victoria's reign, should read the brilliant essay of the late Lord Bowen in *The Reign of Queen Victoria*, published in the Jubilee year 1887. Two systems of jurisprudence were administered by the Common Law Courts and by the Court of Chancery, differing from each other in their rules and methods, and in some respects antagonistic and even contradictory. One person might be recognized as the owner of an estate in the Common Law Courts, and another in the Court of Chancery. Each system had been built up on its own lines by a succession of eminent judges, and was within its limits logical and complete. But the practice in each system was bound fast by subtle distinctions and useless technicalities, and preserved anomalies which, however interesting to the legal historian, were devoid of all meaning to the modern practitioner. The Court of Chancery was a byword for dilatory proceeding and magnitude of expense. The number of judges in that court was insufficient for the work, while in the arrangements of the Common Law Courts there was a waste of the highest judicial ability. Between the year 1837 and the year 1873 much was done by the Common Law Procedure Acts and the Chancery Amendment Acts to reform the more obvious defects in the practice of the courts; but until the passing of the Judicature Act, 1873, the Courts of Common Law and the Court of Chancery retained and exercised their separate jurisdiction. The Court of Chancery still restrained a successful litigant in the Queen's Bench from enforcing his judgment, and so late as the year 1874 (the year before the Judicature Act came into force) a man who had a perfectly good title to relief lost his case in the Court of Chancery because he asked for an injunction, and it was held that his right was to damages, which was cognizable only in a Court of Common Law. His bill was dismissed with costs in Chancery, and he subsequently brought an action-at-law and succeeded (compare *Aspden* v. *Seddon*, L.R., 10 Ch. 394 with *Aspden* v. *Seddon*, L.R., 1 Ex.D. 496). The Court of Chancery still continued to conduct its cases by means of bill and answer. Only those who had to prepare these answers to written interrogatories know the weariness of the task—usually without much effect on the result of the case. Except in rare instances, evidence was still taken on affidavits, subject only to cross-examination before an Examiner in Rolls Yard. There was an efficient court of appeal in Chancery, but a writ of error from a Common Law Court to the Exchequer Chamber lay only in certain cases, and outside these limits there was no appeal.

Judicature Acts.

The Judicature Act of 1873 was carried through Parliament by Lord Selborne, assisted by the Attorney-General and Solicitor-General (Sir J. D., afterwards Lord, Coleridge and Sir George Jessel), and with the support of Lord Cairns. It was originally intended to come into operation on 2nd November 1874, but this date was altered by an Amending Act to 2nd November 1875. Various Amending Acts were subsequently passed, the twelfth of these being in the year 1899. These Acts together form the constitutional charter of the superior courts of England, and with the rules which have been made under them, regulate their jurisdiction, procedure, and practice. By the Act of 1873 the Court of Chancery, the Court of Queen's Bench, the Court of Common Pleas, the Court of Exchequer, the High Court of Admiralty, the Court of Probate, and the Court of Divorce and Matrimonial Causes were consolidated into one Supreme[1] Court of Judicature (sec. 3), divided into two permanent divisions, called "the High Court," with (speaking broadly) original jurisdiction, and "the Court of Appeal" (sec. 4). The reader will at once realize the bold and revolutionary character of this enactment. By one section of an Act the august Queen's Bench, the Common Pleas, in which serjeants only had formerly the right of audience, and the Exchequer, which had its origin in the reign of Henry I., and all their jurisdiction, criminal, legal, and equitable, were vested in the new court. Law and equity can be administered by every branch of the court, and a suitor can no longer be bandied from one court to another, or lose his action merely because he has brought it in a wrong court or sought an inappropriate remedy. Nor can a suitor be deprived of a judgment which he has obtained at common law by an injunction in a court of equity, but every defence, whether legal or equitable, can be raised in the court in which the action is brought (sec. 24). For the more convenient despatch of business, however, certain classes of actions are assigned to particular divisions of the High Court (secs. 22 and 24), and there is a power to transfer causes from one division to another.

There were originally three Common Law Divisions of the High Court corresponding with the three former Courts of Common Law. But after the death of Lord Chief Baron Kelly on the 17th September 1880, and of Lord Chief Justice Cockburn on the 20th November in the same year, the Common Pleas and Exchequer Divisions were (by Order in Council, 10th December 1880) consolidated with the Queen's Bench Division into one division under the presidency of the Lord Chief Justice of England, to whom, by the 25th section of the Judicature Act, 1881 (44 and 45 Vict. c. 68), all the statutory jurisdiction of the Chief Baron and the Chief Justice of the Common Pleas was transferred. The High Court, therefore, now consists of the Chancery Division, the Common Law Division, under the name of the King's Bench Division, and the Probate, Divorce, and Admiralty Division. To the King's Bench Division is also attached, by order of the Lord Chancellor (1st January 1884), the business of the London Court of Bankruptcy.

The Chancery Division originally consisted of the Lord Chancellor as President and the Master of the Rolls, and the three Vice-Chancellors. The Master of the Rolls was also a member of the Court of Appeal, but Sir George

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[1] The comte de Franqueville in his interesting work, *Le Système Judiciaire de la Grande Bretagne*, criticizes the use of the word "supreme" as a designation of this court, inasmuch as its judgments are subject to appeal to the House of Lords, but in the Act of 1873 the appeal to the House of Lords was abolished. He is also severe on the illogical use of the words "division" and "court" in many different senses (vol. i. pp. 180–181).

Chancery Division.

Jessel, who held that office when the new system came into force, regularly sat as a Judge of First Instance until 1881 when, by the Act of that year (sec. 2) the Master of the Rolls became a member of the Court of Appeal only, and provision was made for the appointment of a judge to supply the vacancy thus occasioned (sec. 3). Sir James Bacon (b. 1798, d. 1895) was the last survivor of the Vice-Chancellors. He retained his seat on the Bench until the year 1886, when he retired after more than seventeen years' judicial service. For some reason the solicitors, when they had the choice, preferred to bring their actions in the Chancery Division. The practice introduced by the Judicature Act of trying actions with oral evidence instead of affidavits, and the comparative inexperience of the Chancery judges and counsel in that mode of trial, tended to lengthen the time required for the disposal of the business. Demand was consequently made for more judges in the Chancery Division. By an Act of 1877 (40 and 41 Vict. c. 9, secs. 2, 3) the appointment of an additional judge in that division was authorized, and Sir Edward Fry (afterwards better known as a Lord Justice) was appointed. In August 1899 the Crown consented to the appointment of a new judge of the High Court in the Chancery Division on an address from both Houses of Parliament, pursuant to the 87th section of the Appellate Jurisdiction Act, 1876 (39 and 40 Vict. c. 59), and in the following month of October Mr Justice Farwell was appointed. The Chancery Division, therefore, consisted in 1902 of the Lord Chancellor and six puisne judges. The latter are styled and addressed in the same manner as was customary in the old Common Law Courts.[1] Until lately there were only four judges of this division (being the successors of the Master of the Rolls and the three Vice-Chancellors) to whom chambers were attached. The fifth judge heard only causes with witnesses transferred to him from the overflowing of the lists of his four brethren. In each set of chambers there were three chief clerks, with a staff of assistant clerks under them. The chief clerks had no original jurisdiction, but heard applications only on behalf of the judge to whose chambers they belonged, and theoretically every suitor had the right to have his application heard by the judge himself in chambers. But the appointment of a sixth judge enabled the Lord Chancellor to carry out a reform recommended by a departmental committee, which reported in 1885. The great difficulty in the Chancery Division always was to secure the continuous hearing of actions with witnesses, as nearly one half of the judge's time was taken up with cases adjourned to him from chambers and other administrative business and non-witness actions and motions. The interruption of a witness action for two or three days, particularly in a country case, occasioned great expense, and had other inconveniences. It was a simple remedy to link the judges in pairs with one list of causes and one set of chambers assigned to each pair. This reform was effected by the alteration of a few words in certain rules of court. There were, therefore, in 1902 only three sets of chambers, each containing four chief clerks, or, as they are now styled, Masters of the Supreme Court, and one of the linked judges, by arrangement between themselves, continuously tries the witness actions in their common list, while the other attends in chambers and also hears the motions, petitions, adjourned summonses, and non-witness cases.

Although styled Masters, it does not appear that the chief clerks have any larger or different jurisdiction than they had before. They are still the representatives of and responsible to the judges to whom the chambers are attached. The judge may either hear an application in chambers or may direct any matter which he thinks of sufficient importance to be argued before him in court, or a party may move in court to discharge an order made in chambers with a view to an appeal, but this is not required if the judge certifies that the matter was sufficiently discussed before him in chambers.

Under the existing rules of court many orders can now be made on summons in chambers which used formerly to require a suit or petition in court (see Order LV. as to foreclosure, administration, payment out of money in court and generally). The judge is also enabled to decide any particular question arising in the administration of the estate of a deceased person or execution of the trusts of a settlement without directing administration of the whole estate or execution of the trusts generally by the court (Order LV. rule 10), and where an application for accounts is made by a dissatisfied beneficiary or creditor to order the accounts to be delivered out of court, and the application to stand over till it can be seen what questions (if any) arise upon the accounts requiring the intervention of the court (Order LV. 2, 10*a*). Delay and consequent worry and expense are thus saved to the parties, and, at the same time, a great deal of routine administration is got rid of and a larger portion of the judicial term can be devoted to hearing actions and deciding any question of importance in court. The work of the chambers staff of the judges has probably been increased; but, on the other hand, it has been lightened by the removal of the Winding-up business. The Chancery Division has also inherited from the Court of Chancery a staff of registrars and taxing masters.

King's Bench Division.

The King's Bench Division consists of the Lord Chief Justice and fourteen puisne judges. It exercises original jurisdiction and also appellate jurisdiction from the county courts and other inferior courts. By the Act of 1873 (sec. 45) this appellate jurisdiction is conferred upon the High Court generally, but in practice it is exercised by a Divisional Court of the King's Bench Division only. The determination of such appeals by the High Court is final, unless leave to appeal is given by the court which heard the appeal or by the Court of Appeal. There was an exception to this rule as regards certain orders of Quarter Sessions, the history of which involves some complication. But by sec. 1 (5) of the Act of 1894 the rule applies to all cases where there is a right of appeal to the High Court from any court or person. It may be here mentioned that if leave is given to appeal to the Court of Appeal there is a further appeal to the House of Lords, except in bankruptcy (47 Vict. c. 9, sec. 104 (*a*)), when the decision of the Court of Appeal on appeal from a divisional court sitting in appeal is made final and conclusive. It is suggested that under the new distribution of business in the Chancery Division, appeals from the county courts in equity and some other matters might advantageously go to two judges in that division.

There are masters in the King's Bench Division. Unlike the masters in the Chancery Division, they have original jurisdiction, and are not attached to any particular judge. They hear applications in chambers, act as taxing masters and occasionally as referees to conduct inquiries, take accounts, and assess damages. There is an appeal from the master to the judge in chambers. Formerly there was an appeal from the judge in chambers to a divisional court in every case and thence to the Court of Appeal, until the multiplication of appeals in small interlocutory matters became a scandal. Under the Act of 1894 (57 and 58 Vict. c. 16, sec. 1) there is no right of appeal to the Court of Appeal in any interlocutory matters (except those mentioned in subs. (*b*)) without the leave of the judge or of the Court of Appeal, and in matters of "practice and procedure" the appeal lies (with leave) directly to the Court of Appeal from the judge in chambers.

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[1] The comte de Franqueville comments on the misuse of the title "Lord" in addressing judges as another anomaly which only adds to the confusion, but perhaps unnecessarily. According to Foss (vol. viii. p. 200) it was only in the 18th century that the judges began to be addressed by the title of "Your Lordship." In the Year Books (he adds) they are constantly addressed by the title of "Sir." "Sir, vous voyez bien," etc.

Probate, Divorce, and Admiralty Division.

The Probate, Divorce, and Admiralty Division consists of the president and one puisne judge. To it are assigned all causes and matters over which the Court of Probate, or the Court for Divorce and Matrimonial Causes, or the High Court of Admiralty had exclusive jurisdiction before the Judicature Act. But any cause or matter assigned to this division may be heard at the request of the President of the High Court by any other judge of the High Court. The union of the admiralty with the probate and divorce business in one division is an interesting relic of the time when the jurisdiction in admiralty, probate, and matrimonial causes was confined to the "civilians" in Doctors' Commons.

There are two registrars of the probate and divorce side of the division. In contentious matters they perform similar duties to those performed by the masters in the King's Bench Division, and during the long vacation they exercise most of the powers of the judges as to matters heard upon motion (20 and 21 Vict. c. 77, sec. 44). In non-contentious matters they issue grants of probate in common form and letters of administration, and exercise a general control over the procedure in the district registries of the court. There are a registrar and an assistant-registrar on the admiralty side of the division. The office of the registrar is of some antiquity. They hear interlocutory applications in pending actions, and they tax costs. The more important part of their duties is to act as referees on references to them, "assisted by merchants," to assess damages in collision and salvage cases, and to take accounts on all matters within the admiralty jurisdiction of the court.

Court of Appeal.

The keystone of the structure is a strong Court of Appeal. Changes have from time to time been made in the constitution of this court.[1] As constituted in 1902, it consisted of *ex-officio* members and five ordinary members, who are styled Lords Justices of Appeal. The *ex-officio* members are the Lord Chancellor, every person who has held the office of Lord Chancellor, the Lord Chief Justice, the Master of the Rolls, and the President of the Probate, &c. Division. It usually sits in two divisions of three judges, under the presidency of the Master of the Rolls and the senior Lord Justice. The Lord Chancellor, when not engaged in the judicial business of the House of Lords, frequently sits in the court, and the other *ex-officio* judges also sit when their presence is required, owing to the absence of any of the Lords Justices from illness or public engagements. Lord Herschell, after he ceased to be Lord Chancellor, not unfrequently sat. All courts, however good, have a tendency to run in grooves, and it is eminently desirable to secure such variety in the composition and presidency of this court as will counteract that tendency, and command general confidence for their decisions. It was fortunate that the services were secured of such men (to speak only of those who have gone) as Lord Selborne, Lord Cairns, Sir George Jessel, Lord Justice James, Lord Justice Mellish, Lord Bramwell, Lord Esher, Lord Justice Cotton, and Lord Bowen in building up the new system.

The jurisdiction of the Court of Appeal extends to (1) appeals from decrees and orders of all the divisions of the High Court; (2) appeals from the Court of Chancery of the county palatine of Lancaster; (3) appeals from the Court of Chancery of the county palatine of Durham (52 and 53 Vict. c. 47, sec. 11); (4) appeals from the railway commissioners on questions of law (51 and 52 Vict. c. 25, secs. 17 and 55); (5) applications for a new trial or to set aside a verdict, finding, or judgment after trial by a jury (53 and 54 Vict. c. 44, sec. 1); (6) appeals from the Lord Chancellor or any other person having jurisdiction in lunacy; (7) appeals from orders of the Liverpool Court of Passage (*Anderson* v. *Dean*, 1894, 2 Q.B. 222); (8) appeals from error on the record from the Lord Mayor's Court (*Le Blanche* v. *Heaton Telegram Co.*, 1 Ex.D. 408); and (9) last but not least, appeals from a county court judge or arbitrator on a case stated under the Workmen's Compensation Act, 1897, 60 and 61 Vict. c. 27, Sched. 2 (4). By a letter of request of the Lord Chancellor, under sec. 51 of the Lunacy Act (53 and 54 Vict. c. 5) the Lords Justices are entrusted with the jurisdiction of the judge in lunacy, and act as additional judges of the Chancery Division for the purpose of making orders in Chancery as well as lunacy when necessary. Practically, therefore, the Court of Appeal exercises the entire lunacy jurisdiction. It has been doubted whether the reference to the "Court of Appeal" in Sched. 2 (4) of the Workmen's Compensation Act, 1897, was not a mistake, and it has been thought that what was intended was the court exercising appellate jurisdiction from county courts, viz., a divisional court of the King's Bench Division. But the construction of the Act is free from ambiguity, and numerous appeals have been entertained, with the result that there is a further appeal in England to the House of Lords, whereas neither in Scotland nor (it is believed) in Ireland is there any such appeal. This, however, was not the only anomaly or difficulty in this singularly ill drawn Act. The jurisdiction of the Court of Appeal is subject to the following exceptions:—(1) orders of the High Court in appeals from inferior courts, unless leave be obtained of the court by which the order is made, or of the Court of Appeal; (2) orders of the High Court in registration and election cases without the like leave; (3) orders made by consent of parties, or as to costs only which by law are left to the discretion of the court; (4) certain interlocutory orders mentioned in sec. 1 of the Act of 1894 (57 and 58 Vict. c. 16); (5) orders made in any criminal cause or matter, save for some error of law apparent on the record, as to which no question shall have been reserved for the Court for Crown Cases Reserved; (6) orders of the Admiralty Division in cases of prize, the appeal from which lies to His Majesty in Council. The right of appeal is also subject to this limitation, that it does not extend to matters which from their nature were not appealable to any court before the Judicature Act, or in which the Court of Appeal has no means of enforcing or executing its judgment, and therefore it was held in the House of Lords, overruling the Court of Appeal, that no appeal lies from the order of a judge discharging a prisoner under a writ of *habeas corpus* (*Cox* v. *Hakes*, 15 A.C. 506). "If," said Lord Herschell, "the contention of the respondent is to prevail, the statute has effected a grave constitutional change"; and later, "if" the High Court "has inherited the combined powers of the courts whose functions were transferred to it, but none of them had any jurisdiction or authority to review a discharge by a competent court under a writ of *habeas corpus*, or to enforce the arrest of one thus freed from custody . . . it seems to me to follow, that however wrong the Court of Appeal might think a discharge to have been, it would have been powerless to order a rearrest or at least to enforce such an order." The question whether an appeal would lie from order of the High Court refusing a writ of *habeas corpus* was left open.

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[1] 1875 (38 and 39 Vict. c. 77, sec. 4); 1881 (44 and 45 Vict. c. 68, secs. 2, 4); 1884 (47 and 48 Vict. c. 61, sec. 3); 1891 (54 and 55 Vict. c. 43, sec. 1).

"In the Court of Appeal," says the editor of the *Judicial Statistics* for 1899,[1] "there was a large increase of business during that year. The appeals entered rose from 767 to 826, and were 28·76 in excess of the average for 1894–98. The increase was chiefly in appeals under the Workmen's Compensation Act. Out of a total of 826 appeals entered those under this Act were 140, or 16·95 per cent. of the whole." The list of appeals at the commencement of each successive sittings during the years 1900–1901 showed a steady increase in the numbers waiting to be heard. It was not very clear how these arrears were to be overtaken. An addition to the number of ordinary members of the Court of Appeal would not achieve that end, unless arrangements could be made for the court to sit (temporarily at least) in three divisions; and it would not do to weaken the authority of the court. And while a special commission might be appointed, the difficulty was that the House of Lords and judicial committee could not spare any of their members.

The order of the Court of Appeal is final in appeals from the High Court in Bankruptcy, unless leave be given to appeal to the House of Lords (sec. 104 Bankruptcy Act, 1883) and in divorce appeals, except where the decision either is upon the grant or refusal of a decree for dissolution or nullity of marriage or for a declaration of legitimacy, or is upon any question of law on which the court gives leave to appeal (44 and 45 Vict. c. 68, sec. 9), but no further appeal to the House of Lords lies, even with leave of the Court of Appeal, on appeals from the High Court sitting as a court of appeal from county courts in bankruptcy. With these exceptions, there is now a right of appeal from every order of the Court of Appeal to the House of Lords. By sec. 20 of the Act of 1873, the appellate jurisdiction of the House of Lords (so far as it affects England) was abolished, but this section was repealed by the Act of 1876. Experience has probably convinced most persons of the wisdom of retaining a final court of appeal.

Practice and procedure.

The practice and procedure of the supreme court are regulated by rules made by a committee of judges, to which have been added the president of the Incorporated Law Society, and a practising barrister and one other person nominated by the Lord Chancellor. The rules in force in 1902 were those of 1883, with some subsequent amendments. With the appendices they filled a moderately-sized volume. Complaints are made that they are too voluminous and go into too much detail, and place a burden on the time and temper of the busy practitioner which he can ill afford to bear. In the opinion of the writer, the authors of the rules attempted too much, and it would have been better to provide a simpler and more elastic code of procedure. Rules have sometimes been made to meet individual cases of hardship, and rules of procedure have been piled up from time to time, sometimes embodying a new experiment, and not always consistent with former rules. It is, however, proverbially easy to criticize.

The most important matter dealt with by the rules is the mode of pleading. The authors of the Judicature Act had before them two systems of pleading, both of which were open to criticism. The common-law pleadings (it was said) did not state the facts on which the pleader relied, but only the legal aspect of the facts or the inferences from them, while the Chancery pleadings were lengthy, tedious, and to a large extent irrelevant and useless. There was some exaggeration in both statements. In pursuing the fusion of law and equity which was the dominant legal idea of law reformers of that period, the framers of the first set of rules devised a system which they thought would meet the defects of both systems, and be appropriate for both the common law and the Chancery divisions. In a normal case, the plaintiff delivered his statement of claim, in which he was to set forth concisely the facts on which he relied, and the relief which he asked. The defendant then delivered his statement of defence, in which he was to say whether he admitted or denied the plaintiff's facts (every averment not traversed being taken to be admitted), and any additional facts and legal defences on which he relied. The plaintiff might then reply, and the defendant rejoin, and so on until the pleaders had exhausted themselves. This system of pleading was not a bad one if accompanied by the right of either party to demur to his opponent's pleading, *i.e.*, to say, "admitting all your averments of fact to be true, you still have no cause of action," or "defence" (as the case may be). The writer, however, thinks that the authors of the new system were too intent on uniformity when they abolished the common-law pleading, which, shorn of its abuses (as it had been by the Common Law Procedure Acts), was an admirable instrument for defining the issue between the parties, though unsuited for the more complicated cases which are tried in Chancery, and he thinks it would have been better to try the new system in the first instance in the Chancery Division only. It should be added that the rules contain provisions for actions being tried without pleadings if the defendant does not require a statement of claim, and for the plaintiff in an action of debt obtaining immediate judgment unless the defendant gets leave to defend. In the Chancery Division there are of course no pleadings in those matters which by the rules can be disposed of by summons in chambers instead of by ordinary suit as formerly.

The judges seem to have been dissatisfied with the effect of their former rules, for in 1883 they issued a fresh set of consolidated rules, which, with subsequent amendments, were those in force in 1902. By these rules a further attempt was made to prune the exuberance of pleading. Concise forms of statement of claim and defence were given in the appendix for adoption by the pleader. It is true that these forms do not display a high standard of excellence in draftsmanship, and it was said that many of them were undoubtedly demurrable, but that was not of much importance. Demurrers were abolished, and instead thereof it was provided that any point of law raised by the pleadings should be disposed of at or after the trial, provided that by consent or order of the court the same might be set down and disposed of before the trial (Ord. xxv. 22. 1, 2). In the opinion of the writer, this was a disastrous change. The right of either party to challenge his opponent *in limine*, either where the question between them was purely one of law, or where even the view of the facts taken and alleged by his opponent did not constitute a cause of action or defence, was a most valuable one, and tended to the curtailment of both the delay and the expense of litigation. Any possibility of abuse by frivolous or technical demurrers (as undoubtedly was formerly the case) had been met by powers of amendment and the infliction of costs. Many of the most important questions of law had been decided on demurrer both in common law and Chancery.

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[1] *Judicial Statistics*, 1899, p. 20.

In the writer's experience it was a useful and satisfactory mode of trying questions in Chancery (on bill and demurrer), and was frequently adopted in preference to a special case, which requires the statement of facts to be agreed to by both parties and was consequently more difficult and expensive. It is obvious that a rule which makes the normal time for decision of questions at law the trial or subsequently, and a preliminary decision the exception, and such exception dependent on the consent of both parties or an order of the court, is a poor substitute for a demurrer as of right, and it has proved so in practice. The editors of the *Yearly Practice* (by Messrs Muir Mackenzie, Lushington, and Fox, 1901) say (p. 272), "Points of law raised by the pleadings are usually disposed of at the trial or on further consideration after the trial of the issues of fact," that is to say, after the delay, worry, and expense of a trial of disputed questions of fact which after all may turn out to be unnecessary. The abolition of demurrers has also (it is believed) had a prejudicial effect on the standard of legal accuracy and knowledge required in practitioners. Formerly the pleader pleaded with the fear of a demurrer before him. Nowadays he need not stop to think whether his cause of action or defence will hold water or not, and anything which is not obviously frivolous or vexatious will do by way of pleading for the purpose of the trial and for getting the opposite party into the box.

Another change was made by the rules of 1883, which was regarded by some common-law lawyers as revolutionary. Formerly every issue of fact in a common-law action, including the amount of damage, had to be decided by the verdict of a jury. "The effect of the rules of 1883," says Lord Lindley, who was a member of the Rule Committee, "was to make trial without a jury the normal mode of trial, except where trial without a jury is ordered under rules 6 or 7a, or may be had without an order under rule 2" (Timson and Wilson, 38 Ch.D. 72, at p. 76). The effect of the rules may be thus summarized. (1) In the Chancery Division no trial by jury unless ordered by the judge. (2) Generally the judge may order trial without a jury of any cause or issue, which before the Judicature Act might have been so tried without consent of parties, or which involves prolonged investigation of documents or accounts, or scientific or local investigation. (3) Either party has a right to a jury in actions of slander, libel, false imprisonment, malicious prosecution, seduction, or breach of promise of marriage, upon notice without order; (4) or in any other action, by order. (5) Subject as above, actions are to be tried without a jury unless the judge, of his own motion, otherwise orders.

Further steps have been taken with a view to simplification of procedure. By Order xxx. 21 (as amended in 1897), a summons, called a summons for directions, has to be taken out by a plaintiff immediately after the appearance of the defendant, and upon such summons an order is to be made respecting pleadings, and a number of interlocutory proceedings. To make such an order at that early stage would seem to demand a prescience and intelligent anticipation of future events which can hardly be expected of a master, or even a judge in chambers, except in simple cases, involving a single issue of law or fact which the parties are agreed in presenting to the court. The effect of the rule is that the plaintiff cannot deliver his statement of claim, or take any step in the action without the leave of the judge. The writer is informed that in Chancery cases the order usually made is that the plaintiff deliver his statement of claim, and the rest of the summons stand over, and the practical effect is merely to add a few pounds to the costs. It may be doubted whether, as applied to the majority of actions, the rule does not proceed on wrong lines, and whether it would not be better to leave the parties, who know the exigencies of their case better even than a judge in chambers, to proceed in their own way, subject to stringent provisions for immediate payment of the costs occasioned by unnecessary vexatious or dilatory proceedings. The order does not apply to Admiralty cases or to proceedings under the order next mentioned.

In Order xviii. *a* (made in November 1893), the Committee took a bolder flight. A plaintiff is thereby allowed to dispense with pleadings altogether, provided that the indorsement of his writ of summons contains a statement sufficient to give notice of his claim, or of the relief or remedy required in the action, and states that the plaintiff intends to proceed to trial without pleadings. The judge may, on the application of the defendant, order a statement of claim to be delivered or the action to proceed to trial without pleadings, and if necessary particulars of the claim or defence to be delivered. Out of this order grew what is called the Commercial Court. This is not a distinct court or division or branch of the High Court, and is not regulated by any special rules of court made by the Rule Committee. It originated in a notice issued by the Judges of the Queen's Bench Division, in February 1895 (see W.N., 2nd March 1895), the provisions contained in which represent only "a practice agreed on by the judges, who have the right to deal by convention among themselves with this mode of disposing of the business in their courts" (per Lord Esher in *Barry* v. *Peruvian Corporation*, 1896, 1 Q.B. p. 209). A separate list of causes of a commercial character is to be made and assigned to a particular judge, charged with commercial business, to whom all applications before the trial are to be made. The 8th paragraph is as follows:—

> (8) Such judge may at any time after appearance and without pleadings make such order as he thinks fit for the speedy determination, in accordance with existing rules, of the questions really in controversy between the parties.

Practitioners before Sir George Jessel, at the Rolls, in the years 1873 to 1880, will be reminded of his mode of ascertaining the point in controversy and bringing it to a speedy determination. Obviously the scheme is only applicable to cases in which there is some single issue of law or fact, or the case depends on the construction of some contract or other instrument or section of an Act of Parliament, and such issue or question is either agreed upon by the parties or at once ascertainable by the judge. The success of the scheme must also depend largely on the personal qualities of the judge to whom the list is assigned. Under the able guidance of Mr (afterwards Lord) Justice Mathew, the Commercial Court became very successful in bringing cases to a speedy and satisfactory determination without any technicality or unnecessary expense, and the business is increasing.[1] The question occurs why the same experiment should not be tried with actions of other descriptions. Why should not lists be assigned to other selected judges, who should deal with them in the same way as the judge to whom the commercial list is assigned deals with his actions? Such a practice might go far to meet the complaint frequently made, and not without some foundation, of the time expended in the trial of actions, when in the result the real question between the parties turns out to be one of law or an issue of fact, capable of more summary treatment. Complaint is also made by counsel and solicitors in the King's Bench Division, that they cannot ascertain in which court, or, even approximately, when their cases will come on for trial until the evening on which they are placed in the list for the following day. This would be met by assigning his own list to every judge appointed to try actions, as is in fact done in the Chancery Division. And why should not the system of "linked judges," adopted in the Chancery Division, be extended to the other division, and a list be assigned at the commencement of every sittings to each pair of judges, and even (if the suggestion does not shock susceptibilities) a master or masters be specially attached to each pair? One judge might then proceed continuously with the list whilst the other was engaged on circuit, or in chambers, or in a divisional court, or elsewhere.

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[1] *Judicial Statistics*, 1899, p. 21.

Circuits.

By sec. 23 of the Judicature Act, 1875, power is conferred on the Crown, by Order in Council, to make regulations respecting circuits, including the discontinuance of any circuit, and the formation of any new circuit, and the appointment of the place at which assizes are to be held on any circuit. Under this power an Order of Council, dated the 5th February 1876, was made, whereby the circuit system was remodelled. A new circuit, called the North-Eastern Circuit, was created, consisting of Newcastle and Durham taken out of the old Northern Circuit, and York and Leeds taken out of the Midland Circuit. Oakham, Leicester, and Northampton, which had belonged to the Norfolk Circuit, were added to the Midland. The Norfolk Circuit and the Home Circuit were abolished and a new South-Eastern Circuit was created, consisting of Huntingdon, Cambridge, Ipswich, Norwich, Chelmsford, Hertford, and Lewes, taken partly out of the old Norfolk Circuit and partly out of the Home Circuit. The counties of Kent and Surrey were left out of the circuit system, the assizes for these counties being held by the judges remaining in London. Subsequently Maidstone and Guildford were united under the revived name of the Home Circuit for the purpose of the summer and winter assizes, and the assizes in these towns were held by one of the judges of the Western Circuit, who, after disposing of the business there, rejoined his colleague in Exeter. In 1899 this arrangement was abolished, and Maidstone and Guildford were added to the South-Eastern Circuit. Other minor changes in the assize towns were made, which it is unnecessary to particularize. Birmingham first became a circuit town in the year 1884, and the work there became, by arrangement, the joint property of the Midland and Oxford Circuits. There are alternative assize towns in the following counties, viz.:—On the Western Circuit, Salisbury and Devizes for Wiltshire, and Wells and Taunton for Somerset; on the South-Eastern, Ipswich and Bury St Edmunds for Suffolk; on the North Wales Circuit, Welshpool and Newtown for Montgomery; and on the South Wales Circuit, Cardiff and Swansea for Glamorgan.

According to the arrangements in force in 1902 there were four assizes in each year. There were two principal assizes, viz., the winter assizes, beginning in January, and the summer assizes, beginning at the end of May. At these two assizes criminal and civil business was disposed of in all the circuits. There were two other assizes, viz., the autumn assizes and the Easter assizes. The autumn assizes were regulated by Acts of 1876 and 1877 (39 and 40 Vict. c. 57, and 40 and 41 Vict. c. 46) and Orders of Council made under the former Act. They were held for the whole of England and Wales, but for the purpose of these assizes the work was to a large extent "grouped," so that not every county had a separate assize. For example, on the South-Eastern Circuit Huntingdon was grouped with Cambridge; on the Midland, Rutland was grouped with Lincoln; on the Northern, Westmorland was grouped with Cumberland; and the North Wales and South Wales Circuits were united, and no assizes were held at some of the smaller towns. At these assizes criminal business only was taken, except at Manchester, Liverpool, Swansea, Birmingham and Leeds. The Easter assizes were held in April and May on two circuits only, viz., at Manchester and Liverpool on the Northern and at Leeds on the North-Eastern. Both civil and criminal business was taken at Manchester and Liverpool, but criminal business only at Leeds.

Other changes had been made, with a view to preventing the complete interruption of the London sittings in the Common Law Division by the absence of the judges on circuit. The assizes were so arranged as to commence on different dates in the various circuits. For example, the summer assizes began in the South-Eastern and Western Circuits on 29th May; in the Northern Circuit on 28th June; in the Midland and Oxford Circuits on 16th June; in the North-Eastern Circuit on 6th July; in the North Wales Circuit on 7th July; and in the South Wales Circuit on 11th July. Again, there had been a continuous development of what may be called the single-judge system. In the early days of the new order the members of the Court of Appeal and the judges of the Chancery Division shared the circuit work with the judges in the Common Law Division. This did not prove to be a satisfactory arrangement. The assize work was not familiar and was uncongenial to the Chancery judges, who had but little training or experience to fit them for it. Arrears increased in Chancery, and the Appeal Court was shorn of much of its strength for a considerable part of the year. The practice was discontinued in or about the year 1884. The Appeal and Chancery judges were relieved of the duty of going on circuit, and an arrangement was made by the Treasury for making an allowance for expenses of circuit to the Common Law judges, on whom the whole work of the assizes was thrown. In order to cope with the assize work, and at the same time keep the Common Law sittings going in London, an experiment, which had been previously tried by Lord Cairns and Lord Cross (then Home Secretary) and discontinued, was revived. Instead of two judges going together to each assize town, it was arranged that one judge should go by himself to certain selected places—practically, it may be said, to all except the more important provincial centres. The only places to which two judges went in 1902 were Exeter, Winchester, Bristol, Manchester, Liverpool, Nottingham, Stafford, Birmingham, Newcastle, Durham, York, Leeds, Chester, and Cardiff or Swansea.

It could scarcely be said that, even with the amendments introduced under Orders in Council, the circuit system was altogether satisfactory or that the last word had been pronounced on the subject. In the first report of the Judicature Commission, dated 25th March 1869, p. 17 (*Parl. Papers*, 1868–69), the majority report that "the necessity for holding assizes in every county without regard to the extent of the business to be transacted in such county leads, in our judgment, to a great waste of judicial strength and a great loss of time in going from one circuit town to another, and causes much unnecessary cost and inconvenience to those whose attendance is necessary or customary at the assizes." And in their second report, dated 3rd July 1872 (*Parl. Papers*, 1872, vol. xx.), they dwell upon the advisability of grouping or a discontinuance of holding assizes "in several counties, for example, Rutland and Westmorland, where it is manifestly an idle waste of time and money to have assizes." In the opinion of experienced persons, the defects thus pointed out have not been adequately remedied. It is thought that such towns as Oakham[1] and others might even cease to be assize towns; that the grouping of counties which has been effected for the autumn assizes might be carried still further and applied to all the assizes; and that the system of holding the assizes alternately in one of two towns within a county might be extended to two towns in adjoining counties, for example, Gloucester and Worcester. The facility of railway communication renders this reform comparatively easy, and reforms in this direction have been approved by the judges, but ancient custom and local patriotism, interests, or susceptibility bar the way. Nor can it be said that the single-judge system has been altogether a success. When there is only one judge for both civil and criminal work, he properly takes the criminal business first. He can fix only approximately the time when he can hope to be free for the civil business. If the calendar is exceptionally heavy or one or more of the criminal cases prove to be unexpectedly long (as may easily happen), the civil business necessarily gets squeezed into the short residue of the allotted time. Suitors and their solicitors and witnesses are kept waiting for days, and after all perhaps it proves to be impossible for the judge to take the case, and a "remanet" is the result. It is the opinion of persons of experience that the result has undoubtedly been to drive to London much of the civil business which properly belongs to the provinces, and ought to be tried there, and thus at once to increase the burden on the judges and jurymen in London, and to increase the costs of the trial of the actions sent there. Some persons advocate the continuous sittings of the High Court in certain centres, such as Manchester, Liverpool, Leeds, Newcastle, Birmingham, and Bristol, or (in fact) a decentralization of the judicial system. There is already an excellent court for Chancery cases for Lancashire in the County Palatine Court, presided over by the Vice-Chancellor, and with a local bar which has produced many men of great ability and even eminence. The Durham Chancery Court is also capable of development. Another suggestion has been made for continuous circuits throughout the legal year, so that a certain number of the judges, according to a rota, should be continuously in the provinces while the remaining judges did the London business. The value of this suggestion would depend on an estimate of the number of cases which might thus be tried in the country in relief of the London list. This estimate it would be difficult to make. Mr Justice Kennedy, to whom the writer is indebted for valuable assistance in this portion of the article, expresses the opinion that it is essential in any changes that may be made to retain the occasional administration by judges of the High Court of criminal jurisdiction, both in populous centres and in remote places. It promotes a belief in the importance and dignity of justice and the care to be given to all matters affecting a citizen's life, liberty, or character. It also does something, by the example set by judges in country districts, to check any tendency to undue severity of sentences in offences against property.

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[1] It appears from the *Judicial Statistics*, 1899 (pp. 21, 22), that no actions were entered or tried in that year at Brecon, Mold, Oakham and Welshpool, or Newtown, and in no less than sixteen towns five or fewer actions had been entered and tried during the preceding six years.

In connexion with the trial of actions, reference may be made to the Arbitration Act, 1889 (52 and 53 Vict. c. 49).

Arbitration.

This Act is both a consolidating Act and an amending Act, and is, in fact, a concise code of the law relating to the subject. By the common law, no agreement to refer between parties ousted the jurisdiction of the courts of the sovereign, or could be pleaded in bar of an action by one of the parties for the same matter, though where the right of action was only for a sum of money to be ascertained by arbitration, the award of the arbitrator was a condition precedent to the action, which could not therefore be maintained until the arbitrator had made his award (*Scott* v. *Avery*, 5 H.L. 811). But this general rule of law was modified by sec. 11 of the Common Law Procedure Act, 1854,[1] by which a party to a submission, and persons claiming through him, were enabled, if an action was brought by another party to the submission, to apply to the court to stay the proceedings, and the court was empowered (but not obliged) to make an order to that effect. The result was to enable the party sued to obtain, under certain conditions, specific performance of the agreement to refer. This provision is repeated with some variation of language in sec. 4 of the Arbitration Act. Again, by the common law either party might revoke the authority of a particular arbitrator at any time before the award. This was modified by legislation (9 and 10 Will. III. c. 15, and 3 and 4 Will. IV. c. 42), with the result that where the submission might be made a rule of court there was no power to revoke without the leave of the court. The Common Law Procedure Act, 1854, enabled any submission to be made a rule of court unless it was otherwise provided in the submission. By sec. 1 of the Arbitration Act a submission, unless a contrary intention appears therein, is made irrevocable except by leave of the court, and is declared to have the same effect in all respects as if it had been made an order of court. The effect of the latter words is that an award without the submission having been made a rule of court can be enforced as a judgment of the court, and thus to abolish the necessity in such a case of bringing a fresh action on the award, but by sec. 12 the leave of the court must be obtained. By sec. 14 (which is substituted for sec. 57 of the Judicature Act, 1873) the court is empowered in any civil proceeding, (*a*) by consent, (*b*) where a prolonged examination of documents or scientific or local investigation is required, (*c*) in matters of account, to refer the whole cause or matter or any question or issue of fact therein either to a special referee or arbitrator agreed upon by the parties or to an official referee or officer of the court. It will thus be seen that facilities have been afforded for giving effect to agreements by the parties referring their differences to arbitration and for compulsory arbitration, where matters can be more conveniently dealt with in that manner. On the other hand, assistance is given to arbitrators in the performance of their duties, and the parties are protected against the consequence of mistakes in law by arbitrators by sec. 7 (*b*), which enables arbitrators to state an award wholly or partly in the form of a special case for the opinion of the court, and sec. 19, which enables an arbitrator at any stage of the proceedings, and obliges him, if so directed by the court, to state in the form of a special case for the opinion of the court any question of law arising in the course of the reference. The arbitrator is not bound to state a case at the request of either of the parties, but his refusal to do so would lead to an application to the court for an order upon him, and, if not justifiable, might amount to misconduct on his part. Practically, therefore, any party to a reference may remove the decision of any real question of law from the arbitrator to the court. There is an appeal to the Court of Appeal, and thence to the House of Lords from the High Court on a case stated under sec. 7, but it has been held that there is no appeal on a case stated under sec. 19, because (it is said) the office of the court is consultative only, and what the court pronounces is an opinion and not an order. (In re *Knight*, 1892, 2 Q.B. 613. In re *Kirkleatham Board*, 1893, 1 Q.B. 375.)

Inquiry may now be made as to the results of the new procedure. The expected fusion of law and equity is not complete, because in the nature of things it cannot be so.

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[1] 17 and 18 Vict. c. 125.

Results of new procedure.

In English jurisprudence law and equity deal with different classes of subjects, and, to a large extent, proceed on different lines and by different methods. But equity, as well as law, is now cognizable in all the courts; procedure has been simplified, and technicalities have been reduced to even a dangerous minimum. The more important part of the work of the old courts in banc is now done by the Court of Appeal, but their shadow, under the name of a divisional court, still survives. The divisional court is an obsolete institution, and ought to be abolished, except as a court of appeal from inferior courts. The multiplication of appeals in the earlier stages of an action has been mitigated, and, with a better organization of the Common Law Courts and judicial staff, still further steps might be taken in reducing the expenses of the initial stages of actions. It is difficult to say whether either in the King's Bench or the Chancery Division the costs of trial have been reduced, because so many elements enter into the examination. In the latter case they have probably been increased, because trial by oral evidence takes longer and is more expensive than trial by affidavit evidence. Circumlocution and delay in Chancery (the favourite theme of the novelist and satirist) are things of the past, and the expenses of the administrative business of the division have certainly been reduced without any loss of efficiency. Actions come on for trial within a reasonable time after they are ready. During the six years 1894 to 1899[1] the business in the Chancery Division appeared to be nearly stationary, with a tendency to decrease in some heads. The number of actions heard in 1899 was 575, which is smaller than the number heard in 1898, but somewhat greater than the average of the previous four years. In the Queen's Bench Division there was for several years a regular and marked decrease of the business until the year 1897. In that year there were 69,050 writs and other originating proceedings and 2743 actions heard, while in the year 1898 there was a still further increase, the number of writs and other originating proceedings being 71,375, and 3266 actions were heard. On the other hand, in 1899 the figures were 68,464 writs and other originating proceedings and 2704 actions tried.[2] It should be added that the percentage of actions entered in the list for speedy trial of actions under Order XIV. showed a distinct increase of actions so tried, both actual and proportional.[3] The average time which elapsed between date of writ and trial of action was estimated to be 194·8 (say 195) days, or, if cases of an exceptional kind were eliminated, 125·7 days.

Royal Courts of Justice.

The outward and visible sign of the passing of the old order was given when the judges left their historical home in Westminster Hall for the new Palace of Justice in the Strand in the year 1882, and law and equity forgathered under one roof. Vast as it is, the new building is not adequate for the accommodation of all its inmates, and a judge in 1902 still sat in old Lincoln's Inn Hall. At the time of the opening of the new courts it was remarked that those who were responsible for their arrangement had apparently forgotten that the Court of Appeal sat in two divisions. There is a large hall which leads nowhere, and is as silent and deserted as Westminster Hall itself. The corridors are dark and narrow. The accommodation for counsel in the courts is confined and inconvenient, and the furniture is bare and mean. There is no room in which counsel can wait for their cases to be called on except the library, which is upstairs and unfitted for the purpose. The accommodation for the judges, on the other hand, is excellent.

Bankruptcy.

Bankruptcy proceedings were in 1902 regulated by the Bankruptcy Act, 1883 (46 and 47 Vict. c. 52), amended by an Act of 1890 (53 and 54 Vict. c. 71), and in minor details by other Acts. There has been a curious change of policy in this branch of legal administration. Under the Act of 1849 the bankrupt's property was administered by two assignees, one of whom, called the official assignee, was an officer of the court, and the other was chosen by the creditors. In 1869 this procedure was reversed, and under the Act of that year there was one trustee only chosen by the creditors, and facilities were given for administration of an insolvent's estate outside the court, under deeds of arrangement. The Act of 1883 reintroduced officialism. All bankruptcies were placed under the administration of the Board of Trade, and officers of this department (called official receivers) managed the estate until, and unless, another trustee was chosen by the creditors. Alterations were at the same time made in the procedure on a petition of bankruptcy against a debtor. Instead of an immediate adjudication the court made what was called a receiving order, the effect of which was to place the property under the care of an official receiver and to protect it against action by other creditors (sec. 9). A general meeting of the creditors was then held for the purpose of considering whether a proposal for a composition, if made by the debtor, or a scheme of arrangement should be entertained, or whether the debtor should be adjudged bankrupt, and generally as to the mode of dealing with the debtor's property (sec. 15), and a public examination of the debtor was held, at which any creditor might attend and question the debtor (sec. 17). If the creditors resolved on a bankruptcy or came to no decision, or if any composition which might be proposed was not accepted and approved by the court, an adjudication in bankruptcy ensued (sec. 20). The creditors, or the committee of inspection (where one was appointed), selected the trustee (sec. 21). Until one was appointed (sec. 54), and during any vacancy in the office (sec. 87 (4)) the official receiver acted as trustee. The punitive part of bankruptcy administration was strengthened. The court now had an absolute discretion to grant or refuse an order of discharge or suspend the operation of the order for a specified time, or to grant the order subject to any conditions as to the bankrupt's future earnings or after-acquired property, except that no order of discharge could be made where the bankrupt had been guilty of certain offences, which were made misdemeanours, and an absolute order might not be made where the bankrupt had been guilty of other offences enumerated in sec. 28 (3). The vesting of a discretion in the court as to the order of discharge was again a return to the principle of the Act of 1849. Under the Act of 1861, as subsequently amended in 1869, it was held that the court had no discretion, and that on complying with the prescribed conditions the bankrupt was entitled to his discharge unless he had been guilty of any of the offences mentioned in the Act (In re *Mew and Thorne*, 31 L.J. Bank. 87, and Ex parte *Hamilton*, 9 Ch.D. 694). Other novel features in the Act of 1883 were, the power of the court to order summary administration where the official receiver reported that the estate was not likely to exceed in value £300 (sec. 121); the power of a county court judge to make an immediate administration order where the debtor's whole indebtedness did not exceed £50 (sec. 122), and the jurisdiction given to the Bankruptcy Court to administer the estate of a deceased debtor according to the law of bankruptcy (sec. 125). Original jurisdiction in bankruptcy is exercised in the London district by a judge of the High Court assigned by the Lord Chancellor for that purpose, subject to an appeal to the Court of Appeal, but not to the House of Lords without leave of the latter court. The jurisdiction in the country districts is exercised by the County Courts whatever be the amount of the estate, subject to an appeal to a divisional court of the High Court, of which the judge to whom bankruptcy business is assigned shall be a member. There is no further appeal without leave of the Divisional court or the Court of Appeal, and (where leave is given) no further appeal to the House of Lords—see sec. 2 of the Bankruptcy Appeals County Courts Act, 1884 (47 Vict. c. 9), repealing sec. 104 (2) (A) of the Act of 1883, which provided for appeals from the County Courts in bankruptcy to the Court of Appeal directly. The Lord Chancellor may exclude any County Court from the exercise of bankruptcy jurisdiction.

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[1] *Judicial Statistics*, 1898, 1899.

[2] *Ibid.*, 1899, pp. 75, 76.

[3] *Ibid.*, 1898, 1899.

It is difficult to form any estimate as to the improvement in efficiency or costs effected by the Bankruptcy Act, 1883. As regards large estates, where it is worth while for the creditors to look after their own interests and the percentage of the costs on the value of the estate is less, probably there is no great change. Indeed, comparatively few of these estates ever come into bankruptcy. They are usually wound up under deeds of arrangement. The bulk of the bankruptcies are of small estates where the percentage of expenses of liquidation is large and dividends are infrequent. It is sometimes said that the tendency of the official receivers is to sacrifice the assets for the sake of an immediate return. This is perhaps inevitable, and it must be remembered that creditors are impatient and few estates will bear the expense of a prolonged bankruptcy or of "nursing" the assets. The report of the Inspector-General in Bankruptcy for the year ending 31st March 1900 contained some interesting statistics which illustrate the working of the Act. There were 720 effective receiving orders made in the High Court and 3363 in the County Courts, and 713 adjudications made in the High Court and 3332 in the County Courts. Summary administration under sec. 121 was ordered in 511 cases in the High Court and 2881 in the County Courts. No composition was approved by the court for a less sum than 7s. 6d. in the £. There were 3823 estates wound up by official receivers and closed during the year 1899. Of these in no less than 1734 the assets were under £25. The gross assets in these cases amounted to £18,915, the percentage of costs on gross assets was 96·35, and the total amount paid in dividends was £502 only, or, in other words, the estates were practically absorbed in costs. As the estates increase in value up to £2000 the percentage of costs decreases, being 17·38 only in estates between £1500 and £2000, and the proportionate amount paid in dividends increases. There were 16 estates between £1000 and £2000. The average percentage of costs in these was about 15·9. There were only four estates of £2000 and upwards, viz., one estate between £2000 and £3000, one between £4000 and £5000, one between £5000 and £6000, and one over £20,000. In the last-mentioned case the gross assets were £40,032, the percentage of costs was 4·51 only, and no less than £38,046 was paid in dividends. Table VII. contained an analysis of the results of administration of 738 estates wound up by non-official trustees during the same year, of which 158 were above £1000 in value as compared with cases in the previous table. The percentage of costs is generally higher, but the proportionate amount paid in dividends to the gross assets is larger, and it appears from a subsequent table that rather more than one-fifth were closed without dividend, whereas rather less than three-fifths were so closed in the estates wound up by official trustees. Roughly, therefore, the estates which paid no dividend under official administration were twice as many as those wound up by non-official trustees. These statistics show that in the larger estates, and in those which are expected to yield a dividend, the creditors prefer to have the estates wound up by trustees of their own selection, but the costs in that case are rather higher.

Consistently with its policy of officialism, the Act of 1883 contained no power for an insolvent debtor and the majority of his creditors to come to an arrangement between themselves binding on all the creditors outside the court. Conveyance by a debtor of his property in trust for his creditors does not therefore protect a debtor from bankruptcy, unless assented to by all his creditors, and is, moreover, itself an act of bankruptcy. Estates, however, continued to be wound up under deeds of arrangement, whether in the form of an assignment, or composition, or inspectorship deed. By the Deeds of Arrangement Act, 1887 (50 and 51 Vict. c. 57) every deed of arrangement is made void unless registered with the registrar of bills of sale within seven days of its first execution by the debtor or any creditor, but the Act gives no validity to any deed or instrument which by law is an act of bankruptcy or void or voidable. By a subsequent Act (53 and 54 Vict. c. 71, sec. 25) provision is made for a report to Parliament by the Board of Trade of proceedings under the above Act, and for return to the Board by the registrar of all deeds registered and by the trustee thereof of his receipts and payments. The Inspector-General in Bankruptcy in his Report for 1899, already quoted, criticized severely the administration of insolvent estates under deeds of arrangement, and pointed to instances of abuses and hardship to creditors. No doubt liquidation by private arrangement is exposed to many abuses and dangers from which official administration is comparatively free. But for all that, it seems that some persons among the commercial classes prefer private arrangements to bankruptcy proceedings. It appears from the Inspector-General's report that 3162 deeds were registered in the year 1899, of which 188 were cancelled by subsequent receivership orders, leaving 2974 estates to be wound up privately, of the total estimated value of £1,774,321. Final accounts were rendered during the year of the administration of 2338 estates under deeds of arrangement, in fifteen of which the gross assets were £6000 and upwards. The estates closed without payment of a dividend were 9·97, or, say, one-tenth, and in the majority of cases the dividends were between 2s. 6d. and 7s. 6d. in the £. The percentage of costs on gross assets is not appreciably higher (if at all) than in estates wound up either by official receivers or non-official trustees in bankruptcy. These statistics prove, not that liquidation by private arrangement is superior generally to that in bankruptcy, but that many people think that it is, and they prefer to have the best estates wound up in that manner.

Companies winding up.

By the Companies (Winding Up) Act, 1890 (53 and 54 Vict. c. 63), the winding up of companies also was placed under the administration of the Board of Trade and the official receivers. The aim of this Act was as far as possible to assimilate the procedure of winding up insolvent companies to that in bankruptcy. The analogy is of course imperfect, because there is no individual or personal insolvent debtor to be dealt with, and the attempt to impose some of the obligations and penal provisions of the Bankruptcy Act upon directors of insolvent companies is neither just in principle nor expedient in practice. For some few years after the passing of the Act, directors (whether alleged to have been guilty of fraud or not) were frequently called upon by the official receivers to submit themselves to the trying ordeal of a public examination under sec. 8, in which the official receiver, the liquidator (where the official receiver is not the liquidator), and any creditor or contributory of the company may take part either personally or by solicitor or counsel. But it was decided in the House of Lords (*ex parte* Barnes, 1896, A.C. 146) that an order could not be made for the public examination of any person against whom a *primâ facie* case of fraud had not been found by the report of the official receiver. The general effect of the Act is thus summed up by Mr Justice Buckley in his work on the Companies Act (7th ed. p. 671): "The first section and the whole Act which follows are addressed solely to administration. There is to be found in the Act no alteration of rights, but only an alteration of the courts and officers and mode of selection of officers who are to administer those rights, with detailed provisions as to financial control and subsidiary matters." The reader may be reminded that there were three modes of winding up provided by the Companies Act, 1862:—(1) Voluntary winding up by resolution of the members; (2) voluntary winding up under the supervision of the court; and (3) compulsory winding up by the court on the petition of a creditor or contributory in case of insolvency, and in certain other cases specified in sec. 79 of the Act of 1862. The effect of a supervision order is to leave the liquidators to exercise their powers without the sanction or intervention of the court in the same manner as if the company were being wound up altogether voluntarily, but to enable the court, when called upon, to exercise all the coercive jurisdiction which it might exercise if it were a winding up by the court (sec. 151 of the Act of 1862), and the order usually contains a power for creditors to apply to the court as well as the liquidator and contributories. The Act of 1890, speaking generally, deals only with winding up by the court, but some sections (notably sec. 10) apply to voluntary liquidations also. The winding up business is no longer the exclusive property of the Chancery Division, and one incidental benefit conferred by the Act is the relief thus afforded to the over-burdened chambers of that division. It was provided (sec. 1) that where the capital of the company paid up or credited as paid up exceeded £10,000, a petition for a winding up or supervision order should be presented to the High Court, with concurrent jurisdiction to the two Palatine courts of Lancaster and Durham as regards companies within their jurisdiction. When the capital did not exceed £10,000, and its registered office was within the jurisdiction of a County Court having jurisdiction, the petition was to be presented to that County Court. The County Courts having jurisdiction were those having jurisdiction in bankruptcy, with power to the Lord Chancellor to exclude any court from winding up jurisdiction. The jurisdiction of the High Court was exercised by a judge of the Chancery Division assigned by the Lord Chancellor, or by the judge exercising the bankruptcy jurisdiction of the court (sec. 2). In practice the winding up business has hitherto been assigned to the bankruptcy judge, who has been made a judge of the Chancery Division for that purpose. The official receiver is the provisional liquidator, and the definitive liquidator of the company, unless another person is appointed official liquidator by the court on the application of creditors or contributories (secs. 4–6). But whether the official receiver be appointed liquidator or not, he exercises a large control over the course of the winding up under secs. 7 and 8, which require a statement of affairs to be submitted to him, and require him to make certain reports to the court, including a report whether in his opinion any fraud has been committed by any person in the formation of the company, or by any director or other officer since its formation. Upon such last-mentioned report the court may order the public examination of the person whose conduct is impugned (see *ex parte* Barnes, referred to above). The Board of Trade also takes cognizance of the conduct of liquidators of companies which are being wound up by order of the court, and either *mero motu*, or on the application of any creditor or contributory, may inquire into his conduct and take action thereon (sec. 25). Secs. 15 and 20 contain what are perhaps the most useful provisions in the Act. By sec. 15 (which applies to voluntary liquidations as well as windings up by the court) every liquidator after the expiration of the first year is required at stated intervals (by the rules twice in every year) to send to the Registrar of Joint-Stock Companies a full statement and account with respect to the proceedings in and position of the liquidation, and monies in his hands representing assets unclaimed or undistributed for six months are required to be paid into the Bank of England. And sec. 20 provides for an audit by the Board of Trade twice a year of the accounts of every liquidator of a company which is being wound up by the court. This provision might with advantage have been applied with some modification to voluntary liquidations.

There is no doubt more notoriety about winding up proceedings under the new system of procedure. The Inspector-General in Bankruptcy makes his yearly report to Parliament on Companies in Liquidation. The provision for the rendering of accounts and audits of accounts are admirable as far as they go, and have done much to mitigate frequent abuses in the liquidation of companies. But in the actual administration of the estate and recovery of monies recoverable from promoters and officers of the company on the ground of fraud, breech of trust, or negligence, it may be doubted whether any great improvement or change can be discerned. Probably (as in bankruptcy) in the larger estates things remain pretty much as they were, but in the smaller estates, where there is very little for either creditors or contributories, the winding up is effected with greater despatch. In his report for the year ending 31st March 1901 the Inspector-General stated that there were during that year 1687 voluntary liquidations, of which 38 were subject to supervision and 117 compulsory liquidations by order of the court. Some of the voluntary liquidations (estimated by the Inspector-General in a previous report at one-fourth of the number) were for the purpose of reconstruction or amalgamation with other companies. On this basis the number of bankrupt companies for the year would be 1372. In the estates, the winding up of which was completed in the years 1898, 1899, and 1900, the percentage of costs on gross assets was decidedly least in the purely voluntary liquidations, and remarkably so in the larger estates, and less in the companies wound up under supervision than in the compulsory liquidations under order of the court, whether by the official receiver or by non-official liquidators, but the percentage in companies wound up by official receivers is less than in those wound up by non-official liquidators. It must, however, be remembered that in the voluntary liquidations some (say one-fourth) were formal liquidations for the purpose of reconstruction or amalgamation, and also that the amount of the costs depends very much upon the circumstances of the particular company and the amount of litigation involved, and where the percentage is based on an average of a few companies only, as in the larger estates, one unusually expensive liquidation unduly affects the result. Moreover, litigation is more likely to take place in windings up under the order of the court. The Inspector-General's Comparative Table II. (p. 74 of the Report) therefore does not afford much assistance in arriving at a comparative estimate of the expenses of the two modes of liquidation.

The Companies Act, 1862 (25 and 26 Vict. c. 89), has been in almost daily use, and under its provisions joint-stock enterprise in England has been developed to enormous dimensions. A committee appointed by the Board of Trade in 1895 stated in their Report[1] (p. vi.):—

Companies Acts.

> According to the recent report of the Board of Trade, there were in the United Kingdom, in April 1894, 18,361 companies with a paid-up capital of £1,035,029,835, whereas the capital of all companies in France, *anonymes* and *en commandite*, was, in December 1894, calculated approximately at £420,000,000. The capital of German companies was estimated by Mr Gerb of H.M. Consulate-General in Berlin at £200,000,000, but Mr Schuster puts it at £300,000,000. The capital embarked in English companies, therefore, exceeds that represented by French and German companies together by at least £315,000,000.

Notwithstanding a continuous criticism of the Act of 1862, comparatively few serious questions of construction have arisen, and judged by results the Act must be regarded as a great success. It was amended by the Act of 1867 (30 and 31 Vict. c. 131). This Act was chiefly concerned with the reduction of capital by order of the Court, but it contained two obscurely expressed sections, each of which has led to a vast amount of litigation, and in some cases oppression to individuals without any great advantage to anybody. The 25th section provided for every share being deemed to have been issued subject to the payment of the whole amount thereof in cash, unless otherwise determined by a contract in writing filed at or before the issue of the share. Under this section persons who had taken shares represented to be fully paid up in payment of a debt or purchase-money of property, have not only got nothing, but have had to pay large sums in addition. The other section is the 38th, which (to state the effect of it shortly) provided for the date and names of the parties to any contract entered into by the company, or the promoters, directors, or trustees thereof, being specified in a prospectus, and declared that any prospectus not specifying the same shall be deemed fraudulent on the part of the persons issuing the same. This section was full of difficulties of construction, and both sections were examples of well-intentioned but inconsiderate and, therefore, mischievous legislation. The Act of 1862 has been further amended or added to in some minor details, as well as by the Companies Winding Up Act, 1890. In the year 1900 the Companies Act of that year (63 and 64 Vict. c. 48) was passed. This Act was founded on a proposed Bill scheduled to the Report of the Committee of 1895 already referred to, and was designed to meet some of the more flagrant abuses which have been found to attend the formation and management of joint-stock companies. That such abuses too frequently exist there is no doubt, but unfortunately the dishonest cases are those which strike the public eye. The affairs of the vastly greater number of companies are stated in the Report of the Committee to be conducted with honesty and capacity. It is just at this point that the difficulty of legislation arises. For, while endeavouring to anticipate and counteract the devices of professional promoters and others, the legislator has to be on his guard against imposing such fetters and onerous obligations on directors as will deter men of character and substance from accepting the office. Again, an Act of Parliament cannot endow a rogue with honesty, or his dupe with sagacity, or the imprudent with wisdom. All it can do is to require such information and means of information to be given as will enable an intending subscriber to protect himself. At the same time the maxim *caveat emptor* has no application to the relation of such a person towards the persons who invite his subscription, for any adequate investigation into the statements of a prospectus is beyond the powers of many people, and could not practically be undertaken in the time allowed between the receipt of the prospectus and the closing of the subscription list. The obligations of a person who issues a prospectus ought not, therefore, to be limited to that which the law imposes on vendors and parties to an ordinary contract of making no misrepresentation. He should be placed in what is called a "fiduciary position" for this purpose towards those to whom the prospectus is addressed, and bear the duty of not only telling what he believes to be or has been informed is the truth, but also of doing his best to ascertain the truth and disclosing in good faith every fact within his knowledge which is material for the consideration of the investor. Some people have inferred from certain expressions of noble lords in *Central Railway Co. of Venezuela* v. *Kisch* (L.R. 2 H.L. 99) that this was in fact the law, but it has been decided in *Derry* v. *Peek* (14 A.C. 337) that directors who issue a prospectus can only be made personally liable for wilful misrepresentation in an action of deceit. The Directors' Liability Act (53 and 54 Vict. c. 64) went some way in the suggested direction. The Act of 1900 follows the plan of requiring certain specified particulars to be stated in the prospectus (sec. 10). The section is indeed comprehensive, and it is difficult to suggest anything which ought to be stated and is not included. It is, however, the opinion of some reformers that it would have been better policy and more scientific legislation to enact the broad principle, and leave the courts to work it out in detail.

There are, however, at least four valuable provisions in the Act of 1900. It requires a statement in every prospectus of the minimum subscription on which the directors will proceed to allotment, and in the absence of such statement forbids any allotment unless the whole capital offered is subscribed (secs. 4, 5). The absence of such a provision has been a most fruitful cause of disaster. A man who only intended to become a shareholder in a company with a capital of (say) £100,000, finds himself saddled with shares in a company which has failed to obtain subscriptions for one-tenth of that amount. An attempt is made (sec. 12) to give vitality to the first meeting of shareholders required to be held by sec. 29 of the Act of 1862. Certain information has to be given, and the shareholders have the opportunity of considering their position before they are finally embarked on the adventure. An attempt is also made (sec. 10 (1) (f) and (2)) to unmask the "nominal vendor" (who plays a large part in companies' promotion), and to discover the intermediate profits made between the real vendor and the purchasing company. By secs. 14 to 18 a register of securities is to be kept by the Registrar, subject to public inspection. Every charge created (1) as security for debentures, (2) on uncalled capital, (3) on "personal chattels" within the Bills of Sales Acts, and (4) a floating charge on the company's undertaking, is made void as against the liquidator and creditors unless registered within twenty-one days after execution. Finally, secs. 25 and 38 of the Companies Act, 1867, are repealed (schedule), and less objectionable modes provided for attaining the same result.

One novel feature is to be found in sec. 8 of the Act of 1890, whereby it is declared lawful to pay out of the company's funds either a commission on underwriting or a brokerage for placing shares, provided such payment is authorized by the articles of association and does not exceed the amount so authorized, and the payment is mentioned in the prospectus; otherwise such payments are prohibited. Mr Justice Buckley, in his book on the Companies Acts (7th ed. p. 610), considers that the legality of the payments of brokerage or commission for placing shares, after some conflicting opinions in the courts, was settled by the case of *Metropolitan Association* v. *Scrimgeour* (1895, 2 Q.B. 604). A distinction has been made between the payment of brokerage and that of an underwriting commission, but there does not appear to be any real difference in principle. Whether legal or not, such payments were so generally made, either directly out of the company's funds, or indirectly by adding the amount to the price paid to the vendor who made them, that it was no doubt considered better to legalize them under certain restrictions. But the bearing of this section on the issue of shares at a discount will have to be considered. Such issue has been decided by the House of Lords to be inconsistent with the provisions of the Companies Act, 1862, either as between the company and its creditors (*Ooregum Company* v. *Roper*, 1892, A.C. 125), or as between the company and its members (*Wilton* v. *Saffery*, 1897, A.C. 299, diss. Lord Herschell). But if the company may pay 1s. per share to A for inducing B to take a £1 share, there does not seem to be any sound reason why the company should not pay the same sum to A if he takes the share himself, and indeed the payment of a commission to an underwriter is, or may be, a direct payment or return to the shareholder himself off the nominal amount of his share. The issue of shares at a discount excites an unreasonable prejudice in some minds. It is allowed to companies incorporated under the Companies Clauses Acts on the issue of new shares (26 and 27 Vict. c. 118, as amended by 30 and 31 Vict. c. 127, ss. 27–29), and in other companies the prohibition may be evaded, or at least the same result attained, with the greatest ease. For example, on a new issue the shares may be £10 shares, with a 10 per cent. preference dividend, and the articles may provide that the shareholders shall receive £20 for each share on distribution of surplus assets in a winding up and have twice the voting power of other £10 shareholders. How does this differ in substance from the issue of a £20 share with a 5 per cent. preference dividend at a discount of 50 per cent.? In the opinion of the writer the issue of shares at a discount might safely be permitted in circumstances and under conditions similar to those prescribed for companies under the Companies Clauses Acts. Another anomaly of company law is illustrated by what are called "one-man companies." A man may turn a business, of which he is sole proprietor, into a limited company, with the assistance of six clerks or members of his family, to whom he gives one share a piece, taking the rest of the capital himself. He may thus carry on business with limited liability, defy the bankruptcy law, and even issue debentures to himself which will have priority over the trade creditors (*Salomon* v. *Salomon and Co.*, 1897, A.C. 22). The Act of 1862 (sec. 6) requires seven persons associated for a lawful purpose to form a company, and so much importance is attached to the number of seven, that the failure to maintain that number of shareholders is made a cause of winding up by the Court (sec. 79 (3)). It may be assumed that the creation of "one-man companies" was not contemplated by the framers of the Act of 1862, but no person has ever suggested a practical remedy (if one be desired) which would be consistent with the scheme of the Acts, and not do more harm than good. The point is not touched by the Act of 1900. That Act is not the last word on company reform, but it contains some good provisions, and may do some good, and probably no harm.

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[1] Report of Departmental Committee appointed by the Board of Trade, presented to Parliament in 1895.

Shares at a discount.

One-man companies.

Contemporaneously with the Bankruptcy Act, 1883, the Patents, Designs, and Trade Marks Act, 1883 (46 and 47 Vict. c. 57) was passed. By this Act (which has been subsequently amended in some details not affecting the general scheme of the Act by Acts of 1885, 1886, and 1888) the administration of the law as to patents, copyright in designs, and trade marks is carried on in one office called the Patent Office, under the immediate control of an officer called the comptroller-general of patents, designs, and trade marks, who acts under the superintendence and direction of the Board of Trade (sec. 82). The Board of Trade is empowered by sec. 101 to make rules and do such things as it thinks expedient, subject to the provisions of the Act, for regulating the practice of registration under the Act, and other ancillary purposes, and generally for regulating the business of the Patent Office. The Act deals chiefly with the machinery for making applications for and granting patents and registration of designs and trade marks, and but few changes have been made in substantive law. The application for a patent is made to the comptroller, accompanied by a provisional specification. It is then referred to an examiner to report whether the nature of the invention has been fairly described, whether the application, specification, and drawings (if any) have been prepared in the prescribed manner, and whether the title sufficiently indicates the subject matter of the invention (sec. 6). The reader will notice the limited scope of the duties of the examiner. He does not, for instance, report on the novelty of the invention having regard to previous patents. If the examiner reports unfavourably the comptroller may require an amendment and vary the date so as to make the application run from the time when the amendment is made (Patents Act, 1888, 51 and 52 Vict. c. 10, sec. 2). Under the Patent Law Amendment Act, 1852, all provisional specifications were published. Under the present Acts they are now only published after the complete specification has also been filed, and not at all if the application is abandoned (Patents Act, 1885, 48 and 49 Vict. c. 63, sec. 4). The complete specification must be left at the Patent Office within nine months from the date of application (sec. 8 (1)), with power for the comptroller to extend the term for not exceeding one month (Act of 1885, sec. 3). The complete specification is again referred to the examiner, and if accepted the comptroller advertises his acceptance, and any person may within two months oppose the grant on various specified grounds, including the ground that the invention has been patented in Great Britain on an application of prior date (secs. 9, 10, and 11). The comptroller hears the parties and gives his decision on the case, but there is an appeal to the law officer (either the Attorney-General or the Solicitor-General) from the comptroller's decision on this question, as well as from the other decisions of the comptroller of each stage of the proceedings. The law officer's decision is final. He has therefore to exercise important judicial functions, but where there is a serious question to be tried the practice is for the law officer to allow the grant to be made, leaving the opponents to assert their right in a court of law. Increased facilities for amending a complete specification, after grant of a patent, are given by sec. 18, and restrictions are placed on the recovery of damage in respect of infringement before amendment by sec. 20. The proceeding by *scire facias* to repeal a patent is abolished, but revocation of a patent may be obtained on petition to the Court by the Attorney-General or any other person authorized by him, or, speaking generally, any person aggrieved by the grant of a patent (sec. 25). There are two alterations of substantive law which should be noticed. By sec. 22 the Board of Trade is empowered in certain defined cases to order the patentee to grant licences on such terms as the Board may deem just, and any such order may be enforced by

Patents, designs, and trade marks.

mandamus. And by sec. 27 a patent has the like effect against the Crown as it has against a subject, but with power to the officers of the Crown to use the invention for the service of the Crown on terms agreed upon, or in default of agreement to be settled by the Treasury. Formerly the rule was otherwise, the Crown not being bound, unless expressly named in the terms of the grant (*Feather* v. *The Queen*, 6 B. and S. 257).

The practice in trials of patent actions remains unaltered, except that in a claim for infringement or a proceeding for revocation the Court may at any time give the patentee, on terms, liberty to apply for leave to amend his specification by way of disclaimer, and postpone the trial in the meantime (sec. 19). No attempt has been made, nor perhaps can successfully be made, by legislation to limit the length and expense of patent actions, for which the parties are chiefly responsible. Something may be done by the judge, no doubt, to limit the number of expert witnesses or curtail the cross-examination, but it is always a delicate matter for the judge to interfere with the discretion of counsel, when the exclusion of evidence may involve defeat in the Courts of Appeal, or, at best, a new trial. Frequently when the case is heard on appeal it is found that the questions both of validity of the patent and infringement turn on the construction of the specification, on which the expert evidence is of little assistance.

It is unnecessary to comment on the procedure prescribed for applications to the comptroller for registration of designs and trade marks. The appeal from decisions of the comptroller is to the Board of Trade, which has power to refer the matter to the High Court, and usually does so in a case of any difficulty. One incidental result of the registration of trade marks (first established in 1875) deserves notice. Formerly no distinction was made, and it was not necessary to make any distinction between trade marks and trade names, meaning a name which by usage has come to denote the goods of a particular person or firm in the market. Many of the cases described as trade mark cases are really cases of a trade name. But trade names are not within the Trade Marks Acts. Consequently a person may still prove his right to a trade name and prevent the use of it on the goods of another person, although as a trade mark it does not fulfil the conditions required by the Acts, and is therefore incapable of registration. The jurisdiction of the Court is undoubted, and is founded on elementary principles of mercantile morality (see the cases of *Montgomery* v. *Thompson*, 1891, A.C. 217, and *Reddaway* v. *Banham*, 1896, A.C. 199, both in the House of Lords). But a distinction must be made between the name attached to a new article introduced by a manufacturer, in the sale of which he has no monopoly, and a name denoting the manufacture of a particular person (see the Cellular Clothing Company's case, 1899, A.C. 326). If all the world may manufacture and sell the goods, they may *primâ facie* describe them by the name by which they are known in the market.

County Courts.

The County Courts (remarks the comte de Franqueville) are at once the most ancient and the most modern of English civil tribunals. The Saxon Curia Comitatus, maintained after the Norman Conquest, was a local court and a small debts court. But otherwise it had little similarity to the County Courts founded in the year 1846 by an Act (9 and 10 Vict. c. 95) with the modest title of "An Act for the Recovery of Small Debts and Demands in England." The original limit of the jurisdiction of the new courts was £20, but this was extended in 1850 to £50 in actions of debt. Thirteen amending Acts were passed, by which new jurisdiction was from time to time conferred on the County Courts, and in the year 1888 an Act (51 and 52 Vict. c. 43 was passed) repealing the previous Acts and consolidating their provisions, with some amendment. This is now the code or charter of the County Courts. The grain of mustard-seed sown in 1846 has grown into a goodly tree, with branches extending over the whole of England and Wales; and they embrace within their ambit a more multifarious jurisdiction than is possessed by any other courts in the kingdom. England and Wales were mapped out into 59 circuits (not including the City of London), with power for the Crown, by Order in Council, to abolish any circuit and rearrange the areas comprised in the circuits (sec. 4). This power has been exercised, and there are now 54 circuits only. There is at present one judge to each circuit, but the Lord Chancellor is empowered to appoint two judges in a circuit, provided that the total number of judges does not exceed 60. Every circuit (except in Birmingham, Clerkenwell, and Westminster) is divided into districts, in each of which there is a court, with a registrar and bailiffs. The judges are directed to attend and hold a court in each district at least once in every month, unless the Lord Chancellor shall otherwise direct (secs. 10, 11). But in practice, says Judge Snagge,[1] the judge sits several times a month in the large centres of population, and less frequently than once a month in the court town of sparsely inhabited districts. By sec. 185 of the Act of 1888 the judges and officers of the City of London Court have the like jurisdiction, powers, and authority as those of a County Court, and the County Court rules apply to that Court.

The ordinary jurisdiction of the County Courts is thus tabulated by Judge Snagge:—

Subject matter.	Pecuniary limit of jurisdiction.
Common-law actions, with written consent of both parties	Unlimited.
Actions founded on contract (except for breach of promise of marriage, in which the County Courts have no jurisdiction) .	£50.
Actions founded on tort (except libel, slander, and seduction, in which the County Courts have no jurisdiction) . .	£50.
Counter claims (unless plaintiff gives written notice of objection)	Unlimited.
Ejectment or questions of title to realty .	£50 annual value.
Equity jurisdiction	£500.
Probate jurisdiction	£200 personalty and £300 realty.
Admiralty jurisdiction	£300.
Bankruptcy jurisdiction	Unlimited.
Replevin	Unlimited.
Interpleader transferred from High Court .	£500.
Actions in contract transferred from High Court	£100.
Actions in tort transferred from High Court	Unlimited.
Companies (winding up), when the paid-up capital does not exceed	£10,000.

There is no discoverable principle upon which these limits of the jurisdiction of the County Courts have been determined. For example, it is difficult to understand why a County Court should be trusted to try an action of debt for £100 when transferred from the High Court, but not when commenced in the Court itself. Yet it has been so decided on the construction of a badly-drawn section (sec. 85 of the Act of 1888) in *Curtis* v. *Stovin* (22 Q.B.D. 513). But the above table is not by any means an exhaustive statement of the jurisdiction of the County Courts. For many years it has been the practice of Parliament to throw on the County Court judges the duty of acting as judges or arbitrators for the purpose of new legislation relating to social subjects. Judge Snagge writes,[2] "A mere catalogue of these Acts of Parliament would fill a couple of pages, but a short alphabetical list of a few of them may serve by way of illustration:—

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[1] "Fifty Years of the English County Courts," by His Honour Judge Snagge, in the *Nineteenth Century*, October 1897, which contains an exhaustive review of the whole subject.

[2] *Nineteenth Century*, October 1897, p. 567.

Agricultural Holdings Act, 1883.
Bankruptcy Act, 1883.
Coal Mines Regulation Act, 1881.
Debtors Act, 1869.
Employers' Liability Act, 1880.
Friendly Societies Act, 1875.
Guardianship of Infants Act, 1886.
Habitual Drunkards Act, 1879.
Industrial Assurance, &c., Act, 1896.
Law of Distress Amendment Act, 1888.
Mercantile Law Amendment Act, 1856.
Open Shares, &c., Act, 1890.
Public Health Act, 1875.
Railways Regulation Act, 1871.
Settled Land Acts, 1882–90.
Tithe Act, 1891 ; and (last but not least)
Workmen's Compensation for Injuries Act, 1897."

It appears from the judicial statistics for 1899[1] that there were in that year 1,152,163 plaints entered in the County Courts to recover sums amounting altogether to £3,485,698. The number of plaints is smaller, but the amount sued for is slightly larger than the corresponding figures for 1898. On the whole the number of plaints has been steadily increasing, and in 1901 there were nearly twice as many as there were in 1889. There were also 1618 actions remitted from the High Court during the year 1899. These figures do not include proceedings in bankruptcy, winding up, and other matters.

There is an appeal from the County Courts on matters of law in all cases where the debt or damage or claim in interpleader exceeds £20, and in actions for the recovery of land exceeding £20 in yearly value, to a divisional court of the High Court, *i.e.*, to the Admiralty Division in Admiralty cases and to the King's Bench Division in other cases (sec. 120 of Act of 1888). The determination of the divisional court is final, unless leave be given by that court or the Court of Appeal (Judicature Act, 1894, sec. 1 (5)). But if leave be given there is a further appeal from the Court of Appeal to the House of Lords, except in bankruptcy (47 Vict. c. 9, sec. 2). In proceedings under the Workmen's Compensation Act, 1897 (as we have seen), the appeal from a County Court judge is to the Court of Appeal, with a subsequent appeal to the House of Lords.

The County Courts may have a still greater future. The Judicature Commissioners in their second report[2] suggested that the jurisdiction of the County Courts over common-law actions might be made unlimited, with power for defendants to demand a transfer to the High Court. This suggestion (as has been seen) was not adopted, but in the process of decentralization (which seems inevitable) the County Courts may hereafter become local courts of first instance for legal business of every description, without limit of jurisdiction, leaving the courts in London to do the appeal business and the London business proper, with power to remove any action to London for trial for stated reasons.

Criminal trials.

Few alterations have been made in the administration of the criminal business in the courts during the period under review. Between 1875 and 1880 an attempt was made to consolidate and codify the criminal law of England. The subject was referred to a commission, consisting of Lord Blackburn, Lord Justice Lush, Mr Justice Barry (of the Irish Bench), and Mr Justice Stephen, and upon their report a Bill was introduced by Lord Justice Holker, then Attorney-General, but it did not become law, and has not since been introduced.[3] The same fate befell a Bill brought in by Lord James of Hereford, when he was Attorney-General, in 1884, for the establishment of a court of criminal appeal. There is a great difference of opinion as to the expediency of a court of criminal appeal, and, as usually happens, the difference is aggravated by persons not exactly realizing what it is they mean. The King's Bench Division (Crown side) and the Court of Crown Cases Reserved exist for the purpose of correcting errors of law which appear on the record in a criminal case, or which arise in the course of the trial, and act as courts of cassation for that purpose. If their jurisdiction is not wide enough to embrace all cases of legal error in criminal trials, let it be amended. The supporters of a court of criminal appeal, however, point to the anomaly of an appeal on facts existing in every civil case affecting property, but there being none in cases affecting a subject's liberty or even life. The statement is not correct. There is no appeal from the verdict of a jury in a civil case where there was evidence for their consideration, but only a right to a new trial where the verdict is against the weight of evidence; and under the rule of Lord Esher a new trial on this ground was practically unattainable. What they really want is a re-trial by the court, and that the court should do formally what the Home Secretary does informally. On the other hand, it is urged that it would have a bad effect on juries to take from them the sense of the finality of their verdict and consequent responsibility. One use of a court of criminal appeal would be to attain some general standard in the sentences on convicted persons. In the opinion of the writer a court might safely be established for granting new trials where the verdict is against the weight or (say) preponderance of evidence, or where fresh evidence can be adduced, and with power to diminish but not increase sentences.

By the Criminal Evidence Act, 1898 (60 and 61 Vict. c. 36) a prisoner, or the wife or husband of a prisoner, is made a competent witness for the defence at every stage of the proceedings, subject to certain conditions, of which the principal are that a prisoner shall not be called except on his or her own application, and the failure of the prisoner or his wife or her husband to give evidence is not to be the subject of comment by the prosecution, and the prisoner cannot be cross-examined as to any previous offence or conviction or as to character, unless the proof of a previous offence is admissible evidence in the case, or he or she has given evidence of his or her good character, or cross-examined with that view. A party, therefore, is now competent to give evidence on his or her own behalf, both in civil and criminal matters.

Legal reforms affecting administration.

Attention may now be called to other legal reforms which do not relate to the machinery for administration of the law, but deal with subjects of first-rate importance and directly touch administration, more particularly in the Chancery Division of the High Court.

The Conveyancing Act, 1881 (44 and 45 Vict. c. 41, amended by 45 and 46 Vict. c. 39) simplifies and improves the practice of conveyancing. It vests in trustees, mortgagees, and others various powers commonly conferred by provisions inserted in settlements, mortgages, wills, and other instruments. It prescribes what matters covered by general words shall be deemed to be included, and what covenants for title shall be implied in conveyances of land. And it amends, in certain particulars, the law of property. But the Act does not lay down or proceed upon any new departure in principle.

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[1] *Judicial Statistics*, 1899, pp. 42, 147.

[2] Parliamentary Paper, 1872, No. 631.

[3] It may be of interest to observe that a Code of Criminal Law following with some amendments the Bill of 1880 has been passed by the Parliament of New Zealand, and a similar Code, founded largely on the Report, has been passed by the Parliament of Queensland.

Settled Land Acts.

Lord Cairns's Settled Land Act, 1882 (45 and 46 Vict. c. 38, amended in details by three subsequent Acts of 1885, 1889, and 1890[1]) is an Act of a different character. The general scheme of these Acts is to invest the tenant for life of a settled estate with all the powers of management and disposition which are enjoyed by a fee-simple owner. A tenant for life is empowered to sell the estate (sec. 24) or the heirlooms held with it (sec. 37). But he cannot sell the principal mansion-house, its pleasure-grounds, park, and land usually occupied there, without the consent of the trustees of the settlement or of the court (53 and 54 Vict. c. 69, sec. 10), or the heirlooms without an order of the court (Act of 1882, sec. 37 (3)), and in case of any sale he has to give notice to the trustees (sec. 45 (1)). A tenant for life is required to have regard to the interests of all parties, and is to be deemed to be in the position and to have the duties and liabilities of a trustee for those parties (sec. 53). What the effect of this section is, beyond requiring the tenant for life to use reasonable means of selling to the best advantage without any profit to himself or reservation in his own favour, it is not easy to see. He is made the absolute judge whether the estate shall be sold or not, and it is no objection to a sale that the necessity for it arises from his own extravagance or improvidence, or that it is for his own relief, or that all the other parties interested are opposed to it. In the Ailesbury case (1892, A.C. 356) the tenant for life of a large estate, with a family mansion and park, had encumbered his life estate to such an extent that it was of no pecuniary value to him, and at the instance of his creditors proposed to sell the whole estate. All the persons interested in remainder opposed the sale, and Mr Justice Stirling refused to consent to the sale; but his decision was reversed in the Court of Appeal, and the decision of the latter court was affirmed in the House of Lords. The important principle was there laid down that in exercising its discretion the court might have regard to the interests of the tenants on the estate, as well as of the remainder men, and as a tenant for life in that position could not do his duty to the land, the sale was permitted to take place notwithstanding the opposition of the family. The contract was subsequently rescinded on a question of title, and shortly afterwards the tenant for life died. It may be inferred from the judgment of the Court of Appeal in Lord Radnor's case (45 Ch.D. 402), which was an application for leave to sell certain heirlooms, that the court will not overrule the discretion of the tenant for life when exercised in good faith and on reasonable ground, notwithstanding the opposition of remainder men. The tenant for life is also empowered to grant leases for ninety-nine years for building and for sixty years for mining purposes, and, with the consent of the court, for any term or in perpetuity where it is the custom in the district for land to be sold or where it is difficult otherwise to make leases or grants for these purposes (secs. 6–10), and on a grant in fee for building purposes a rent charged may be reserved (Act of 1890, sec. 9). By sec. 11 of the last-mentioned Act the tenant for life is also empowered to raise money by mortgage of the estate for the discharge of incumbrances. The Acts contain provisions for the investment and application of purchase money, or other capital money, arising from exercise of the powers of the Act and other ancillary provisions, and a very wide definition of the persons included under the expression "tenant for life." It may be added that the powers of the tenant for life cannot be assigned and will not pass by an assignment of the life estate, but cannot be exercised without the consent of the assignee, and that a contract by a tenant for life not to exercise his power is void (Act of 1882, sec. 50 (1) (2)).

The Settled Land Act was unquestionably a bold and well-conceived piece of legislation. It has proved extremely beneficial in ridding land of encumbered owners and making it marketable. It has also benefited owners of settled property, the income of which, when invested in land, is insufficient to support their social position or family obligations. And, on the other hand, an owner who prefers to retain his family estate is enabled, either by selling outlying parts or by mortgage, to raise money for its development and permanent improvement.

Registration of titles to land.

The history of the registration[2] either of assurances or of titles to land in England is one of half-hearted legislation and consequent failure. The subject was agitated in the Long Parliament, but it was not until the reign of Queen Anne that the experiment was made. Registries of deeds and wills were established for the county of Middlesex by 7 Anne c. 20, for the West Riding of Yorkshire by 2 and 3 Anne c. 4, and for the East Riding and Kingston-upon-Hull by 6 Anne c. 62; and by 8 Geo. II. c. 6 similar provisions were applied to the North Riding. Presumably these Acts were intended as an experiment, with a view to the ultimate extension of a similar system to other parts of England. The policy of the Acts was to give priority to registered assurances over unregistered ones, and thereby secure publicity and safety to transactions in land. This object, however, was defeated by the lawyers in the Court of Chancery. It was there held by Lord Hardwicke that the equitable doctrine as to the effect of notice was not excluded by the Acts, and consequently a settlement prior in date, but unregistered, was allowed priority over a subsequent registered settlement made with notice of the first one (*Le Neve* v. *Le Neve*, Amb. 436). Sir William Grant in following this decision said, "It has been much doubted whether the courts ought ever to have suffered the question of notice to be agitated against a party who has registered his assurance" (*Wyatt* v. *Barwell*, 19 Ves. 435). On the other hand it was held that registration is not notice, so that a prior registered owner for an equitable interest was postponed to a subsequent purchaser with the legal estate and with no notice (except by the registration) of the prior interest. This was decided by Lord Camden on the authority of an earlier unreported case. In his judgment Lord Camden said, "If it were a new case I should have my doubts, but the point is closed by the earlier case," and expressed his opinion that the previous decision had led to great laxity in searching the registers (*Morecock* v. *Dickins*, Amb. 678). The experiment was not extended to other parts of England. The chief result of the statutes of Anne was to confer valuable pieces of patronage on the Lord Chancellor, and to increase the cost of conveyancing in the two counties and occasionally furnish materials for litigation.

So things remained until the year 1862, when Lord Westbury carried an Act (25 and 26 Vict. c. 53) for the registration of titles to land. This, it will be observed, was a new departure. The difference between a system of registration of assurances and one of registration of titles is vital. In the former case the conveyance creates the title, and the registration is only for the purpose of preserving a record of it and giving it publicity. In a system of registration of titles, on the other hand, the entry of the person's name on the register constitutes his title. The previous deed is but the authority to the registrar to enter the name of the grantee in the place of the grantor, and the subsequent certificate is evidence only of the entry. Registration under Lord Westbury's Act was optional, and the Act required an official investigation and judicial declaration of title before registration. The Act was useful to persons who desired to sell their land in small lots without the expense to the purchasers of investigation of title, but was not likely to be generally adopted. Few titles could pass the ordeal of an official examination, and no prudent person would run the risk of his title being rejected or "blown upon." As it would be necessary to have the title examined by the applicant's own conveyancer before being submitted to the office, the expense of registration under this Act was also excessive.

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[1] 48 and 49 Vict. c. 72, 52 and 53 Vict. c. 36, 53 and 54 Vict. c. 69.

[2] See REGISTRATION (LAND), *Encyclopædia Britannica*, vol. xx. p. 342, and LAND REGISTRATION in the present volume.

In 1875 Lord Cairns's Land Transfer Act (38 and 39 Vict. c. 87) was passed. Like its predecessor, this Act was optional only. But it introduced the principle of registration without previous investigation. The scheme of the Act was to enable (1) a purchaser of an estate in fee simple, (2) any person entitled in law or equity to a like estate, (3) any person entitled to dispose for his own benefit of a like estate, and in each case, whether subject to incumbrances or not, to be registered, either with an absolute or qualified title, after an official investigation of the title, or with "a possessory title," without such investigation. A "possessory title" gives no better right to the holder of it than he had before, but forms a root of a new title which, if the land remains on the register, will by lapse of time mature into an absolute registered title. The result is that a vendor with a registered "possessory title" can only be required to give a purchaser an abstract of his title antecedent to registration for such a period as, together with the period subsequent to registration, would make up forty years. But in practice a purchaser would probably be satisfied with a much shorter period. One objection to Lord Westbury's Act was thus removed, and in the opinion of the writer this is undoubtedly the sound principle on which legislation should proceed, though some impatient reformers clamour for more drastic treatment. It will be observed that the Act of 1875 does not provide for the registration of land in settlement, except where the legal estate is vested in trustees.

Prior to 31st December 1898, when the Registry Act came into force, 411 titles had been registered under Lord Westbury's Act, and 187 absolute or qualified titles, and only 144 possessory titles under Lord Cairns's Act. What is the reason for the failure of landowners to make greater use of these Acts? It must sorrowfully be admitted that the solicitors (speaking generally) assumed an attitude of hostility or indifference to the new system, and did not advise their clients to register their titles. It would be unfair to a profession of high-minded men to attribute this entirely to motives of self-interest. It arose partly from a natural conservatism, and partly from a professional fear of leaving a system of conveyancing in which they were brought up, and which they understood, for an untravelled country, the charms of which they inadequately understood and were slow to appreciate. It is not wonderful that eminent members of that branch of the profession have persuaded themselves and publicly maintained that the disadvantages of a system of registration of title exceed its advantages. But it is strange that the bankers have not been advocates of the new system. They seem to regard the facility of lending money to their customers on deposit of deeds without the publicity of registration as essential to their business, though it does not exist in Scotland, or at the present time in Yorkshire. And they forget that they have been the principal sufferers from the frauds which have arisen out of this very facility, and which would have been impossible with an efficient system of registration either of title-deeds or of titles.

In the year 1884 the Yorkshire Registries Act (47 and 48 Vict. c. 54) was passed for the purpose of consolidating and amending the law relating to the registration of deeds and other matters affecting lands within the three Ridings. The Act provides for the registration of assurances and wills (sec. 4), memoranda of lien or charge (sec. 7), and intestacies (sec. 12). It is provided (sec. 7) that no lien or charge shall have any effect or priority against a registered assurance for valuable consideration unless and until a memorandum thereof has been registered; and (sec. 14) that all assurances shall have priority according to the date of registration, and every registered will shall have priority according to the date of the testator's death if registered within six months thereafter, or according to the date of registration if not made within that period; and further, that all priorities given by the Act shall have full effect in all courts except in cases of actual fraud, and no person claiming legal or equitable interests under any registered instrument shall lose his priority merely in consequence of having been effected with actual or constructive notice, except in cases of actual fraud. By sec. 15 registration of any instrument has the effect of notice of such registration, and of the fact of registration to all persons and for all purposes whatsoever, as from the date of registration. There are other ancillary and necessary provisions. It will thus be seen that the main defects of the Acts of Anne have been remedied so far as the Yorkshire registries are concerned, with the singular result that one county enjoys a system of land tenure differing in material respects from those prevailing in other English counties.

In the successive years 1893, 1894, and 1895, Bills were brought in by Lord Herschell for the compulsory registration of titles to land. The general scheme and main features of all these Bills are the same as those of the Torrens system adopted in Australia, and as those of the system in use in Germany and Austria-Hungary, but they are drafted on the lines of amending and supplementing the Act of 1875. At length, in 1897, the Land Transfer Act (60 and 61 Vict. c. 65) was passed on a Bill brought in by Lord Halsbury. This Bill was, in fact, the Bill of 1895, with some special provisions to meet objections which had been urged by opponents before the Select Committee of the House of Commons on the earlier Bill. Part I. provides for the real estate of a deceased person becoming vested in his personal representative from time to time as if it were a chattel real. This is an excellent provision, and is essential for any efficient system of registration. Part II. contains amendments of the Act of 1875. Amongst other things provision is made for the registration of settled land at the option of the tenant for life either in his name or in the names of trustees, with a power of sale (if any), or in the names of persons having an over-riding power of appointment of the fee simple (sec. 6), with a special provision as to land held by incumbents of a benefice (sec. 15); and a power is given to remove land from the register (sec. 17), which meets one objection which has been made. Part III. provides for compulsory registration and an insurance fund. The Crown is empowered by Order in Council, as respects any county or part of a county, to declare that after a named day registration of title (under the Act of 1875) shall be compulsory on sale (not, it will be observed, on any devolution of title by death), subject to a veto of the county council. Such an Order in Council has been made as regards the county of

London, and registration is therefore now compulsory in that county. But registration cannot be made compulsory in any other county except upon a resolution of the county council, passed at a meeting at which two-thirds of the whole number of the members shall be present. It remains to be seen whether the success of the experiment in London will induce other counties to adopt the Act, or whether the Act will share the neglect of previous Acts.

In the meantime the old system of conveyancing will continue. Abstracts of title will still be delivered and investigated afresh on every transaction. Bankers and others will still lend money on deposits of deeds, and find themselves postponed to an earlier equitable title of which they had no notice, or to a subsequent purchaser who has acquired the legal estate without notice of their incumbrance. And it will still be possible for ingenious persons to defraud creditors and purchasers by manufacturing a duplicate set of deeds. Much has no doubt been done by the Conveyancing Acts to restrain the exuberance of legal language in conveyances and other instruments, and perhaps still more has been done by the Solicitors' Remuneration Act, 1881 (44 and 45 Vict. c. 44), which permits *ad valorem* charges for conveyancing business. Under this Act a scale of costs for conveyancing business has been established by General Order, 1882. This scale was prepared and agreed upon by the solicitors themselves, but, from the number of decisions on the construction of it, its language does not appear to be free from ambiguity.

Legislation as to married women.

A favourite fiction of the common law that husband and wife make one person, and that person, it may be added, the husband, was rudely shaken by the Married Women's Property Act, 1882 (45 and 46 Vict. c. 75), repealing an earlier Act of 1870. Under this Act a married woman may possess and enjoy her own, whether acquired before or after marriage, and may contract with the consequent ability to sue and liability to be sued in respect of her separate property. Mention may also be made of the Guardianship of Infants Act, 1886 (49 and 50 Vict. c. 27), which for the first time recognizes the right of a widow to be guardian of her own child. The Bill for this Act, as introduced into the House of Commons, contained a declaration of the equal rights of the spouses in their children during marriage. But this conception of marriage as a partnership between equal partners enjoying equal rights secured by community of interests was thought to be too wide of the facts of life to form a safe basis for legislation. The consideration of the status of married women enjoying separate property has lately come before the courts, chiefly in connexion with the enforcement of judgments against them. Some ladies seem to have a rooted distrust of their solicitors and counsel alike, and an imperfect appreciation of the nature or meaning of a judgment. The quarrels between a notorious litigant and her solicitors have had the solitary advantage of helping to settle the law as to the mode of enforcing a judgment against the separate property of a married woman.

Codification.

The materials with which the lawyer has to do his work are second only in importance to the rules in accordance with which his work has to be done. Reports and statutes are his stock-in-trade. England is not yet within a measurable distance of a civil or criminal code; but some progress has been made towards that end by the passing from time to time of various Acts codifying branches of law. The principal ones are the Bills of Exchange Act, 1882 (45 and 46 Vict. c. 61), the Partnership Act, 1890 (53 and 54 Vict. c. 39), the Trusts Act, 1893 (56 and 57 Vict. c. 53), and the Interpretation Act, 1889 (52 and 53 Vict. c. 63). These Acts have been prepared with great care under the best expert advice, and experience has demonstrated their utility to the layman as well as the lawyer. A Bill for the like treatment of the law relating to marine insurance has been proposed in more than one session. A Bill for a criminal code was brought in in 1879 and dropped.

The Statute Law Revision Committee have continued their useful work of excising dead law from the statute book, partly by repeal of obsolete and spent Acts and parts of Acts, and partly by pruning redundant preambles and words. The construction of a section of an Act may depend on the preamble and the context, and the repeal of the preamble and certain parts of the Act may therefore affect the construction of what is left. This is provided for by a clause which is said to have been settled by Lord Westbury. It provides (in effect) that the repeal of any words or expressions of enactment shall not affect the construction of any statute or part of a statute. The lawyer, therefore, cannot rely on the revised edition of the statutes alone, and it is still necessary for him to consult the complete Act as it was originally enacted. Perhaps it does not very much matter.

Drafting.

But it is a pity, while efforts are made to get rid of dead law and improve the record of that which is kept alive, that equal care is not taken that new enactments should be made in accurate and intelligible language. The most superficial acquaintance with the current decisions in the courts will show how much of the time of the judges is taken up in coping with the obscurity of modern Acts of Parliament. This is not altogether the fault of the distinguished lawyers who have filled the place of Treasury counsel or Government draftsmen. Bills are required to be drawn so as to be passed on the lines of least resistance, and this is found in the clauses incorporating or making applicable sections of a previous Act, or providing that a previous enactment should be read as if *a* were *b* or *c* were *d*. Sometimes on referring to a previous Act you find that you are referred back to an even earlier one. Legislation by reference has its merits and a use of its own, no doubt, but lucidity is not one of the merits. Again, a minister in charge of a Bill is always desirous of getting it through within his allotted time, and sometimes too readily accepts an amendment without complete appreciation of its bearing on the particular section or the general scheme of the Bill. In the House of Lords ministers are naturally anxious to get a difficult Bill through without serious amendment which will occasion fresh opposition or debate in the Commons. More may no doubt be done in the way of revision by the authors of the Bill in the interval between the two Houses, and in the House of Lords if the Bill originates in the Commons. But the remedy in the long-run lies with the House of Commons. The costs of interpreting an obscure enactment (by means of an action with an appeal first to the Appeal Court and then to the House of Lords) fall upon the suitor, *i.e.*, upon the electorate. If members steadily set their faces against the consideration of any Bill the meaning of which cannot be discovered within its four corners, it would do some good; and if greater care were exercised in accepting amendments, and in revising those that have been accepted, still greater improvement might be hoped for.

The pressure on the time of Parliament is the excuse for the growing tendency of leaving the details of legislation to be dealt with by rules to be made by an authority named in the Act. This is no doubt necessary in some cases, as for instance in the Judicature Acts. But it is, in fact, the delegation by Parliament to other bodies, or even individuals, of legislation, often of an important character. In many cases the mode in which the enactments are to be worked out in practice may affect the whole question of the expediency or justice of the Act itself. Again, under the guise, and for the purpose of framing rules, the rule-making authority may and sometimes must put its own interpretation on the Act, and if (as is usually the case) the rules have the effect of a statute the interpretation thus given becomes irrevocable. In this way the function of the courts of law is usurped. It is true that by 56 and 57 Vict. c. 66, notice of the proposal to make any statutory rules (with large exceptions) is required to be published in the *London Gazette* forty days before the making thereof; and in some cases the rules are required to be laid on the tables of both Houses of Parliament before they come into operation. But every one who has sat in either House knows how slender are the means of the private member to call attention to the subject with effect, and how little real protection is secured by the presentation of the rules to Parliament.

Law reporting.

The lawyer relies on the reporter as well as on the legislator, and here he is better served. The movement originated by Mr Daniel led to the formation of the Council of Law Reporting in the year 1863. The council now consists of three *ex-officio* members—the Attorney-General, the Solicitor-General, and the President of the Incorporated Law Society, and ten members appointed by the three Inns of Court, the Incorporated Law Society, and the council itself on the nomination of the General Council of the Bar. Amongst the eminent persons who have presided over the council the most conspicuous for his services is Mr Joseph Brown, K.C., who for many years successfully devoted a large amount of his valuable time to the details of the business with a view to the improvement of the Reports and to economy in their production. The practitioner and the student now get for a subscription of four guineas a year the Reports in all the Superior Courts and the House of Lords, and the Judicial Committee of the Privy Council issued in monthly parts, a king's printer's copy of the Statutes, and Weekly Notes, containing short notes of current decisions and announcements of all new rules made under the Judicature Acts and other Acts of Parliament, and other legal information. In addition the subscriber receives the Chronological Index of the Statutes published from time to time by the Stationery Office, and last, but not least, the Digests of decided cases published by the Council from time to time. In 1892 a Digest was published containing the cases and statutes for twenty-five years, from 1865 to 1890, and this was supplemented by one for the succeeding ten years, from 1891 to 1900. The digesting is now carried on continuously by means of "Current Indexes," which are published monthly and annually, and will be consolidated into a digest at stated intervals (say) of five years. The Indian appeals series, which is not required by the general practitioner, is supplied separately at one guinea a year. Those who remember the cost of keeping up a law library before the publication of the Law Reports will appreciate the immense benefit conferred on the practitioner and on the public by the work of the Council. That the Reports are perfect no one will dare to affirm. Criticisms were freely made on the editing and reporting, and for a few years a rival set of reports with the ambitious title of *The Reports* was published. But this series died a natural death, and under the present editorship it is believed that there is less room for criticism. When the writer was chairman of the Council the complaints were for the most part that too much or too little was reported, showing how difficult is the work of the editor in drawing the line between cases laying down new principles or merely applications of old principles. Usually the critic complained that some case in which he had a special interest was not reported. A great portion of the reports is taken up with the construction of public Acts or of statutory rules which is of comparatively ephemeral value.

The Bar.

But what of the Bar itself? It was widely felt amongst members of the Bar that it was not adequately represented by the Inns of Court with their self-elected bodies of benchers. At length a Bar council was formed, consisting of a just proportion of Queen's [King's] Counsel and outer barristers elected by all the members of the Bar. This council was subsequently reorganized under the name of the General Council of the Bar. It receives complaints and suggestions from barristers and watches over the discipline of the Bar, but its most useful public work is in criticizing proposed legal changes and publishing reports of its committees thereon. The reports of the Council of the Bar are often of great value and receive attention in the highest quarters. It has sometimes seemed to the writer that to advocate a high standard of legal training for admission to the Bar is presumptuous in one who was called at a time when neither legal education nor examination was required, and who is estopped from saying that a fair measure of success may not be attained both at the Bar and on the Bench without either one or the other. But, nevertheless, the writer believes such a training is essential to the wellbeing or even the continued existence of the Bar. England is no doubt the paradise of amateurs, but, after all, the need of a distinct professional training is gradually being recognized in every profession and calling. A commission which was appointed in 1854 recommended by their report the formation of the Inns of Court into a Legal University, with power to confer degrees in law. In 1875 Lord Selborne brought in a Bill for this purpose, but failed to pass it through Parliament. The writer regrets that the Inns of Court did not avail themselves of the opportunity of carrying out this recommendation in substance by accepting the invitation of the London University Commissioners to become the Law Faculty of that university. However, the benchers have for some time past recognized the call for some legal education in candidates for the Bar. They have appointed a committee of their own members, called the Council of Legal Education, under whose auspices lecturers are appointed in the various branches of law, and their lectures have been opened to the general public as well as to the students of the Inns. Candidates since 1872 have been required to pass an examination before being called to the Bar. It has been suggested that a law degree of some English or (under conditions) foreign university might be accepted as a test of general legal knowledge, and that the tests imposed by the Inns of Court might in that case be confined to such practical or purely professional training as may be thought necessary. For admission as a solicitor, a candidate has long been required by the Incorporated Law Society to pass two examinations, but this body has ceased to provide lectures for students.

We have thus seen that within the last thirty years of the Victorian reign the Superior Courts were entirely reorganized on a new model and their procedure cleared of technicality and reduced to the simplest forms, the law relating to bankruptcy, patents, and joint-stock companies reformed, prisoners admitted to give evidence on their own behalf, great innovations made in the law relating to settled estates and the transfer of land, married women entrusted with the ownership of their property and the guardianship of their children, and some progress made towards codification of the law and reduction of the Statute Book to manageable proportions. (D.)

II. UNITED STATES.

The laws of the various states and territories of the United States, and those of England, rest at bottom on the same foundation, namely, the English common law as it existed at the beginning of the 17th century. (See *Common Law*, below.) The only exceptions worth noting are to be found in the state of Louisiana, the territory of New Mexico, and the acquisitions following the Spanish war of 1898. Those derive most of their law from France or Spain, and thus remotely from the principles of Roman jurisprudence. A part also, but comparatively a small part, of the law of Texas, Missouri, Arizona, and the Pacific states comes from similar sources. The United States as a whole has no common law, except so far as its courts have followed the rules of English common-law procedure in determining their own. Most of the positive law of the United States comes from the several states. It is the right of each state to regulate at its pleasure the general relations of persons within its territory to each other, as well as all rights to property subject to its jurisdiction. Each state has also its own system of adjective law. The trial courts of the United States of original jurisdiction follow in general the practice of the state in which they sit as to procedure in cases of common-law character. As to that in equity, or what means the same thing, chancery causes, they follow in general the practice of the English Court of Chancery as it existed toward the close of the 18th century, when the original Judiciary Act of the United States was adopted. The public statutes of the United States are to be found in the *Revised Statutes* of 1873, and in the succeeding volumes of the *Statutes at Large*, enacted by each Congress. Those of each state and territory are printed annually or biennially as they are enacted by each legislature, and are commonly revised every fifteen or twenty years, the revision taking the place of all former public statutes, and being entitled *Revised Statutes*, *General Statutes*, or *Public Laws*. The private or special laws of each state, so far as such legislation is permitted by its constitution, are in some states published separately, and made the subject of similar compilations or revisions; in others they are printed with the public session laws. American courts are often given power by statute to make rules of procedure which have the force of laws. Municipal subdivisions of a state generally have authority from the legislature to make ordinances or bye-laws on certain subjects, having the character of a local law, with appropriate sanctions, commonly by fine or forfeiture.

The XIVth Amendment.

Law in the United States has been greatly affected by the results of the Civil War. During its course (1861–1865) the powers of the President of the United States may be said to have been re-defined by the courts. It was its first civil war, and thus for the first time the exercise of the military authority of the United States within a state which had not sought its aid became frequent and necessary Next followed the Amendments of the Constitution of the United States having for their special purpose the securing beyond question of the permanent abolition of slavery and the civil and political rights of the coloured race. At the outset the Supreme Court of the United States was inclined to treat them as having a very limited operation in other directions. One of the provisions of the XIVth Amendment is that no state shall deny to any person within its jurisdiction the equal protection of the laws. The benefit of this guarantee was claimed by the butchers of New Orleans, in contending against a monopoly in respect of the slaughter of cattle granted by the state of Louisiana to a single corporation. Their suit was dismissed by the Supreme Court in 1873, with the expression of a doubt whether any action of a state not directed by way of discrimination against the negroes as a class, or on account of their race, would ever be held to come within the purview of the provision in question.[1] The Chief Justice and three of his associates dissented from the judgment, holding that the XIVth Amendment did protect the citizens of the United States against the deprivation of their common rights by state legislation.[2] Public sentiment supported the view of the minority, and it was not long before changes in the *personnel* of the court, occurring in common course, led it to the same conclusions. The protection of the XIVth Amendment is now invoked before it more frequently than is that afforded by any other article of the Constitution. In one of its recent terms twenty-one cases of this nature were decided.[3] Very few of them related to the negro. Since the decision in the Slaughter-house cases, the controversies as to the constitutional rights of the negro have been comparatively infrequent, but there has been a great and steadily increasing number in all the courts in the country, involving questions of discrimination in favour of or against particular individuals, or of changes affecting the rights of parties in the accustomed forms of judicial procedure.

Down to 1868, when this Amendment was adopted, it was, as to most matters, for the state alone to settle the civil rights and immunities of those subject to its jurisdiction. If they were to be free from arbitrary arrests, secure in liberty and property, equal in privilege, and entitled to an impartial administration, it was because the constitution of the state so declared. Now they have the guarantee of the United States that the state shall never recede from these obligations. This has readjusted and reset the whole system of the American law of personal rights.[4]

The Supreme Court of the United States has used the great power thus confided to it with moderation. Its general rules of decision are well stated in these words of Mr Justice Brown, found in one of its recent opinions:—

> In passing upon the validity of legislation, attacked as contrary to the XIVth Amendment, it has not failed to recognize the fact that the law is, to a certain extent, a progressive science; that in some of the states methods of procedure, which at the time the constitution was adopted were deemed essential to the protection and safety of the people or to the liberty of the citizen, have been found to be no longer necessary; that restrictions which had formerly been laid upon the conduct of individuals, or of classes of individuals, had proved detrimental to their interests; while, upon the other hand, certain other classes of persons, particularly those engaged in dangerous or unhealthful employments, have been found to be in need of additional protection. Even before the adoption of the constitution, much had been done toward mitigating the severity of the common law, particularly in the administration of its criminal branch. The number of capital crimes, in this country at least, had been largely decreased. Trial by ordeal and by battle had never existed here, and had fallen into disuse in England. The earlier practice of the common law, which denied the benefit of witnesses to a person accused of felony, had been abolished by statute, though, so far as it deprived him of the assistance of counsel and compulsory process for the attendance of his witnesses, it had not been changed in England. But, to the credit of her American colonies, let it be said that so oppressive a doctrine had never obtained a foothold there. The 19th century originated legal reforms of no less importance. The whole fabric of special pleading, once thought to be necessary to the elimination of the real issue between the parties, has crumbled to pieces. The ancient tenures of real estate have been largely swept away, and land is now transferred almost as easily and cheaply as personal property. Married women have been emancipated from the control of their husbands, and placed upon a practical equality with them with respect to the acquisition, possession, and transmission of property. Imprisonment for debt has been abolished.

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[1] The Slaughter-House Cases, 16 Wallace's Reports, 36, 81.

[2] *Ibid.* 89, 111, 129.

[3] *Guthrie on the Fourteenth Amendment*, 27.

[4] Baldwin's *Modern Political Institutions*, 111, 112.

> Exemptions from execution have been largely added to, and in most of the states homesteads are rendered incapable of seizure and sale upon forced process. Witnesses are no longer incompetent by reason of interest, even though they be parties to the litigation. Indictments have been simplified, and an indictment for the most serious of crimes is now the simplest of all. In several of the states grand juries, formerly the only safeguard against a malicious prosecution, have been largely abolished, and in others the rule of unanimity, so far as applied to civil cases, has given way to verdicts rendered by a three-fourths majority. This case does not call for an expression of opinion as to the wisdom of these changes, or their validity under the XIVth Amendment, although the substitution of prosecution by information in lieu of indictment was recognized as valid in *Hurtado* v. *California*, 110 U.S. 516. They are mentioned only for the purpose of calling attention to the probability that other changes of no less importance may be made in the future, and that while the cardinal principles of justice are immutable, the methods by which justice is administered are subject to constant fluctuation, and that the Constitution of the United States, which is necessarily and to a large extent inflexible and exceedingly difficult of amendment, should not be so construed as to deprive the states of the power to amend their laws so as to make them conform to the wishes of the citizens as they may deem best for the public welfare without bringing them into conflict with the supreme law of the land. Of course, it is impossible to forecast the character or extent of these changes, but in view of the fact that from the day Magna Charta was signed to the present moment, amendments to the structure of the law have been made with increasing frequency, it is impossible to suppose that they will not continue, and the law be forced to adapt itself to new conditions of society, and particularly to the new relations between employers and employés, as they arise.[1]

The Civil War deeply affected also the course of judicial decision in the Southern states. During its progress it engaged the attention of a very large part of the population, and the business of the courts necessarily was greatly lessened. Upon its close political power passed, for a time, into new hands, and many from the Northern and Western states took prominent positions both at the bar and on the bench. The very basis of society was changed by the abolition of slavery. New state constitutions were adopted, inspired or dictated by the ideas of the North. The transport system was greatly extended, and commerce by land took to a large extent the place formerly filled by commerce by navigation. Manufacturing came in to supplement agricultural industry. Cities grew and assumed a new importance. Northern capital sought investment in every state. It was a natural consequence of all these things that the jurisprudence of the South should come to lose whatever had been its distinctive character. The unification of the nation inevitably tended to unify its law.

The Bar Association.

An important contribution towards this result was made by the organization of the American Bar Association in 1878. Of the fourteen signers of the call for the preliminary conference, five were from the Southern states. Its declared objects were "to advance the science of jurisprudence, promote the administration of justice and uniformity of legislation throughout the Union, uphold the honour of the profession of the law, and encourage cordial intercourse among the members of the American Bar." Each meeting is opened by an address from the president, in which he is to "communicate the most noteworthy changes in statute law on points of general interest made in the several states and by Congress during the preceding year." It has discussed and published papers upon such subjects as "American institutions and laws"; "the civil law and codification"; "avoidable causes of delay and uncertainty in our courts"; "the relationship of law and national spirit"; "the distinction between legislation and judicial functions"; "the opportunity for development of jurisprudence in the United States"; "law reports and law reporting"; "jurisprudence considered as a branch of the social science"; "judicial independence"; "the necessity for uniformity in the laws governing commercial paper"; and "the development of the law of contracts." The reports of its committees, and the action which it has taken from time to time, have had a wide influence, not only in shaping legislation, but in directing the course of legal opinion and legal education.

Law schools.

Largely through its efforts, the American law schools have taken on a new character. The course of study has been both broadened and prolonged, and the attendance of students has increased in full proportion to the additions to the facilities for obtaining a more thorough training in the profession. In 1898–99 there were nearly 12,000 matriculations in these institutions, which is more than double the number at the close of the preceding decade. When the association commenced its labours, those studying law in the offices of practising lawyers very largely outnumbered those found in the law school. The proportion is now reversed. During the year 1900, for instance, the State Board of Law Examiners in New York examined 899 applicants for admission to the bar of that state. Of these all but 157 had received their legal education wholly or in part at a law school.[2] In 1878 few law schools had adopted any system of examination for those desiring to enter them. Such a requirement for admission is now common. In only one school were opportunities then afforded for advanced studies by graduate students with a view to attaining the doctorate in law. Courses of this description are now offered by several of the university schools.

Reports.

A more scientific character has thus been taken on by American law. It is noticeable both in legal text-books and in the opinions of the courts of last resort. In the latter precision of statement and method in discussion are invited by the uniform practice of preparing written opinions. The original practice of reading these from the bench has been generally discontinued. They are simply handed down to an official reporter for publication, which is done at the expense of the Government by which the court is commissioned. With the judicial reports of each state the lawyers of that state are required to be familiar; and this is rendered possible, even in the larger ones, by state digests, prepared every few years by private enterprise. Outside of the state their circulation is comparatively limited, though sets of all are generally found in each state library, and of many in the Bar libraries at the principal county seats. The private libraries of lawyers in large practice also often contain the reports of adjoining and sometimes those of distant states, as well as those of their own and of the Supreme Court of the United States. The decisions of one state, however, are now best known in others through unofficial reports. One large publishing concern prints every case decided in the courts of last resort. They are published in several distinct series, those, for instance, coming from the Northern Atlantic states being grouped together as the *Atlantic Reporter*, and those from the states on the Pacific coast as the *Pacific Reporter*. Another house has published a compilation professing to give all the leading American cases from the first to the latest volume of reports. Another makes a similar selection from the decisions of each year as they appear, and publishes them with critical annotations. There are also annual digests of a national character, comprehending substantially all American cases and the leading English cases reported during the preceding year.

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[1] *Holden* v. *Hardy*, 169 United States Reports, 336, 385–87.

[2] *Columbia Law Review*, i. 99.

These various publications are widely diffused, and so the American lawyer is enabled, in preparing for the argument of any cause involving questions of difficulty, to inform himself with ease of such precedents as may apply. A court in Texas is thus as likely to be made acquainted with a decision in Maine or Oregon as with one in any nearer state, and in the development of American law all American courts are brought in close touch with each other.

English and American law.

This tendency has been advanced by the steady growth of codification. (See *Code.*) That is beginning also to serve to bring English and American law nearer together in certain directions. A Negotiable Instruments Act, promoted by the American Bar Association, and prepared by a conference of commissioners appointed by the several states to concert measures of uniform legislation, has been adopted in the leading commercial states. It is founded upon the English "Chalmers's Act," and the English decisions giving a construction to that have become of special importance. The Acts of Parliament known as the Employers' Liability Act and the Railway and Canal Traffic Act have also served as the foundation of similar legislation in the United States, and with the same result. Modern English decisions are, however, cited less frequently in American courts than the older ones; and the older ones themselves are cited far less frequently than they once were. In the development of their legislation, England and the United States have been in general harmony so far as matters of large commercial importance are concerned, but as to many others they have since 1850 drawn apart. Statutes, at one point or another, probably now affect the disposition of most litigated causes in both countries. Their application, therefore, must serve more or less to obscure or displace general principles, which might otherwise control the decision and make it a source of authority in foreign tribunals. The movement of the judicial mind in the United States, and also its modes and form of expression, have a different measure from that which characterizes what comes from the English bench. American judges are so numerous, and (except as to the Supreme Court of the United States) the extent of their territorial jurisdiction so limited, that they can give more time to the careful investigation of points of difficulty, and also to the methodical statement of their conclusions. Whatever they decide upon appeal being announced in writing, and destined to form part of the permanent published records of the state, they are expected and endeavour to study their words and frame opinions not only sound in law but unobjectionable as literary compositions.

The choice of American judges, particularly in the older states, has been not uninfluenced by these considerations. Marshall, Bushrod Washington, Story, Kent, Ware, Bradley, and many of their contemporaries and successors, were put upon the bench in part because of their legal scholarship and their power of felicitous expression. Hence the better American opinions have more elaboration and finish than many which come from the English courts, and are more readily accepted as authorities by American judges. But the great multiplication of reports has so widened the field of citation, as in effect to reduce it. Each of the larger and older states has now a settled body of legal precedent of its own, beyond which its judges in most cases do not look. If a prior decision applies, it is controlling. If there be none, they prefer to decide the case, if possible, on principle rather than authority.

While the state courts are bound to accept the construction placed upon the Constitution and laws of the United States by the Supreme Court of the United States, and thus uniformity of decision is secured in that regard, the courts of the United States, on the other hand, are as a rule obliged to accept in all other particulars the construction placed by the courts of each state on its constitution and laws. This often gives a seeming incongruity to the decisions of the Supreme Court of the United States. A point in a case coming up from one judicial circuit may be determined in a way wholly different from that followed in a previous judgment in a cause turning upon the same point, but appealed from another circuit, because of a departure from the common law in one state which has not been made in another. In view of this, a doctrine originally proposed by Mr Justice Story in 1842[1] has not been infrequently invoked of late years, which rests upon the assumed existence of a distinctive federal jurisprudence of paramount authority as to certain matters of general concern, as for example those intimately affecting commerce between the states or with foreign nations. The consequence is that a case involving such questions may be differently adjudged, according as it is brought in a state or in a federal court.[2]

The divergences now most noticeable between English and American law are in respect of public control over personal liberty and private property, criminal procedure, and the scope of the powers of municipal corporations.

Under the constitutional provision that no one shall be deprived of life, liberty, or property without due process of law, American courts frequently declare void statutes which in England would be within the acknowledged powers of Parliament. These provisions are liberally expounded in favour of the individual, and liberty is held to include liberty of contract as well as of person. Criminal procedure is hedged about with more refinements and safeguards to the accused than are found in England, and on the other hand, prosecutions are more certain to follow the offence, because they are universally brought by a public officer at public expense. The artificiality of the proceedings is fostered by a general right of appeal on points of law to the court of last resort. It is in criminal causes involving questions of common-law liability and procedure[3] that English law-books and reports are now most frequently cited. American municipal corporations are confined within much narrower limits than those of England, and their powers more strictly construed.

Trial by jury.

Trial by jury in civil causes seems to be declining in public esteem. The expenses necessarily incident to it are naturally increasing, and the delays are greater also from a general tendency, especially in cities, where most judicial business is transacted, to reduce the number of hours a day during which the court is in session. The requirement of unanimity is dispensed with in a few states, and it has been thus left without what many deem one of its essential features. The judge interposes his authority to direct and expedite the progress of the trial less frequently and less peremptorily than in England. A jury is waived more often than formerly, and there is a growing conviction that, with a capable and independent judiciary, justice can be looked for more confidently from one man than from thirteen.

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[1] *Swift* v. *Tyson*, 16 Peters' Reports, 1, 19.

[2] See *Forepaugh* v. *Delaware, Lackawanna, and Western Railroad Company*, 128 Pennsylvania State Reports, 267; *Faulkner* v. *Hart*, 82 New York Reports, 313; and *Lake Shore and Michigan Southern Railway Company* v. *Prentice*, 147 United States Reports, 101.

[3] See as examples, *Commonwealth* v. *Rubin*, 165 Massachusetts Reports, 453, in which Holmes, C.J., traces the rule that, if a man abuse an authority given him by the law, he becomes a trespasser *ab initio*, back to the Year Books; and *Commonwealth* v. *Cleary*, 172 Massachusetts Reports, 175, in which the same judge refers to Glanville and Fleta as authority for the proposition that the admission in evidence, in cases of rape, of complaints made by the woman soon after the commission of the offence is a perverted survival of the old rule that she could not bring an appeal unless she had made prompt hue and cry.

The United States entered on the work of simplifying the forms of pleading earlier than England, but has not carried it so far. Demurrers have not been abandoned, and in some states little has been done except to replace one system of formality by another hardly less rigid. The general plan has been to codify the laws of pleading by statute. In a few states they have proceeded more nearly in accordance with the principles of the English Judicature Act, and left details to be worked out by the judges, through rules of court.[1]

The legislature and the courts.

Most of the state constitutions assume that the powers of government can be divided into three distinct departments, executive, legislative, and judicial; and direct such a distribution. In thus ignoring the administrative functions of the state, they have left a difficult question for the courts, upon which the legislature often seeks in part to cast them. The general tendency has been to construe, in such circumstances, the judicial power broadly, and hold that it may thus be extended over much which is rather to be called quasi-judicial.[2] A distinction is taken between entrusting jurisdiction of this character to the courts, and imposing it upon them. Where the statute can be construed as simply permissive, the authority may be exercised as a matter of grace, when it would be peremptorily declined, were the meaning of the legislature that it must be accepted.[3] The courts, for similar reasons, have generally declined (in the absence of any constitutional requirement to that effect) to advise the legislature, at its request, whether a proposed statute, if enacted, would be valid. While its validity, were it to be enacted, might become the subject of a judicial decision, it is thought for that reason, if for no other, to be improper to prejudge the point, without a hearing of parties interested. The constitutions of several states provide for such a proceeding, and in these the Supreme Court is not infrequently called upon in this way, and gives responses which are always considered decisive of legislative action, but would not be treated as conclusive in any subsequent litigation that might arise.

Police power of states.

The general trend of opinion in the Supreme Court of the United States since 1870, upon questions other than those arising under the XIVth Amendment, has been towards recognizing the police power of the several states as entitled to a broad scope. Even, for instance, in such a matter as the regulation of commerce between different states, it has been upheld as justifying a prohibition against running any goods trains on a Sunday, and a requirement that all railway cars must be heated by steam.[4] In the "Granger Cases,"[5] the right of the state to fix the rate of charges for the use of a grain elevator for railway purposes, and for general railway services of transportation, was supported, and although the second of these was afterwards overruled,[6] the principle upon which it was originally rested was not shaken.

On the other hand, reasons of practical convenience have necessarily favoured the substantial obliteration of state lines as to the enforcement of statutory private rights. Massachusetts in 1840, six years before the passage of Lord Campbell's Act, provided a remedy by indictment for the negligent killing of a man by a railway company, a pecuniary penalty being fixed which the state was to collect for the benefit of his family. In most of the other states by later statutes a similar result has been reached through a civil action brought by the executor or administrator as an agent of the law. In some, however, the state must be the plaintiff; in others the widow, if any there be. The accident resulting in death often occurs in a state where the man who was killed does not reside, or in which the railway company does not have its principal seat. It may therefore be desirable to sue in one state for an injury in another. Notwithstanding such an action is unknown to the common law, and rests solely on a local statute, the American courts uniformly hold that, when civil in form, it can be brought under such statutes in any state the public policy of which is not clearly opposed to such a remedy. In like manner the responsibilities of stockholders and directors of a moneyed corporation, under the laws of the state from which the charter is derived, are enforced in any other states in which they may be found. Thus a double liability of stockholders to creditors, in case of the insolvency of the company, or a full liability to creditors of directors who have made false reports or certificates regarding its financial condition, is treated as of a contractual nature, and not penal in the international sense of that term.[7] As a judgment of one state has equal force in another, so far as the principle of *res adjudicata* is concerned, the orders of a court in a state to which a corporation owes its charter, made in proceedings for winding it up, may be enforced to a large extent in any other. The shareholders are regarded as parties by representation to the winding-up proceedings, and so bound by decrees which are incidental to it.[8]

See also COOLEY on *The Constitutional Limitations which rest upon the Legislative Power of the States of the American Union;* ANDREWS on *American Law;* and RUSSELL on *The Police Power of the State, and Decisions thereon as illustrating the Development and Value of Case Law.*

Appendix.

The following series of sub-titles, alphabetically arranged, deals with points in American law not treated elsewhere in this work, generally showing a divergence from English law or practice.

Adoption.—Adoption of minors is permitted by statute in many of the states. These statutes generally require some public notice to be given of the intention to adopt, and an order of approval after a hearing before some public authority. The consequence commonly is that the person adopted becomes, in the eye of the law, the child of the person adopting, for all purposes. Such an adoption, if consummated according to the law of the domicile, is equally effectual in any other state into which the parties may remove. The relative status thus newly acquired is ubiquitous. (See Whitmore, *Laws of Adoption; Ross* v. *Ross*, 129 Massachusetts Reports, 243.)

Adultery.—This is everywhere ground of divorce, and there is commonly no prohibition against marrying the paramour or other re-marriage by the guilty party. Even if there be such a prohibition, it would be unavailing out of the state in which the divorce was granted; marriage being a contract which, if valid where executed, is generally treated as valid everywhere. Adultery gives a cause of action for damages to the wronged husband. It is in some states a criminal offence on the part of each party to the act, for which imprisonment in the penitentiary or state prison for a term of years may be awarded.

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[1] This has been carried farthest in Connecticut. See *Botsford* v. *Wallace*, 72 Connecticut Reports, 195.

[2] Norwalk Street Railway Company's Appeal, 69 Connecticut Reports, 576; 38 *Atlantic Reporter*, 708.

[3] *Zanesville* v. *Zanesville Telephone Company*, 63 Ohio State Reports, 442; 59 *North-Eastern Reporter*, 109.

[4] *New York Railroad* v. *New York*, 165 United States Reports, 628.

[5] *Munn* v. *Illinois*, 94 United States Reports, 113; *Chicago Railroad Company* v. *Iowa*, *ibid.* 155.

[6] *Wabash Railway Company* v. *Illinois*, 118 United States Reports, 557; *Reagan* v. *Farmers' Loan and Trust Company*, 154 United States Reports, 362.

[7] *Huntington* v. *Attrill*, 146 United States Reports, 657.

[8] *Great Western Telegraph Company* v. *Purdy*, 162 United States Reports, 329; *Fish* v. *Smith*, 73 Connecticut Reports, 377; 47 *Atlantic Reporter*, 710.

Allegiance.—The English doctrine (prior to the Naturalization Act of 1870) that no man can cast off his native allegiance without the consent of his sovereign, was early abandoned in the United States, and in 1868 Congress declared that "the right of expatriation is a natural and inherent right of all people, indispensable to the enjoyment of the rights of life, liberty, and the pursuit of happiness," and one of "the fundamental principles of the republic." (*United States Revised Statutes,* sec. 1999.) Every citizen of a state owes a double allegiance, one to it and one to the United States. He may be guilty of treason against one or both. If the demands of these two sovereigns upon his duty of allegiance come into conflict, those of the United States have the paramount authority.

Appeal.—This term may mean (1) a removal of a cause to a higher court for a new trial on all the questions involved, or (2) taking up points of law only by proceedings in error, for revision by a higher court. Decrees in admiralty and equity in the courts of the United States are the subjects of an appeal; judgments in actions at law, of a writ of error. On an equity appeal the evidence taken at the original hearing is reported at length to the appellate court, and it has the right to review the conclusions of fact reached by the court below and come to different ones. This, however, is seldom done, the appeal being almost always decided on points of law based upon the conclusions of fact reached in the original hearing. In admiralty appeals the conclusions of fact reached by the trial court are specially set forth, and are final.

"Appeal" in many of the states is the general term for reviewing any judgment of an inferior court on assignments of error. It is also often used to signify a mode of reviewing proceedings of municipal bodies, affecting the interests of particular persons, *e.g.*, in matters of licences or assessments.

In criminal prosecutions an appeal, or writ of error on points of law, is almost everywhere allowed to the defendant, and often to the state. This is a matter of statute regulation. (*United States* v. *Sanges,* 144 United States Reports, 310; *State* v. *Lee,* 65 Connecticut Reports, 265.)

Appraiser.—This is a term often used to describe a person specially appointed by a judicial or quasi-judicial authority to put a valuation on property, *e.g.*, on the items of an inventory of the estate of a deceased person, or on land taken for public purposes by the right of eminent domain. Appraisers of imported goods and boards of general appraisers have extensive functions in administering the customs laws of the United States.

Arbitration.—Arbitration is ordinarily conducted out of court, but in most states an agreement to settle a controversy in this way may be filed in a court and enforced by its authority. There are also statutes of the United States providing facilities for adjusting disputes between certain classes of employers and workmen in this way. The United States law allows arbitration proceedings between corporations engaged in commerce between the states and their employés to take place before official arbitrators and at the public expense. (30 United States Statutes at Large, 424.)

The United States ratified in 1900 the convention agreed on at The Hague in 1899 with reference to international arbitration. (For a discussion of the mode of proceeding before the court which has been organized under its provisions, and of the initiative belonging to the President of the United States, see an article on "The Entry of the United States into World Politics as one of the Great Powers," in the *Yale Review* for February 1901.)

Attachment.—Attachment of debts is a statutory remedy accorded in most of the states in certain circumstances for the security of creditors, by the seizure by the sheriff of the debtor's goods or the imposition of a lien upon his land, before judgment, and sometimes at the very commencement of the action. In some states it is only allowed in special cases, as when the debtor has absconded, or is a non-resident, or guilty of fraud; in a few it may be had, as of right, at the commencement of ordinary actions. The common-law courts of the United States (by Act of Congress) follow the practice in this regard of the state in which they sit. Such attachments (on mesne process) can generally be dissolved by the substitution of a bond with surety. The body can also be attached in most states on civil actions of tort (for a wrongful or negligent act to the damage of another), but not in actions on contract.

Attainder.—Bills of attainder are expressly forbidden by the constitution of the United States, both as respects them and the several states. This prohibition is understood not to be confined to attainders of death, but to extend to any law inflicting a punishment for a criminal offence, without a previous opportunity for a hearing and defence.

Attorney-at-Law.—Formerly, in some states, there existed a grade among lawyers of attorneys-at-law, which was inferior to that of counsellors-at-law, and in colonial times New Jersey established a higher rank still—that of serjeant-at-law. Now the term attorney-at-law is precisely equivalent to that of lawyer. Attorneys are admitted by some court to which the legislature confides the power, and on examination prescribed by the court, or by a board of state examiners, as the case may be. The term of study required is generally two or three years, but in some states less. In one no examination is required. College graduates are often admitted to examination after a shorter term of study than that required from those not so educated. In the courts of the United States admission is regulated by rules of court and based upon a previous admission to the state bar. The American attorney exercises all the functions distributed in England between barristers, attorneys, and solicitors. When acting in a court of admiralty he is styled "proctor" or "advocate." (See *Bar.*)

Attorney-General.—The United States has an officer of this name, who has a seat in the Cabinet. Every state but one or two has a similar officer. He represents the state in important legal matters, and is often required to assist the local prosecutor in trials for capital offences. He appears for the public interest in suits affecting public charities. He is generally elected by the people for the same term as the Governor, and on the same ticket.

Bar.—Each state has its own bar, consisting of all attorneys-at-law (*q.v.*) residing within it who have been admitted to practice in its courts. As a general thing, attorneys are admitted in one court to practice in all courts. Each of the United States courts has a bar of its own. An attorney of a state cannot practise in a court of the United States unless he has been admitted to it, or to one of the same class in another district or circuit. He cannot appear in the Supreme Court of the United States unless specially admitted and sworn as an attorney of that court, which is done on motion in case of any one who has practised for three years in the highest courts of his state and is in good standing at its bar. In most of the states there is a state Bar Association, and in some cities and counties local Bar Associations. These consist of such members of its bar as desire thus to associate, the object being to guard and advance the standards of the profession. Some own valuable libraries. These associations have no official recognition, but their influence is considerable in recommending and shaping legislation respecting the judicial establishment and procedure. They also serve a useful purpose in instituting or promoting proceedings to discipline or expel unworthy attorneys from the bar. There is an American Bar Association, founded in 1877, composed of members of the bars of different states of like character and position. Some of these associations publish annually a volume of transactions.

Betting.—Many of the states make this a penal offence when the bet is upon a horse-race, or an election, or a game of hazard. Betting contracts and securities given upon a bet are often made void, and this may destroy a gaming note in the hands of an innocent purchaser for value. The United States has no statutes on this subject. It lies outside of its field.

Carrier.—A railway company receiving goods destined for transportation by rail to a point beyond its line is generally held liable only for their transportation to the end of its line and delivery there to the connecting line, unless it specially stipulates for their carriage to the final point of destination. (*Myrick* v. *Michigan Central R. R. Co.*, 107 United States Reports, 102.)

Chancellor.—The principal judge of equity (or, what is the same thing, chancery) causes in a state. Only a few states have such an officer. His functions are purely judicial. In states where legal and equitable remedies are administered by the same judges, a judge in disposing of an equity cause is sometimes spoken of as a chancellor, but the meaning is simply that he is performing functions similar to those of a chancellor.

Chancery.—This word is generally used as the synonym of equity. Chancery practice is practice in causes of equity. Chancery courts are equity courts. (See *Equity.*)

Code.—An orderly and systematic statement of the law on one or more large subjects. This word is sometimes used to signify an official revision of the statutes of a state. That, however, simply undertakes to state the existing statute lâw, not (as is the true office of a code) to combine this with the unwritten or customary law and so turn that into statute also. Most of the states have codes stating the law of pleading in civil actions, and such states are often described as code states to distinguish them from those adhering to the older forms of action, divided between those at law and those in equity. A few states have general codes of political and civil rights. The general drift of legislation and of public sentiment is toward the extension of the principle of codification, but the contrary view has been ably maintained. (See James C. Carter's *Provinces of the Written and the Unwritten Law*, 1889.) New York and Georgia were pioneers in American codification. California has carried it as far as any state.

Common Law, the unwritten or customary law, which is the substratum of the municipal law of each state. For every state, except Louisiana, which has been added since the adoption of the Constitution of the United States, it is (unless otherwise provided by statute) the common law of England as it stood at the early part of the 17th century, subject to such modifications or omissions as were generally considered essential throughout the old thirteen colonies to adjust it to American conditions, and to such others as were deemed necessary to that end in the states from which most of the early settlers came, and also to such as have been made from time to time since the early settlements, within what are now the limits, by the usages of the people and common consent. It comprehends the main body of the law in each state, which has not a complete code or set of codes. As a matter of fact, it does not essentially differ in any of them. There are occasional points of divergence, but they are few, and seldom of great practical importance.

The common law is to be found in such books as Blackstone's *Commentaries*, Kent's *Commentaries*, and Swift's *Digest*, in unofficial treatises of acknowledged weight on particular topics, and in the reported decisions of the courts. The main work of giving it such form and precision as it may be said to possess has been done by the judges in disposing of actions at law. They have necessarily assumed the function of declaring what of English law the people have treated as unsuited to their social conditions, or obsolete, and also of declaring what has been added to or derived from the ancient common law from time to time.

Offences against the common law can be prosecuted in many states, though not violations of any statute. This is not so in the courts of the United States. The United States has no common law, except so far as its courts have adopted it as to matters of judicial procedure, and as resort must be had to it to explain the meaning of terms used in their constitution or statutes. There are, however, certain uniform rules of general jurisprudence, mainly relating to commercial transactions, which the courts apply without regard to any common law to the contrary existing in any particular state.

Common Pleas, Court of.—This name is given to certain inferior courts in several of the states. These are generally the lowest courts of general jurisdiction in which a jury trial, as at common law, can be had. Frequently they have also equitable jurisdiction over causes involving only small amounts.

Constitutional Law.—The law peculiarly conversant with the effect and meaning of written constitutions of political government. The constitution of the United States is the supreme law of the land as to the matters which it embraces. The constitution of each state is the supreme law of the state, except so far as it may be controlled by the constitution of the United States. Every statute in conflict with the constitution to which it is subordinate is void so far as this conflict extends. If it concerns only a distinct and separable part of the statute, that part only is void. Every court before which a statutory right or defence is asserted has the power to inquire whether the statute in question is or is not in conflict with the paramount Constitution. This power belongs even to a justice of the peace in trying a cause. He sits to administer the law, and it is for him to determine what is the law. Inferior courts commonly decline to hold a statute unconstitutional, even if there may appear to be substantial grounds for such a decision. The presumption is always in favour of the validity of the law, and they generally prefer to leave the responsibility of declaring it void to the higher courts.

The judges of the state courts are bound by their oath of office to support the Constitution of the United States. They have an equal right with those of the United States to determine whether or how far it affects any matter brought in question in any action. So, *vice versâ*, the judges of the United States courts, if the point comes up on a trial before them, have the right to determine whether or how far the constitution of a state invalidates a statute of the state. They, however, are ordinarily bound to follow the views of the state courts on such a question. They are not bound by any decision of a state court as to the effect of the Constitution of the United States on a state statute or any other matter. This judicial power of declaring a statute void because unconstitutional has been not infrequently exercised, from the time when the first state constitutions were adopted.

Juries in criminal causes are sometimes made by American statutes or recognized by American practice as judges of the law as well as the fact. The better opinion is that this does not make them judges of whether a law on which the prosecution rests violates the paramount Constitution and is therefore void. (*United States* v. *Callender*, Wharton's *State Trials*, 688; *State* v. *Main*, 69 Connecticut Reports, 123, 128.)

If a state court decides a point of constitutional law, set up under the Constitution of the United States, against the party relying upon it, and this decision is affirmed by the state court of last resort, he may sue out a writ of error, and so bring his case before the Supreme Court of the United States. If the state decision be in his favour, the other side cannot resort to like proceedings.

A decree of the Supreme Court of the United States on a point of construction arising under the Constitution of the United States settles it for all courts, state and national.

Contempt of Court.—The maximum punishment for this offence is generally fixed by statute. It is also a common provision of statute that courts cannot punish for contempts committed out of court, unless in such circumstances as immediately to affect the administration of justice. (See United States Revised Statutes, § 725.) American legislative bodies (being without any judicial functions) have not the power to punish for contempt possessed by the Houses of Parliament in England. (*Kilbourn* v. *Thompson*, 103 United States Reports, 168.)

Corporation.—The United States and each state, each territory, and municipalities in general, are public corporations. They are public agencies for public purposes. Private corporations are those formed for private, or partly for private and partly for public purposes. The United States can create corporations so far as may be necessary for the proper execution of their general powers, but these powers being few, the corporations which it has created are not numerous. Most of them are national banking associations. The organized territories of the United States can create corporations by general incorporation laws, and there are many which have been thus formed. The earlier American corporations were all created by special charter, but the practice of permitting incorporation under general incorporation laws under equal terms to all, which was instituted in the 19th century in some of the states, though at first confined to religious societies, library companies, &c., has gradually spread, until it is now almost the rule. Many of the states have constitutions forbidding special charters for corporations, and in the others most incorporations are effected under appropriate general laws. The charter of a private corporation creates a contract between the corporation and the state, which, under the provisions of the Constitution of the United States, cannot be substantially altered without the consent of the corporation, unless a power to that effect was reserved at the time of the incorporation. Such a power is generally reserved, but even then cannot extend to radical and fundamental changes.

The franchises of municipal corporations can be revoked or altered at the pleasure of the state. They are mere agencies for the public good, and, if better ones can be provided, that should be done. Municipal corporations have, besides the powers expressly granted, such as are necessary for their proper execution or indispensable to attaining the object of the incorporation. Private corporations have such implied powers as are fairly incident to the convenient exercise of those expressly granted.

If a corporation assumes to make a contract beyond its powers, the better opinion is that the contract is void. If, in consequence of it, acts have been done, or values received, these may support an action, not because the contract gave rights, but because the transaction did. Thus there may be a liability to account for benefits received. The contract in such case may be available in evidence for certain purposes, *e.g.*, to limit the recovery to the stipulated price. (*Central Transportation Co.* v. *Pullman's Palace Car Co.*, 139 United States Reports, 24; *Pullman's Palace Car Co.* v. *Central Transportation Co.*, *ibid.* 62; *California Bank* v. *Kennedy*, 167 United States Reports, 362.)

If a private corporation becomes insolvent, and falls into the hands of the courts, its assets are treated as a trust fund for the benefit of its creditors. It does not occupy the position of a trustee towards creditors so long as it is a going concern, under the control of its own managers, and not in a state of insolvency. (*Hollins* v. *Brierfield Coal and Iron Co.*, 150 United States Reports, 371.)

American law differs from the English in recognizing the right of a corporation to adopt or ratify the contracts of its promoters made before its organization. (See Taylor on *Private Corporations*, sec. 87.)

American law also regards directors of corporations as agents of the law, who, when acting as a board, are the general agent of the company, by force of the law. English law looks upon them rather as special agents of the corporation, and so constituted by the agreement of the shareholders. (See Thompson on *Private Corporations*, III., 2881.)

Court.—The United States is divided into a large number of judicial districts, of which each state embraces one or more, each with a separate district court held by a district judge. Several of these districts are created in each circuit, of which there are nine. In each circuit there are one or more circuit judges, who may hold circuit courts, as may also the district judge. The district and circuit courts are courts of original jurisdiction. That of the district court is mainly confined to causes in admiralty or bankruptcy, or in which the United States is a party, including criminal cases. That of the circuit court extends to matters of both common law and equity, where the adverse parties are citizens of different states or where the case arises under the laws of the United States, but ordinarily not unless $2000 in value is in controversy. It has also jurisdiction in all criminal prosecutions. In each circuit there is a circuit court of appeal having appellate jurisdiction only. This jurisdiction is final as to most causes, but does not extend to the determination of errors assigned on points arising under the Constitution of the United States. This court is held by three of the circuit judges. A district judge may also sit in the place of a circuit judge.

The Supreme Court of the United States sits only at Washington, and consists of a Chief Justice and eight associate justices. Its jurisdiction is mainly appellate. Appeals from the inferior federal courts lie to it on points arising under the Constitution of the United States, and in capital causes. It can revise the judgments of the highest court of any state on a claim of right raised under the Constitution, laws, or treaties of the United States, if the decision was adverse to such claim. The justices can also sit in the circuit courts and circuit courts of appeal.

A circuit court can be held by one judge, or by two, or by three. If two sit, the opinion of the ranking judge prevails for the purposes of the case if a difference of opinion arises between them in the course of the trial.

Prize cases are appealed directly from the district court to the Supreme Court.

Causes can be removed, before trial, from a state court to a circuit court of the United States, in certain circumstances.

There is also a court of claims sitting at Washington, having cognizance only of claims against the United States. Such claims may also be sued in the district court, if for not over $1000, and in the circuit court, if for not over $10,000.

There is a court of private land claims, of a temporary character, to pass upon claims against the United States respecting lands in certain parts of the Far West.

In the District of Columbia there is a separate judicial system, with a local court of appeals.

Each territory has a separate judicial system, established by Act of Congress.

Each state has a separate judiciary of its own. In most it is as follows: justices of the peace are allowed to dispose of petty causes, civil and criminal (subject to an appeal), and to bind over those charged with grave offences for trial before a jury in a higher court. In cities and other considerable municipalities there are local courts, having a larger jurisdiction over civil and criminal causes. In each county there are one or more courts, known as county courts, courts of common pleas, or superior courts. These are the main courts of original jurisdiction, and also have some appellate jurisdiction over proceedings before the tribunals previously mentioned. They administer both legal and equitable relief, generally in one form of action. Above all is a supreme court, sometimes styled a court of appeals, or a supreme court of errors, with only appellate jurisdiction. An intermediate appellate court is sometimes created to relieve the higher court of an undue pressure of business. Some of the supreme courts dispose of as many as 600 cases a year. Their opinions are, in all important causes, delivered in writing, and published in a series of state reports at the expense of the state, an official reporter being attached to each court. The practice in this respect is the same in the Supreme Court of the United States.

The opinions of the circuit court of appeals and of the circuit and district courts are published unofficially by private reporters. Those of all the courts of last resort in each of the states are likewise published unofficially in the same way, in advance of their appearance in the regular series of state reports. Selected current cases from the United States and state reports are also made the subject of two series of private reports known as the American State Reports and Lawyers' Reports Annotated.

Criminal Procedure.—Each state, as well as the United States, prosecutes for crimes against itself. In every state there are local prosecuting officers in the small political subdivisions of territory, such as counties, towns, cities, and boroughs, who institute criminal proceedings and conduct the hearing which follows the arrest.

The criminal procedure of the United States is in general based upon that of the respective states. A prosecution for a crime against the United States, committed in Ohio, for instance, would be brought by a complaint and warrant such as are used in the state courts of Ohio under the law of that state, while in Kentucky the law and practice of Kentucky would be followed.

Arrests for violations of the law of the United States are commonly made upon a warrant signed by a federal official, known as a district court commissioner; but a state magistrate has equal authority to sign such warrants. (United States Revised Statutes, sec. 1014.) If the law of the state requires a complaint under oath in prosecutions for offences against the state, complaints charging the commission in that state of a crime against the United States must be made under oath, otherwise not. In many states the local state prosecuting officer can complain as of his own knowledge, without annexing any statement or charge emanating from any other person, and thereupon a warrant issues. In such states the same power belongs to the district attorney of the United States, who is the public prosecutor for all offences against the laws of the United States.

Bail (in a sum fixed by the committing magistrate) is a matter of right in all cases where a sentence of death cannot be inflicted. (*Ibid.* sec. 1015.) In those where such a sentence can be, it may be allowed by one of the judges of the United States courts at his discretion. (*Ibid.* sec. 1016.)

These provisions govern proceedings instituted in the limits of any state.

Each territory fully organized by Act of Congress has its own legislative assembly, which regulates criminal procedure, subject only to the guarantees of individual rights found in the Constitution of the United States.

The District of Columbia has a system provided by Act of Congress, and founded on that formerly in use in the state of Maryland, out of which the territory forming this district was carved.

Equity.—The courts of the United States still maintain an absolute separation between actions at law and actions in equity. Procedure in the latter is settled by rules of court, and is substantially uniform throughout the United States. Procedure in the former follows in general the law of the state in which the court may be held. Some of the states also administer equitable relief only in strict and separate equitable proceedings. In most, beginning with New York in 1848, there is now but one kind of action, based on a plain statement of the facts constituting the plaintiff's case, without any artificial restrictions of form. If a cause involving both legal and equitable causes of action is removed before trial from a state court, where such a system obtains, into a circuit court of the United States, the plaintiff is obliged to re-plead and split his suit into two; one in the form of a bill in equity, and one in the form appropriate to an action in such state brought on a legal demand only.

Factor.—Judge Story, both on the bench and in his work on *Agency*, adhered to the doctrine, held by the English courts until a recent period, that a factor under a *del credere* (or guarantee) commission was a mere surety for the purchaser, and only answerable to his principal, if payment were not made by the purchaser. The courts of several of the leading commercial states early took the opposite view, holding the factor liable at all events for the proceeds of the sale, and this, of late years, has become firmly established as the prevalent American view. (See *Lewis Brothers* v. *Brehone*, 33 Maryland Reports, 412; 3 American Reports, 190.) Legislation similar to the English Factors Act of 1825 has been had in several states. (See *Allen* v. *St Louis Bank*, 120 United States Reports, 20.)

Information.—A complaint charging a criminal offence, preferred by a public prosecutor, without any previous inquiry by a grand jury. In many American states an indictment is only necessary in capital cases; in some it is entirely dispensed with. In the courts of the United States an indictment is required in all cases of crimes punishable by imprisonment in the penitentiary by force of the Vth Amendment to the Constitution. *Quo warranto* proceedings are also commonly brought by an information.

Injunction.—In the courts of the United States the writ of injunction remains purely an equitable remedy. It may be issued at the instance of the President to prevent any organized obstruction to inter-state commerce or to the passage of the mails. (*In re* Debs, 158 United States Reports, 564.) Temporary restraining orders may be issued, *ex parte*, pending an application for a temporary injunction. In the state courts temporary injunctions are often issued, *ex parte*, subject to the defendant's right to move immediately for their dissolution. Generally, however, notice of an application for a temporary injunction is required.

Jury.—The right of trial by jury, both in civil cases of a common-law nature and in criminal causes, is secured to all, with important exceptions, by constitutional provisions both as respects the United States and the several states. Some constitutions provide for dispensing with the rule of unanimity in civil causes. In some states a few petty offences may be finally disposed of by a single magistrate. In criminal causes, as juries can bring in a general verdict of "Not guilty," they have the actual power to acquit should they be of opinion that the statute under which the prosecution may be had is void. Their duty, however, is generally held to be to accept the law from the court, especially if it turn upon the effect of the Constitution. Jury trials in some states can be ordered in equitable causes or divorce cases; in others, and in the courts of the United States, they can only be had in causes not of an equitable character, unless specially ordered for the information of the judge on a "feigned issue"—that is, a question of fact stated by the court for the purpose of obtaining a precise answer, by which the judgment of the court may or may not be guided according to its discretion. In some states the judges are forbidden in criminal causes to give the jurors any direction as to how to find the law, or to express any opinion upon the evidence. In others such an opinion may be freely expressed, and they can be told that it is their duty to return a certain verdict if they find the controlling facts in a certain way (*State* v. *Fetterer*, 65 Connecticut Reports, 287).

Lotteries.—The United States at an early period (1812) empowered the city of Washington to set up lotteries as a mode of raising money for public purposes; but no lotteries were ever directly authorized by Congress itself after the adoption of the Constitution of the United States. In 1890 it forbade the use of the mails for promoting any lottery enterprise by a statute so stringent that it was held to make it a penal offence to employ them to further the sale of Austrian Government bonds, issued under a scheme for drawing some by lot for payment at a premium (see *Horner* v. *United States*, 147 United States Reports, 449). Lotteries of every sort were formerly permitted in most of the American colonies and states, but of late years have been generally prohibited by state legislation (see *Journal of the American Social Science Association*, xxxvi. 17).

Perpetuities.—The common-law rule against perpetuities (as to the vesting of estates within one or more lives in being and twenty-one years afterwards, with a further allowance of nine months in favour of an unborn child) obtains in many of the states; in others it has been replaced or reinforced by statutory rules, such as limiting the postponement of future estates by two lives, &c. Conditions are not regarded here as subject to the common-law rule (Gray on *Alienation*, § 42). There is a difference of judicial opinion as to the application of this rule. By some courts it is held to concern itself only with the time within which an estate must vest, and to have nothing to do with the time during which an estate which has once properly vested may continue. By others it is held to prohibit the creation of estates to continue longer than the period specified (see Gray on *Perpetuities; Lovering* v. *Worthington*, 106 Massachusetts Reports, 86). Charities may be established in perpetuity, and provision may be made for an accumulation of the funds for a reasonable time, *e.g.*, for 100 years (*Woodruff* v. *Marsh*, 63 Connecticut Reports, 125; 38 American State Reports, 346). The general tendency of American legislation and decision is to favour tying up estates for public purposes to a greater extent than was formerly approved.

Real Estate.—The tenure of land is generally allodial. Where estates tail are allowed by law, it is often on condition that they become absolute in the issue of the first donee. Real estate titles are secured, to a degree unknown in Great Britain, against impairment by legislation, through constitutional provisions, both state and national, particularly that against depriving any person of property without due process of law.

Registration.—American legislation favours the general policy of registering all documents in the contents of which the public have an interest, and its tendency has been steadily towards more and more full registration both of documents and statistics. From the early days of the colonial era it has been customary to record wills and conveyances of real estate in full in public books, suitably indexed, to which free access was given. During the last decade of the 19th century, three states—Illinois, Massachusetts, and Ohio—adopted the main features of the Torrens or Prussian system for registering title to land rather than conveyances under which title may be claimed. These are the ascertainment by public officers of the state of the title to some or all of the parcels of real estate which are the subject of individual property within the state; the description of each parcel (giving its proper boundaries and characteristics) on a separate page of a public register, and of the manner in which the title is vested; the issue of a certificate to the owner that he is the owner; the official notation on this register of each change of title thereafter; and a warranty by the Government of the title to which it may have certified. To make the system complete it is further requisite that every landowner should be compelled to make use of it, and that it should be impossible to transfer a title effectually without the issue of such a Government certificate in favour of the purchaser.

Constitutional provisions have been found to prevent or embarrass legislation in these directions in some of the states, but it is believed that they are nowhere such as cannot be obeyed without any serious encroachment on the principles of the new system (*People* v. *Chase*, 165 Illinois Reports, 527; *State* v. *Guilbert*, 56 Ohio State Reports, 575; *People* v. *Simon*, 176 Illinois Reports, 165; *Tyler* v. *Judges*, 173 Massachusetts Reports; 55 North-Eastern Reporter, 812; *Hamilton* v. *Brown*, 161 United States Reports, 256).

Conveyances which have been duly recorded become of comparatively little importance in the United States. The party claiming immediately under them, if forced to sue to vindicate his title, must produce them, or account for their loss; but any one deriving title from him can procure a certified copy of the original conveyance from the recording officer, and rely on that. Equitable mortgages by a deposit of title-deeds are unknown.

The general prevalence of public registry systems has had an influence in the development of American jurisprudence in the direction of supporting provisions in wills and conveyances, which, unless generally known, might tend to mislead and deceive, such as spendthrift trusts (*Nichols* v. *Eaton*, 91 United States Reports, 716).

Riparian Laws.—The common-law right of riparian proprietors on running streams to have the water continue to flow in its usual and natural course has been abrogated in many of the Western states in consequence of their physical geography and peculiar industries. In mining states and those having large stretches of arid lands, the use of all the water that can be got is of the greatest benefit. The upper proprietors are therefore allowed to divert water for mining or agricultural purposes to the prejudice of lower proprietors, even to the extent of virtually appropriating the entire stream, except in the wet season. The general rule is that priority of appropriation gives priority of right (*Basey* v. *Gallagher*, 20 Wallace's Reports, 670). The state has a paramount right to regulate the use of rivers for public purposes in the public interest. In some states this is held to justify an appropriation of the water for a canal (*People* v. *Canal Appraisers*, 33 New York Reports, 461. Cf. *Kaukauna Co.* v. *Green Bay Canal Co.*, 142 United States Reports, 254). It may be exercised to the prejudice of prior grants from the state for private purposes. These are taken subject to such future control (*Water Power Co.* v. *Water Commissioners*, 168 United States Reports, 349, 372). Secondary rights are held subject to primary rights. The use of water for drinking is a primary right; its use for manufacturing a secondary one (*City of Auburn* v. *Union Water Power Co.*, 93 Maine Reports; 38 Atlantic Reporter, 561). Rights in water-courses through public lands are regulated by United States Revised Statutes, § 2476. The United States can restrain by injunction the appropriation of the upper waters tributary to a navigable river, if this would interfere with its navigability (*United States* v. *Rio Grande Irrigation Co.*, 174 United States Reports, 690). They can improve the navigation of any navigable waters by erections in the water which cut off access to the channel of a riparian proprietor, without making compensation (*Gibson* v. *United States*, 166 United States Reports, 269).

Succession Duty.—The United States imposed a succession duty by the War Revenue Act of 1898 on all legacies or distributive shares of personal property exceeding $10,000. It is a tax on the privilege of succession. Devises or distributions of land are not affected by it. The rate of duty runs from 75 cents on the $100 to $5 on the $100, if the legacy or share in question does not exceed $25,000. On those of over that value the rate is multiplied 1½ times on estates up to $100,000, twofold on those from $100,000 to $500,000, 2½ times on those from $500,000 to a million, and threefold for those exceeding a million. This statute has been supported as constitutional by the Supreme Court. Many of the states also impose succession duties, or transfer taxes; generally heavier on collateral and remote successions; sometimes progressive according to the amount of the succession. The state duties generally touch real estate successions as well as those to personal property. If a citizen of state A own registered bonds of a corporation chartered by state B, which he has put for safe keeping in a deposit vault in state C, his estate may thus have to pay four succession taxes, one to state A, where he belongs and which, by legal fiction, is the seat of all his personal property; one to state B, for permitting the transfer of the bonds to the legatees on the books of the corporation; one to state C, for allowing them to be removed from the deposit vault for that purpose; and one to the United States.

Treaty.—By the terms of Article VI. of the Constitution of the United States, all treaties made under their authority are the supreme law of the land. This gives them a new quality. They are no longer mere matters of contract. They stand on the same ground as an Act of Congress. Any state constitution or law in conflict with them must give way. So must any prior Act of Congress. On the other hand, a later Act of Congress may abrogate a treaty; for both are equally in their nature the supreme law of the land, and the latter of two laws prevails over the former. (S. E. B.)

Lawes, Sir John Bennet, Bart. (1814–1900), English agriculturist, was born at Rothamsted on 28th December 1814. Even before leaving Oxford, where he matriculated in 1832, he had begun to interest himself in growing various medicinal plants on the Rothamsted estates, which he inherited on his father's death in 1822. About 1837 he began to experiment on the effects of various manures on plants growing in pots, and a year or two later the experiments were extended to crops in the field. One immediate consequence was that in 1842 he patented a manure formed by treating phosphates with sulphuric acid, and thus started the artificial manure industry. In the succeeding year he enlisted the services of Sir J. H. Gilbert, with whom he carried on for more than half a century those experiments in raising crops and feeding animals which have rendered Rothamsted famous in the eyes of scientific agriculturists all over the world (see also Agriculture). In 1854 he was elected a Fellow of the Royal Society, which in 1867 bestowed a Royal medal on him and Gilbert jointly, and in 1882 he was created a baronet. In the year before his death, which happened on 31st August 1900, he took measures to ensure the continued existence of the Rothamsted experimental farm by setting aside £100,000 for that purpose and constituting the Lawes Agricultural Trust, which is composed of four members from the Royal Society, two from the Royal Agricultural Society, one each from the Chemical and Linnæan Societies, and the owner of Rothamsted mansion-house for the time being.

Lawrence, a city of Kansas, U.S.A., capital of Douglas county, on the south bank of the Kansas river, at an altitude of 822 feet. It is on the main line of the Atchison, Topeka, and Santa Fé, and on the Kansas Pacific branch of the Union Pacific railways. Its site is level and its plan regular. The University of Kansas, situated here, had in 1899 a faculty of 69, and was attended by 1087 students, 413 of whom were women. Population (1890), 9997; (1900), 10,862, of whom 781 were foreign-born and 2032 were negroes.

Lawrence, a city of Massachusetts, U.S.A., capital of Essex county, on the Merrimac river. It is divided into six wards, is supplied with water pumped from the Merrimac and filtered, and is paved mainly with macadam and gravel. It is an important centre of the woollen and cotton goods trade, especially of the former. In 1900 it contained 546 manufacturing establishments, with an aggregate capital of $49,914,035, employing 22,358 hands, and with a product valued at $44,703,278. Of this total product, $25,584,744 was composed of woollen and worsted goods, $8,146,594 of cotton goods, and $1,608,224 of flouring and grist-mill products. Machines and machinery, paper, and food products were also prominent articles of manufacture. In 1900 the assessed valuation of real and personal property was $39,841,697; the net debt was $1,830,300, and the rate of taxation was $15·60 per $1000. Population (1890), 44,654; (1900), 62,559, an increase of 40·1 per cent. during the preceding ten years. Of the population in 1900, 28,577 were foreign-born and 87 were negroes.

Lawrenceburg, a city of Indiana, U.S.A., capital of Dearborn county, on the Ohio river and the Baltimore and Ohio South-western, and the Cleveland, Cincinnati, Chicago, and St Louis railways, at an altitude of 486 feet. It has varied manufactures and some commerce by rail and by river. Population (1890), 4284; (1900), 4326, of whom 413 were foreign-born.

Lawson, Cecil Gordon (1851–1882), English landscape painter, was the youngest son of William Lawson, of Edinburgh, esteemed as a portrait painter. His mother also was known for her flower pieces. He was born near Shrewsbury, 3rd December 1851. Two of his brothers (one of them, Malcolm, a clever musician and songwriter) were trained as artists, and Cecil was from childhood devoted to art with the intensity of a serious nature. Soon after his birth the Lawsons moved to London. In 1866 they were in Bloomsbury, in 1867 at Chelsea. Lawson's first works were studies of fruit, flowers, &c., in the manner of W. Hunt; followed by riverside Chelsea subjects. His first exhibit at the Royal Academy (1870) was "Cheyne Walk," and in 1871 he sent two other Chelsea subjects. These gained full recognition from fellow-artists, if not from the public. Among his friends were now numbered Fred Walker, Pinwell, and their associates. Following them, he made a certain number of drawings for wood-engraving. Lawson's Chelsea pictures had been painted in somewhat low and sombre tones; in the "Hymn to Spring" of 1872 (rejected by the Academy) he turned to a more joyous play of colour, an expansion helped by work in more romantic scenes in North Wales and Ireland. Early in 1874 he made a short tour in Holland, Belgium, and Paris; and in the summer he painted his large "Hop Gardens of England." This was much praised at the Academy of 1876. But Lawson's triumph was with the great luxuriant canvas "The Minister's Garden," exhibited in 1878 at the Grosvenor Gallery, and now in the Manchester Art Gallery. This was followed by several works conceived in a new and tragic mood. His health began to fail, but he worked on. He married in 1879 the daughter of Birnie Philip, and settled at Haslemere. His later subjects are from this neighbourhood (the most famous being "The August Moon," now in the National Gallery of British Art) or from Yorkshire. Towards the end of 1881 he went to the Riviera, returned in the spring, and died at Haslemere 10th June 1882. Lawson may be said to have restored to English landscape the tradition of Gainsborough, Crome, and Constable, infused with an imaginative intensity of his own. Among English landscape painters of the latter part of the 19th century his is in many respects the most interesting name.

See *Cecil Lawson, a Memoir*, by E. W. Gosse, 1893.—Heseltine Owen. "In Memoriam: Cecil Gordon Lawson," *Magazine of Art*, 1894. (L. B.)

Lawson, Sir Wilfrid, 2nd Bart. (1829-——), English politician and Temperance leader, son of the first baronet (d. 1867), was born 4th September 1829. He was always an enthusiast in the cause of total abstinence, and in Parliament, to which he was first elected in 1859 for Carlisle, he became its leading spokesman. In 1864 he first introduced his Permissive Bill, giving to a two-thirds majority in any district a veto upon the granting of licences for the sale of intoxicating liquors; and though this principle failed to be embodied in any Act, he had the satisfaction of seeing a resolution on its lines accepted by a majority in the House of Commons in 1880, 1881, and 1883. He lost his seat for Carlisle in 1865, but in 1868 was again returned as a supporter of Mr Gladstone, and was member till 1885; though defeated for the new Cockermouth division of Cumberland in 1885, he won that seat in 1886, and he held it till the election of 1900, when his violent opposition to the Boer war caused his defeat. For all these years he was the champion of the United Kingdom Alliance (founded 1853), of which he became president. An extreme Radical, he also supported disestablishment, abolition of the House of Lords, and disarmament. Though violent in the expression of his opinions, Sir Wilfrid Lawson remained very popular for his own sake both in and out of the House of Commons; he became well known for his humorous vein, his faculty for composing topical doggerel being often exercised on questions of the day.

Layard, Sir Henry Austen (1817–1894), British author and diplomatist, and the excavator of Nineveh, was born in Paris on 5th March 1817. The Layards were of Huguenot descent. His father, Henry P. J. Layard, of the Ceylon Civil Service, was the son of Charles Peter Layard, dean of Bristol, and grandson of Daniel Peter Layard, the physician. Through his mother, a daughter of Nathaniel Austen, banker, of Ramsgate, he inherited Spanish blood. This strain of cosmopolitanism must have been greatly strengthened by the circumstances of his education. Much of his boyhood was spent in Italy, where he received part of his schooling, and acquired a taste for the fine arts and a love of travel; but he was at school also in England, France, and Switzerland. After spending nearly six years in the office of his uncle, Benjamin Austen, a solicitor, he was tempted to leave England for Ceylon by the prospect of obtaining an appointment in the Civil Service, and he started in 1839 with the intention of making an overland journey across Asia. After wandering for many months, chiefly in Persia, and having abandoned his intention of proceeding to Ceylon, he returned in 1842 to Constantinople, where he made the acquaintance of Sir Stratford Canning, the British ambassador, who employed him in various unofficial diplomatic missions in European Turkey. In 1845, encouraged and assisted by Canning, Layard left Constantinople to make those explorations among the ruins of Assyria with which his name is chiefly associated. This expedition was in fulfilment of a design which he had formed, when, during his former travels in the East, his curiosity had been greatly excited by the ruins of Nimroud on the Tigris, and by the great mound of Kuyunjik, near Mosul, already partly excavated by M. Botta. Layard remained in the neighbourhood of Mosul, carrying on excavations at Kuyunjik and Nimroud, and investigating the condition of various tribes, until 1847; and, returning to England in 1848, published *Nineveh and its Remains: with an Account of a Visit to the Chaldæan Christians of Kurdistan, and the Yezidis, or Devil-worshippers; and an Inquiry into the Manners and Arts of the Ancient Assyrians* (2 vols., 1848–1849). To illustrate the antiquities described in this work he published a large folio volume of *Illustrations of the Monuments of Nineveh* (1849). After spending a few months in England, and receiving the degree of D.C.L. from the University of Oxford, Layard returned to Constantinople as attaché to the British Embassy, and, in August 1849, started on a second expedition to the East, in the course of which he extended his investigations to the ruins of Babylon and the mounds of southern Mesopotamia. His record of this expedition, *Discoveries in the Ruins of Nineveh and Babylon*, which was illustrated by another folio volume, called *A Second Series of the Monuments of Nineveh*, was published in 1853. During these expeditions, often in circumstances of great difficulty, Layard despatched to England the splendid specimens which now form the greater part of the collection of Assyrian antiquities in the British Museum. Apart from the archæological value of his work in identifying Kuyunjik as the site of Nineveh (see the article Nineveh, *Ency. Brit.* vol. xvii. p. 511), and in providing a great mass of materials for scholars to work upon, these two books of Layard's are among the best-written books of travel in the language.

Layard now turned to politics. Elected as a Liberal member for Aylesbury in 1852, he was for a few weeks Under Secretary for Foreign Affairs, but afterwards freely criticized the Government, especially in connexion with army administration. He was present in the Crimea during the war, and was a member of the committee appointed to inquire into the conduct of the expedition. In 1855 he refused from Lord Palmerston an office not connected with foreign affairs, was elected Lord Rector of Aberdeen University, and on 15th June moved a resolution in the House of Commons (defeated by a large majority) declaring that in public appointments merit had been sacrificed to private influence and an adherence to routine. After being defeated at Aylesbury in 1857, he visited India to investigate the causes of the Mutiny. He unsuccessfully contested York in 1859, but was elected for Southwark in 1860, and from 1861 to 1866 was Under Secretary for Foreign Affairs in the successive administrations of Lord Palmerston and Lord John Russell. In 1866 he was appointed a trustee of the British Museum, and in 1868 Chief Commissioner of Works in Mr Gladstone's Government and a member of the Privy Council. He retired from Parliament in 1869, on being sent as Envoy Extraordinary to Madrid. In 1877 he was appointed by Lord Beaconsfield ambassador at Constantinople, where he remained until Mr Gladstone's return to power in 1880, when he finally retired from public life. In 1878, on the occasion of the Berlin Conference, he received the order of the Grand Cross of the Bath. Layard's political life was a somewhat stormy one. His manner was brusque, and his advocacy of the causes which he had at heart, though always perfectly sincere, was vehement to the point sometimes of recklessness. Layard retired to Venice, where he devoted much of his time to collecting pictures of the Venetian school, and to writing on Italian art. On this subject he was a disciple of his friend Morelli, whose views he embodied in his revision of Kugler's *Handbook of Painting, Italian Schools* (1887). He wrote also an introduction to Miss Ffoulkes's translation of Morelli's *Italian Painters* (1892–3), and edited that part of Murray's *Handbook of Rome* (1894) which deals with pictures. In 1887 he published, from notes taken at the time, a record of his first journey to the East, entitled *Early Adventures in Persia, Susiana, and Babylonia.* An abbreviation of this work, which as a book of travel is even more delightful than its predecessors, was published in 1894, shortly after the author's death, with a brief introductory notice by Lord Aberdare. Layard also from time to time contributed papers to various learned societies, including the Huguenot Society, of which he was first president. He died in London on 5th July 1894.

Lazarus, Henry (1815–1895), British clarinettist, was born in London, 1st January 1815, and was a pupil of Blizard, bandmaster of the Royal Military Asylum, Chelsea, and subsequently of Charles Godfrey, senior, bandmaster of the Coldstream Guards. He made his first appearance as a soloist at a concert of Mme Dulcken's, in April 1838, and in that year he was appointed as second clarinet to the Sacred Harmonic Society. From Willman's death in 1840 Lazarus was principal clarinet at the opera, and all the chief festivals and orchestral concerts. His beautiful tone, excellent phrasing, and accurate execution were greatly admired. He was professor of the clarinet at the Royal Academy of Music from 1854 until within a short time of his death, and was appointed to teach his instrument at the Military School of Music, Kneller Hall, in 1858. His last public appearance was at a concert got up for his benefit in St James's Hall, in June 1892, and he died 6th March 1895. (J. A. F. M.)

Lead, a city of Lawrence county, South Dakota, U.S.A. It is in the Black Hills, in a prosperous mining region, and is entered by two railways. Population (1890), 2581; (1900), 6210, of whom 2145 were foreign-born.

Lead.—In the last twenty years of the 19th century the lead-smelting industry underwent important changes. Most of these were the result of new conditions arising in the United States, where the treatment of the ores is carried out, not in small works near the mines, but in large centrally-situated smelting plants, to which the ores are shipped from various mining regions. As the competition is considerable, all the details of work have been greatly improved, the cost reduced, and the yield increased. Lead ores are smelted in the reverberatory furnace, the ore-hearth, and the blast-furnace. The use of the first two is restricted, as they are suited only for galena ores (the more common) or mixtures of galena and carbonate, which contain not less than 58 per cent. lead and not more than 4 per cent. silica; further, ores to be treated in the ore-hearth should run low in or be free from silver, as the loss in the fumes is excessive. In the blast-furnace all lead ores are successfully smelted. Blast-furnace treatment has therefore become more general than any other.

Smelting.

To the two methods of working in the reverberatory furnace, represented by the English and Carinthian furnaces (described in *Ency. Brit.* vol. xiv. p. 375) a third, the Silesian, must be added. While by the former processes as much lead as possible is extracted in the furnace, with the Silesian method a very low temperature is used, thus taking out about one-half of the lead and leaving very rich slags (50 per cent. lead) to be smelted in the blast-furnace, the ultimate result being a very much higher yield than by either of the other processes. The Silesian furnace has an oblong hearth, 16 feet by 8 feet 10 inches, sloping from the fire-bridge to the flue-bridge. This causes the lead to collect at the coolest part of the hearth, whence it is tapped, &c., as in the English furnace. A charge of 6180 pounds galena ore (70 per cent. lead) is worked in twelve hours with three men, 0·46 ton of coal being consumed per ton of ore charged. The loss in lead by the combined reverberatory and blast-furnace treatment is only 3·2 per cent.

In the hearth process the blocks of cast-iron forming the sides and back of the Scottish furnace (see *Ency. Brit.* vol. xiv. p. 375) are now generally replaced in the United States by water-cooled shells (water-jackets) of cast-iron. In this way continuous working has been rendered possible, whereas formerly operations had to be stopped every twelve or fifteen hours to allow the over-heated blocks and furnace to cool down. The latest improvement (which somewhat changes the mode of working) is that by Moffett. While he also prevents interruption of the operation by means of water-jackets, he uses hot-blast, and produces, besides metallic lead, large volumes of lead fumes which are drawn off by fans through long cooling tubes, and then forced through suspended bags which filter off the dust, called blue powder. This, a mixture of lead sulphate (45 per cent.) and oxide (44 per cent.) with some sulphide (8 per cent.), zinc, and carbonaceous matter, is agglomerated by a heap-roast, and then smelted in a slag-eye furnace with gray slag from the ore-hearth. The furnace has, however, in addition to the usual tuyères near the bottom, a second set near the throat in order to effect a complete oxidation of all combustible matter. Much fume is thus produced. This is drawn off, cooled and filtered, and forms a white paint of good body, consisting of about 65 per cent. lead sulphate, 26 per cent. lead oxide, 6 per cent. zinc oxide, and 3 per cent. other substance. Thus in the Moffett method it is no matter whether metal or fume is produced, as in either case it is saved and the price is about the same.

In smelting at once in the same blast-furnace ores of different character, the old use of separate processes of precipitation, roasting and reduction, and general reduction prevailing in the Harz Mountains (see *Ency. Brit.* vol. xiv. p. 376), Freiberg, and other places, to suit local conditions, has had to be abandoned. Ores are smelted raw if the fall of matte (metallic sulphide) does not exceed 5 per cent.; otherwise they are subjected to a preliminary oxidizing roast to expel the sulphur, unless they run too high in silver, say 100 ounces to the ton, when they are smelted raw. The leading reverberatory furnace for roasting lead-bearing sulphide ores has a level hearth 14–16 feet wide and 60–80 feet long. It puts through 9–12 tons of ore in twenty-four hours, reducing the percentage of sulphur to 2–4 per cent., and requires four to six men and about two tons of coal. In many instances it has been replaced by mechanical furnaces, which are now very common in roasting sulphide copper ores. (See ACID AND ALKALI MANUFACTURE.) A modern blast-furnace is oblong in horizontal section and about 24 feet high from furnace floor to feed floor. The shaft, resting upon arches supported by four cast-iron columns about 9 feet high, is usually of brick, red brick on the outside, fire-brick on the inside; sometimes it is made of wrought-iron water-jackets. The smelting zone always has a bosh and a contracted tuyère section. It is enclosed by water-jackets, which are usually cast-iron, sometimes mild steel. The hearth always has an Arents siphon tap. This is an inclined channel running through the side-wall, beginning near the bottom of the crucible and ending at the top of the hearth, where it is enlarged into a basin. The crucible and the channel form the two limbs of an inverted siphon. While the furnace is running the crucible and channel remain filled with lead; all the lead reduced to the metallic state in smelting collects in the crucible, and rising in the channel, overflows into the basin, whence it is removed. The slag and matte formed float upon the lead in the crucible and are tapped, usually together, at intervals into slag-pots, where the heavy matte settles on the bottom and the light slag on the top. When cold they are readily separated by a blow from a hammer. The following table gives the dimensions of some well-known American lead-furnaces:—

Lead Blast-Furnace.

Locality.	Year.	Tuyère Section.	Height, Tuyère to Throat.
		Inches.	Feet.
Leadville, Colorado . .	1880	33×84	14
Denver, ,, . .	1880	36×100	17
Durango, ,, . .	1882	36×96	12·6
Denver, ,, . .	1892	42×100	16
Leadville, ,, . .	1892	42×120	18
Salt Lake City, Utah . .	1895	45×140	20

A furnace, 42 by 120 inches at the tuyères, with a working height of 17–20 feet, will put through in twenty-four hours, with twelve men, 12 per cent. coke, and 2 ℔ blast-pressure, 85–100 tons average charge, *i.e.*, one that is medium coarse, contains 12–15 per cent. lead, not over 5 per cent. zinc, and makes under 5 per cent. matte. In making up a charge, the ores and fluxes, whose chemical compositions have been determined, are mixed so as to form out of the components, not to be reduced to the metallic or sulphide state, typical slags (silicates of ferrous and calcic oxides, incidentally of aluminium oxide, which have been found to do successful work). Such slags contain SiO_2 30–33 per cent., Fe(Mn)O 27–50 per cent., Ca(Mg,Ba)O 12–28 per cent., and retain less than 1 per cent. lead and 1 ounce silver to the ton. The leading products of the blast-furnace are argentiferous lead (base bullion), matte, slag, and flue-dust (fine particles of charge and volatilized metal carried out of the furnace by the ascending gas current). The base bullion (assaying 300 ± ounces per ton) is desilverized (see below); the matte (Pb 8–12 per cent., Cu 3–4 per cent., Ag $\frac{1}{3}$–$\frac{1}{5}$ of the assay-value of the base bullion, rest Fe and S) is roasted and resmelted, when part of the argentiferous lead is recovered as base bullion, while the rest remains with the copper, which becomes concentrated in a copper-matte (60 per cent. copper) to be worked up by separate processes (see COPPER). The slag is a waste product, and the flue-dust, collected by special devices in dust-chambers, is briquetted by machinery, with lime as a bond, and then resmelted with the ore-charge. The yield in lead is over 90 per cent., in silver over 97 per cent., and in gold 100 per cent. The cost of smelting a ton of ore in Colorado in a single furnace, 42 by 120 inches at the tuyères, is about $3.

Refining.

The lead produced in the reverberatory furnace and the ore-hearth is of a higher grade than that produced in the blast-furnace, as the ores treated are purer and richer, and the reducing action is less powerful. The following analysis of blast-furnace lead of Freiberg, Saxony, is from an exceptionally impure lead:—Pb 95·088, Ag 0·470, Bi 0·019, Cu 0·225, As 1·826, Sb 0·958, Sn 1·354, Fe 0·007, Zn 0·002, S 0·051. Of the impurities, most of the copper, nickel and copper, considerable arsenic, some antimony, and small amounts of silver, are removed by liquation. The lead is melted down slowly, when the impurities separate in the form of a scum (dross), which is easily removed. The purification by liquation is assisted by poling the lead when it is below redness. A stick of green wood is forced into it, and the vapours and gases set free stir it up and expose new surfaces to the air, which at this temperature has only a mildly oxidizing effect. The pole, the use of which is awkward, has been replaced by dry steam, which has a similar effect. In order to remove tin, arsenic, and antimony, the lead has to be brought up to a bright-red heat, when the air has a strongly oxidizing effect. Tin is removed mainly as a powdery mixture of stannate of lead and lead oxide, arsenic and antimony as a slagged mixture of arsenate and antimonate of lead and lead oxide. They are readily withdrawn from the surface of the lead, and are worked up into antimony (arsenic)—tin-lead and antimony-lead alloys. Liquation, if not followed by poling, is carried on as a rule in a reverberatory furnace with an oblong, slightly trough-shaped inclined hearth; if the lead is to be poled it is usually melted down in a cast-iron kettle. If the lead is to be liquated and then brought to a bright-red heat, both operations, for convenience' sake, are carried on in the same reverberatory furnace. This has an oblong, dish-shaped hearth of acid or basic fire-brick built into a wrought-iron pan, which rests on transverse rails supported by longitudinal walls. The lead is melted down at a low temperature and drossed. The temperature is then raised, and the scum which forms on the surface is withdrawn until pure litharge forms, which only takes place after all the tin, arsenic, and antimony have been eliminated.

Desilverizing.

Silver is extracted from lead by means of the process of cupellation (see *Ency. Brit.* vol. xiv. p. 376). Formerly all argentiferous lead had to be cupelled, and the resulting litharge then reduced to metallic lead. In 1833 Pattinson invented his process (*ibid.* p. 377) by means of which practically all the silver is concentrated in 13 per cent. of the original lead to be cupelled, while the rest becomes market lead. In 1842 Karsten (*loc. cit.*) discovered that lead could be desilverized by means of zinc. His invention, however, only took practical form in 1850–52 through the researches of Parkes, who showed how the zinc-silver-lead alloy formed could be worked, and the desilverized lead freed from the zinc it had taken up. In the Parkes process only 5 per cent. of the original lead need be cupelled. Thus, while cupellation still furnishes the only means for the final separation of lead and silver, it has become an auxiliary process to the two methods of concentration given. Of these the Pattinson process has become subordinate to the Parkes process, as it is more expensive and leaves more silver and impurities in the market lead. It holds its own, however, when base bullion contains bismuth in appreciable amounts, as in the Pattinson process bismuth follows the lead to be cupelled, while in the Parkes process it remains with the desilverized lead which goes to market, and lead of commerce should contain little bismuth. At Freiberg, Saxony, the two processes have been combined. The base bullion is imperfectly Pattinsonized, giving lead rich in silver and bismuth, which is cupelled, and lead low in silver, and especially so in bismuth, which is further desilverized by the Parkes process.

The effect of the two processes on the purity of the market lead is clearly shown by the two following analyses by Hampe, which represent lead from Lautenthal in the Harz Mountains, where the Parkes process replaced that of Pattinson, the ores and smelting process remaining practically the same:—

Process.	Pb.	Cu.	Sb.	As.	Bi.	Ag.	Fe.	Zn.	Ni.
Pattinson .	99·966200	0·015000	1·010000	none	0·000600	0·002200	0·004000	0·001000	1·001000
Parkes . .	99·983139	0·001413	0·005698	none	0·005487	0·000460	0·002289	0·000834	0·000680

Cupelling.

The reverberatory furnace commonly used for cupelling goes by the name of the English cupelling furnace. It is oblong, and has a fixed roof and a movable iron hearth (test). Formerly the test was lined with bone-ash; at present the hearth-material is a mixture of crushed limestone and clay (3:1), or Portland cement, either alone or mixed with crushed fire-brick; in a few instances the lining has been made of burnt magnesite. In the beginning of the operation enough argentiferous lead is charged to fill the cavity of the test. After it has been melted down and brought to a red heat, the blast, admitted at the back, oxidizes the lead and drives the litharge formed towards the front, where it is run off. At the same time small bars of argentiferous lead, inserted at the back, are slowly pushed forward, so that in melting down they may replace the oxidized lead Thus the level of the lead is kept approximately constant, and the silver becomes concentrated in the lead. In large works the silver-lead alloy is removed when it contains 60–80 per cent. silver, and the cupellation of the rich bullion from several concentration furnaces is finished in a second furnace. At the same time the silver is brought to the required degree of fineness, usually by the use of nitre. In small works the cupellation is finished in one furnace, and the resulting low-grade silver fined in a plumbago crucible, either by overheating in the presence of air, or by the addition of silver sulphate to the melted silver, when air or sulphur trioxide and oxygen oxidize the impurities. The lead charged contains about 1·5 per cent. lead if it comes from a Pattinson plant, from 5–10 per cent. if from a Parkes plant. In a test 7 feet by 4 feet 10 inches, and 4 inches deep, about 6 tons of lead are cupelled in twenty-four hours. A furnace is served by three men, working in eight-hours shifts, and requires about 2 tons of coal, which corresponds to about 110 gallons reduced oil, air being used as atomizer. The loss in lead is about 5 per cent. The latest cupelling furnaces have the general form of a reverberatory copper-smelting furnace. The working door through which the litharge is run off lies under the flue which carries off the products of combustion and the lead fumes, the lead is charged, and the blast is admitted near the fire-bridge.

Pattinson process.

In the *Pattinson* process the argentiferous lead is melted down in the central cast-iron kettle of a series 8–15, placed one next to the other, each having a capacity of 9–15 tons and a separate fireplace. The crystals of impoverished lead which fall to the bottom, upon coaling the charge, are taken out with a skimmer and discharged into the neighbouring kettle (say to the right) until about two-thirds of the original charge has been removed; then the liquid enriched lead is ladled into the kettle on the opposite side. To the kettle, two-thirds full of crystals of lead, is now added lead of the same tenor in silver, the whole is liquefied, and the cooling, crystallizing, skimming, and ladling are repeated. The same is done with the kettle one-third filled with liquid lead, and so on until the first kettle contains market lead, the last cupelling lead. The intervening kettles contain leads with silver contents ranging from above market to below cupelling lead. The original Pattinson process has been in many cases replaced by the Luce-Rozan process (1870), which does away with arduous labour and attains a more satisfactory crystallization. The plant consists of two tilting oval metal pans (capacity 7 tons), one cylindrical crystallizing pot (capacity 22 tons), with two discharging spouts and one steam inlet opening, two lead moulds (capacity 3½ tons), and a steam crane. Pans and pot are heated from separate fireplaces. Supposing the pot to be filled with melted lead to be treated, the fire is withdrawn beneath and steam introduced. This cools and stirs the lead when crystals begin to form. As soon as two-thirds of the lead has separated out in the form of crystals, the steam is shut off and the liquid lead drained off through the two spouts into the moulds. The fire underneath the pot is again started, the crystals are liquefied, and one of the two pans, filled with melted lead, is tilted by means of the crane and its contents poured into the pot. In the meantime the lead in the moulds, which has solidified, is removed with the crane and stacked to one side, until its turn comes to be raised and charged into one of the pans. The crystallization proper lasts one hour, the working of a charge four hours, six charges being run in twenty-four hours.

Parkes process.

It is absolutely necessary for the success of the *Parkes* process that the zinc and lead should contain only a small amount of impurity. The spelter used must therefore be of a good grade, and the lead is usually first refined in a reverberatory furnace (the softening furnace) as described above. The capacity of the furnace must be 10 per cent. greater than that of the kettle into which the softened lead is tapped, as the dross and skimmings formed amount to about 10 per cent. of the weight of the lead charged. The kettle is spherical, and is suspended over a fireplace by a broad rim resting on a wall; it is usually of cast-iron. Most kettles at present hold 30 tons of lead; some, however, have double that capacity. When zinc is placed on the lead (heated to above the melting-point of zinc), liquefied, and brought into intimate contact with the lead by stirring, gold, copper, silver, and lead will combine with the zinc in the order given. By beginning with only a small amount of zinc, all the gold and copper and some silver and lead will be alloyed with the zinc to a so-called gold—or copper—crust, and the residual lead saturated with zinc. By removing from the surface of the lead this first crust and working it up separately (liquating, retorting, and cupelling), doré silver is obtained. By the second addition of zinc most of the silver will be collected in a saturated zinc-silver-lead crust, which, when worked up, gives fine silver. A third addition becomes necessary to remove the rest of the silver, when the lead will assay only 0·1 ounce silver per ton. As this complete desilverization is only possible by the use of an excess of zinc, the unsaturated zinc-silver-lead alloy is put aside to form part of the second zincking of the next following charge. In skimming the crust from the surface of the lead some unalloyed lead is also drawn off, and has to be separated by an additional operation (liquation), as, running lower in silver than the crust, it would otherwise reduce its silver content and increase the amount of lead to be cupelled. A zincking takes 5–6 hours; 1·5–2·5 per cent. zinc is required for desilverizing. The liquated zinc-silver-lead crust contains 5–10 per cent. silver, 30–40 per cent. zinc, and 65–50 per cent. lead. Before it can be cupelled it has to be freed from most of the zinc, which is accomplished by distilling in a retort made of a mixture similar to that of the plumbago crucible. The retort is pear-shaped, and holds 1000–1500 ℔ of charge, consisting of liquated crust mixed with 1–3 per cent. of charcoal. The condenser commonly used is an old retort. The distillation of 1000 ℔ charge lasts 5–6 hours, requires 500–600 ℔ coke or 30 ± gallons reduced oil, and yields about 10 per cent. metallic zinc and 1 per cent. blue powder—a mixture of finely-divided metallic zinc and zinc oxide. About 60 per cent. of the zinc used in desilverizing is recovered in a form to be used again. One man serves 2–4 retorts. The desilverized lead, which retains 0·6–0·7 per cent. zinc, has to be refined before it is suited for industrial use. The operation is carried on in a reverberatory furnace or in a kettle. In the reverberatory furnace, similar to the one used in softening, the lead is brought to a bright-red heat and air allowed to have free access. The zinc and some lead are oxidized; part of the zinc passes off with the fumes, part is dissolved by the litharge, forming a melted mixture which is skimmed off and reduced in a blast-furnace or a reverberatory smelting furnace. In the kettle covered with a hood the zinc is oxidized by means of dry steam, and incidentally some lead by the air which cannot be completely excluded. A yellowish powdery mixture of zinc and lead oxides collects on the lead; it is skimmed off and sold as paint. From the reverberatory furnace or the kettle the refined lead is siphoned off into a storage (market) kettle after it has cooled somewhat, and from this it is siphoned off into moulds placed in a semicircle on the floor. In the process the yield in metal, based upon the charge in the kettle, is lead 99 per cent., silver 100+per cent., gold 98–100 per cent. The plus-silver is due to the fact that in assaying the base bullion by cupellation, the silver lost by volatilization and cupel-absorption is neglected. In the United States the cost of desilverizing a ton base bullion is about $6.

Statistics.—The world's production of lead in 1899 was, according to *The Mineral Industry* (1900, p. 431), 803,273 metric tons, viz.: Austria, 9736; Belgium, 15,700; Canada, 9917; Chile, 171; France, 15,981; Germany, 129,225; Greece, 19,059; Hungary, 2166; Italy, 20,543; Japan, 1989; Mexico, 84,656; New South Wales, 70,000; Russia, 250; Spain, 184,007; Sweden, 1606; United Kingdom, 41,500; United States, 196,938.

Authorities.—J. Percy. *The Metallurgy of Lead.* London, 1870.—H. F. Collins. *The Metallurgy of Lead and Silver.* London, 1899, Part I. "Lead."—H. O. Hofman. *The Metallurgy of Lead*, 6th edition. New York, 1901.—*The Mineral Industry*, begun in 1892, annually records the progress made in lead smelting. (H. O. H.)

Lead Poisoning.—Lead poisoning has become important from the administrative point of view. Its occurrence among persons working in various industries has for some years engaged the attention of the Factory Department of the British Home Office, and from time to time "special rules" have been drawn up in the United Kingdom for workshops and workpeople, with the object of minimizing or preventing it. Previous to 1895, when an Act was passed for the compulsory notification of all cases, the extent of the evil was not at all accurately known; it could only be calculated from hospital records and from the Registrar-General's mortality returns. The number of deaths directly ascribed to lead poisoning, or "plumbism," is a very imperfect measure of its influence on health, as it acts also indirectly by causing or promoting organic disease, particularly of the nervous and urinary systems. The Supplement to the Registrar-General's 55th annual report contains the following table, showing the comparative mortality for 1890–91–92 in various industries :—

	Plumbism.	Diseases of Urinary System.	Diseases of Nervous System.	Gout.	Phthisis.	Circulatory Diseases.	Respiratory Diseases.
Lead-worker . . .	211	161	232	...	148	272	397
File-maker . . .	75	104	212	4	402	204	423
Plumber . . .	21	81	131	13	165	123	218
Painter and Glazier .	18	83	132	9	232	147	225
Potter	17	63	123	1	333	227	668
Glass-maker . . .	12	63	155	9	295	157	445
Copper-worker . .	8	60	85	...	294	186	406
Coachmaker . . .	7	68	105	7	189	134	250
Gasfitter, Locksmith .	6	50	108	5	223	104	205
Lead-miner . . .	5	41	62	...	380	142	325
Printer	3	52	98	4	326	133	214
Cutler	3	56	91	...	382	167	518
Wool manufacturer .	3	45	100	1	191	131	256

The table shows the association of plumbism with diseases of the urinary and nervous systems, and to a less degree with those of the circulatory system. Phthisis and respiratory diseases, on the other hand, are not so associated. They are highest among potters, cutlers, and file-makers, and are undoubtedly due to the inhalation of dust.

The symptoms of lead poisoning vary within very wide limits, from colic and constipation up to total blindness, paralysis, convulsions, and death. They are thus described by Dr Arlidge (*Diseases of Occupations*) :—

> The poison finds its way gradually into the whole mass of the circulating blood, and exerts its effects mainly on the nervous system, paralysing nerve-force, and with it muscular power. Its victims become of a sallow-waxy hue; the functions of the stomach and bowels are deranged, appetite fails, and painful colic with constipation supervenes. The loss of power is generally shown first in the fingers, hands, and wrists, and the condition known as "wrist-drop" soon follows, rendering the victim useless for work. The palsy will extend to the shoulders, and after no long time to the legs also. Other organs frequently involved are the kidneys, the tissue of which becomes permanently damaged; whilst the sight is weakened or even lost.

As a rule the poisoning is gradually established by accumulation, and persons may have lead in the system for years before any symptoms manifest themselves. Dr M'Aldowie, senior physician to the North Staffordshire Infirmary, states that "in the pottery trade lead is very slow in producing serious effects compared with certain other industries." In his experience the average period of working in lead before serious lesions manifest themselves is 18 years for females and 22½ years for males.

But some individuals fall victims to the worst forms of plumbism after a few months' or even weeks' exposure to the danger. Young persons are more readily affected than those of mature age, and women more than men. In addition to age and sex influence, there seems to be an element of personal susceptibility, the nature of which is not understood. Some persons "work in the lead" for twenty, forty, or fifty years without the slightest ill effects; others succumb rapidly and persistently to the poison, having repeated attacks whenever they are brought into contact with it. This is ascribed to "idiosyncrasy"—a long word of little meaning. Possibly the difference is due to the general state of health; robust persons resist the poison successfully, those with impoverished blood and feeble constitution are mastered by it. The explanation is vague, but not without meaning if lead acts, as it is supposed to do, by destroying the red corpuscles in the blood. Robust persons, feeding heartily and keeping up an ample supply of red corpuscles, would naturally resist it better than the ill-nourished, weakly, and anæmic. The great susceptibility of pregnant women, whose nutritive functions are placed under a double strain, bears out this view, which points to the importance of good nutrition. But the different effects of contact with lead on different individuals have another explanation, which is probably more important than any factor of susceptibility—namely, the habits of the workpeople. Lead enters the body chiefly through the nose and mouth, being inspired in the form of dust or swallowed with food eaten with unwashed hands. It is very apt to get under the nails, and is possibly absorbed in this way through the skin. Personal care and cleanliness are therefore of the greatest importance. The dust may be minimized by mechanical appliances and ventilation, but so long as lead particles get on the hands and person they will be liable to be swallowed by careless workpeople. A factory surgeon of great experience in the Potteries reckons that seventeen out of twenty cases of lead poisoning in the china and earthenware industry are due to carelessness (*The Times*, 8th October 1898). This is one of the largest and most important industries affected by lead, and the one to which most attention has been drawn, mainly because of a somewhat sensational agitation in 1898. It was based on the occurrence of recent cases of a very severe and rapid character among women and girls employed in certain processes of manufacture in the Potteries district. It has had the effect of stimulating reforms in the conduct of the industry, and, incidentally, of promoting a manufacturing development of much commercial interest. The health of workpeople in the Potteries had already been the subject of a special inquiry by a scientific committee on behalf of the Home Office in 1893. The committee stated that "the general truth that the potteries occupation is one fraught with injury to health and life is beyond dispute," and that "the ill effects of the trade are referable to two chief causes—namely, dust and the poison of lead." Of these the inhalation of clay and flint dust is the more important. It leads to bronchitis, phthisis, and pneumonia, which are by far the most prevalent disorders among potters, and responsible for 70 per cent. of the mortality. That from lead the committee did not attempt to estimate, but they found that plumbism was less prevalent than in past times, and expressed the opinion "that a large part of the mortality from lead poisoning is avoidable; although it must always be borne in mind that no arrangements or rules, with regard to the work itself, can entirely obviate the effects of the poison to which workers are exposed, because so much depends upon the individual and the observance of personal care and cleanliness." They recommended the adoption of certain special rules in the workshops, with the objects of protecting young persons from the lead, of minimizing the evils of dust, and of promoting cleanliness, particularly in regard to meals. Some of these recommendations were adopted and applied with good results. With regard to the suggestion that "only leadless glazes should be used on earthenware," they did not "see any immediate prospect of such glazes becoming universally applicable to pottery manufacture," and therefore turned their attention to the question of "fritting" the lead. It may be explained here that lead is used in china and earthenware to give the external glaze which renders the naturally porous ware watertight. Both "white" and "red" lead are used. The lead is added to other ingredients, which have been "fritted" or fused together, and then ground very fine in water, making a thick creamy liquid into which the articles are dipped. After dipping the glaze dries quickly, and on being "fired" in the kiln it becomes fused by the heat into the familiar glassy surface. In the manufacture of ware with enamelled colours, glaze is mixed with the pigment to form a flux, and such colours are used either moist or in the form of a dry powder, according to the style of goods. "Fritting" the lead means mixing it with the other ingredients of the glaze beforehand and fusing them all together under great heat into a kind of rough glass, which is then ground to make the glaze. Treated in this way the lead combines with the other ingredients and becomes less soluble, and therefore less dangerous, than when added afterwards in the raw state. The committee thought it "reasonable to suppose that the fritting of lead might ultimately be found universally practicable," but declared that though fritting "no doubt diminishes the danger of lead poisoning," they "could not regard all fritts as equally innocuous."

In the annual report of the chief inspector of factories for 1897, published in 1898, it was stated that there had been "material improvement in dust conditions" in the potting industry, but "of lead poisoning unfortunately the same could not be said, the number of grave cases reported, and particularly cases of blindness, having ominously increased of late." This appears to have been largely due to the erroneous inclusion among potting processes of "litho-transfer making," a new colour industry in which girls are employed. New special rules were therefore imposed, prohibiting the employment of persons under fifteen years of age in the dangerous processes, ordering a monthly examination of all women and young persons working in lead by the certifying surgeon, with power to suspend those showing symptoms of poisoning, and providing for the more effectual removal of dust and the better enforcement of cleanliness. At the same time a scientific inquiry was ordered into the practicability of dispensing with lead in glazes or of substituting fritted compounds for the raw carbonate. The scientific experts reported in 1899, recommending that the use of raw lead should be absolutely prohibited, and expressing the opinion that the greater amount of earthenware could be successfully glazed without any lead at all. These views were in advance of the opinions held by practical potters, and met with a good deal of opposition. By the enterprise of certain manufacturers, who had been working at the problem for years, considerable progress had been made in diminishing the use of raw lead and towards the discovery of satisfactory leadless glazes, and the movement had been much stimulated by the public agitation previously mentioned; but it is a long step from individual experiments to the wholesale compulsory revolution of the processes of manufacture in so large and varied an industry, and in the face of foreign competitors hampered by no such regulations. The materials used by each manufacturer have been arrived at by a long process of experience, and they are such as to suit the particular goods he supplies for his particular market. He cannot change them suddenly without endangering the quality, and consequently risking the loss of the market. Nor does the experience of other manufacturers afford him much practical assistance, for a glaze which has been proved satisfactory for one class of goods may be quite unsuitable to another. And the varieties are endless, on account of differences in the composition of the ware and in firing. It is therefore difficult to apply a uniform rule without jeopardizing the prosperity of the industry, which supports a population of 250,000 in the Potteries alone. However, the bulk of the manufacturers agreed to give up the use of raw lead, and to fritt all their glazes in future, time being allowed to effect the change of process; but they declined to be bound to any particular composition of glaze for the reasons indicated.

In 1901 the Home Office brought forward a new set of special rules. Most of these were framed to strengthen the provisions for securing cleanliness, removing dust, &c., and were accepted with a few modifications. Strong objection, however, was raised to three of the proposed rules—namely, No. 1, which prohibited the use of unfritted lead; No. 2, which provided that "no glaze shall be used which yields to a dilute solution of hydrochloric acid more than 2 per cent. of its dry weight of a soluble lead compound calculated as lead monoxide"; and No. 6, which extended the monthly examination of women and young persons working in lead processes, with power of suspension, to men. The manufacturers objected to No. 1 and No. 2 as impracticable, and the workmen to No. 6 as unnecessary and a vexatious interference with their liberty. Arbitration between the Home Office and the objectors took place under the Factory Acts in November 1901. The arbitrator, Lord James of Hereford, after hearing the case for the Home Office, ruled that the questions in dispute should be left open for eighteen months and come up for reconsideration at the end of that time.

The arbitrator was influenced in this decision by the great diminution of lead poisoning in the industry. The number of cases notified in 1899 was 249; 1900, 200; 1901, 106. This diminution is attributed mainly to the monthly examination and the removal of dust by ventilating fans. The number of cases of lead poisoning notified in the various industries after the Act of 1895 was given in the annual report of the Chief Inspector of Factories for 1899 as follows:—

	1896.	1897.	1898.	1899.
China and Earthenware	432	446	457	249
White Lead	239	370	332	399
Smelting	56	102	82	61
Tinning and Enamelling	35	36	24	24
File-making	20	39	46	41
Paints and Colours	93	35	59	75
Glass	14	23	19	8
Coachmaking	15	18	45	65
Electric accumulator works	...	...	11	32
Litho-transfer works (only classified in 1899)	...	...	...	11
Other Industries	126	145	203	293
Total	1030	1214	1278	1258

These figures include all degrees of severity. In the return for 1899 they were classified, with the following result:—

	Severe.	Moderate.	Slight.	Not stated.
	Per cent.	Per cent.	Per cent.	Per cent.
Males	32·0	13·6	50·8	4·5
Females	21·0	17·6	54·5	6·3

The proportions of each class vary greatly in different industries. Those with the largest proportion of severe cases were file-cutting with 53·9 per cent., certain painting trades with 51·1 per cent., sheet lead with 44·3 per cent., coach-painting with 43·1 per cent., paints and colours with 42·5 per cent. In the potting industry the majority of the cases were slight—namely, males 57·1 per cent., females 60·4 per cent. The percentage of severe cases was—males 29·4, females 19·8. In the white lead industry the proportions are still more favourable, the percentage being—slight, males 68·3, females 77·3; severe, males 23·2, females 13·6. In both these industries there is periodical examination of the workpeople. Out of the whole number of cases returned, 30·4 per cent. of the males and 21·5 per cent. of the females were classed as secondary attacks or chronic cases. In 1900 the percentages in the potting trade were—severe, males 18·5, females 23·8; slight, males 57·6, females 43·8. In 1901 they were—severe, males 33·8, females 20·4; slight, males 45·6, females 51·0.

The increase shown above in the annual returns since 1896 is largely due to a corresponding increase in the number of persons employed. For 1899 there was a very notable decrease—more than 45 per cent.—in the number of cases in the potting industry. It was partly due to the elimination of cases returned twice over, which unduly inflated the returns in previous years, and partly to the operation of the special rules established in 1898. The effect of the monthly examination of women was clearly shown by the fact that the female cases, which had previously exceeded the male, fell below them in 1899. The average number of examinations every month was 223, and of suspensions 10. In 1900 the average monthly number of suspensions was 8, and in 1901 it was 7.

The following notes refer to the more important of the other industries concerned. *White Lead.*—The increase of cases shown in 1899 was largely due to the engagement at one factory of a number of Italians previously employed in smelting works, and already charged with lead, in whom the white lead dust evoked active symptoms. New special rules were adopted in 1899 for the more efficient prevention of dust, promotion of cleanliness, and weekly examination of workers. The introduction of a new method of manufacture, called the Bischof process, whereby dust is avoided, promises to effect a large diminution of danger. *File-cutting.*—This is the most injurious of all the lead industries, and causes far more cases of paralysis than any other. The great majority of the cases are returned from Sheffield, where 2990 men are employed as hand cutters of files. *Smelting.*—In this industry men are exposed to the fumes of lead and other metals, as well as to dust, sulphur, dioxide gas, and great heat. It is under special rules, but the physical difficulty of protecting workmen from fumes has not been surmounted. *Printing.*—The number of cases is very small, and far less than in Germany. Eating with unwashed hands is the chief cause. *Tinning and Enamelling.*—Carbonate of lead in powder is used in the best quality of enamelling, and the process necessarily entails much scattering of the dust. The industry is under special rules. Fritted lead has been introduced in place of the raw carbonate. *Paints and Colours.*—The danger is the inhalation of dust, which is to some extent met by the provision of ventilating fans. It is a large industry, employing, in 1897, 6019 persons in 354 factories. *Coach-painting.*—The percentage of severe and chronic cases is exceedingly high. The danger lies largely in the process of sandpapering a coat of paint to obtain a surface for another coat. The apparent increase in the number of cases is explained by the fact that notification was not at first understood, particularly in some large railway carriage works. *House-painters and Plumbers* do not come under the Factory Acts, but a considerable number of cases are notified. There is no doubt that a great deal of serious lead poisoning occurs among house-painters, but unless it is contracted in factory or workshop, as in grinding or mixing paints, the factory inspectors cannot interfere.

The regulations against industrial lead poisoning in the United Kingdom appear to be very much more complete and stringent than in any Continental country or in the United States.

Leadville, a city of Colorado, U.S.A., capital of Lake county, on the east side of the Arkansas valley, near the head of the river, at an altitude of 10,000 feet. It is the largest city at such an elevation in the United States, and probably in the world. It is situated on a gravel terrace, sloping westwards to the river, just north of California Gulch. It is regularly laid out, divided into three wards, and has a water-supply brought from the Arkansas river by gravity. It is entered by three railways, the Colorado Midland, the Denver and Rio Grande, and the Colorado Southern, which connect it with Denver, Colorado Springs, Pueblo, and Salt Lake. In 1859 gold in placers was discovered in California Gulch, just south of the present city, and in the succeeding five years from $12,000,000, to $15,000,000 worth was taken from it. Indeed, in the heyday of its prosperity California Gulch was as busy and populous as was Leadville twenty years later; but on the exhaustion of its placers the region was almost deserted, 100 or 200 inhabitants, constituting the town of Oro, being all that were left. The accidental discovery here in 1878 of lead carbonates containing silver in vast quantities caused a mining excitement over the whole country, and a second stampede to California Gulch ensued, paralleled only by the first. Two years later, in 1880, Leadville had a population of 14,820. Many very rich mines were discovered and worked, and the district as a whole is still as productive as ever. The ore is mainly a carbonate of lead, but with many accessory metals and combinations. It lies in beds or sheets, between old rock strata much broken by faults and dislocations. The yield of the mines is about $13,000,000 in silver annually, besides a vast amount of lead and other metals. Most of the ore is smelted at Leadville, and the matte transported east for refining. Population (1890), 10,384; (1900), 12,455, of whom 3802 were foreign-born.

Leamington, Leamington Priors, or Royal Leamington Spa, a municipal borough and inland watering-place of Warwickshire, England, on the Leam, 98 miles north-west of London by rail. In 1885 the boroughs of Warwick and Leamington were united in one constituency, returning one member to Parliament. The parish church of All Saints is mostly modern. Recent erections are a theatre and a town hall, containing a free library and a school of art. There is a municipal technical school. There are iron-foundries and brickworks. Area of civil parish, 1595 acres. Population (1891), 26,930; (1901), 26,888.

Lear, Edward (1812–1888), English artist and humorist, was born in London on 12th May 1812. His earliest drawings were ornithological. When he was twenty years old he published a brilliantly coloured selection of the rarer *Psittacidæ*. Its power attracted the attention of the 13th earl of Derby, who employed Lear to draw his Knowsley menagerie. He became a permanent favourite with the Stanley family; and Edward, 15th earl, was the child for whose amusement the first *Book of Nonsense* was composed. From birds Lear turned to landscape, his earlier efforts in which recall the manner of J. D. Harding; but he quickly acquired a more individual style. About 1837 he set up a studio at Rome, where he lived for ten years, with summer tours in Italy and Sicily, and occasional visits to England. During this period he began to publish his *Illustrated Journals of a Landscape Painter:* charmingly written reminiscences of wandering, which ultimately embraced Calabria, the Abruzzi, Albania, Corsica, &c. His wider flights date from 1848–49, when he explored Greece, Constantinople, the Ionian Islands, the wildest recesses of Albania, Lower Egypt, and the desert of Mount Sinai. He returned to London, but the climate did not suit him. In 1854–55 he wintered on the Nile, and migrated successively to Corfu, Malta, and Rome, till he finally settled on the Riviera, building himself a villa at San Remo, where he closed a career of untiring industry. From Corfu Lear visited Mount Athos, Syria, Palestine, and Petra; and when over sixty, by the generous assistance of his intimate friend Lord Northbrook, then Governor-General, he saw the cities and scenery of greatest interest within a large area of India. From first to last he was, in whatever circumstances of difficulty or ill-health, an indomitable traveller. Before visiting new lands he studied their geography and literature, and then went straight for the mark; and wherever he went he drew most indefatigably and most accurately. His sketches are not only the basis of more finished works, but an exhaustive record in themselves. Some defect of technique or eyesight occasionally left his larger oil painting, though nobly conceived, crude or deficient in harmony; but his smaller pictures and more elaborate sketches abound in beauty, delicacy, and truth. Lear modestly called himself a topographical artist; but he included in the term the perfect rendering of all characteristic graces of form, colour, and atmosphere. The last task he set himself was to prepare for popular circulation a set of some 200 drawings, illustrating from his travels the scenic touches of Tennyson's poetry; but he did not live to complete the scheme, dying at San Remo on 30th January 1888. Until sobered by age, his conversation was brimful of humorous fun. The paradoxical originality and ostentatiously uneducated draughtsmanship of his numerous nonsense books appealed to a wider public, and won him a more universal fame than his serious work. He had a true artist's sympathy with art under all forms, and might have become a skilled musician had he not been a painter. Swainson, the naturalist, praised young Lear's great red and yellow macaw as "equalling any figure ever painted by Audubon in grace of design, perspective, and anatomical accuracy." Murchison, examining his sketches, complimented them as rigorously embodying geological truth. Tennyson's lines "To E. L. on his travels in Greece," mark the poet's genuine admiration of a cognate spirit in classical art. Ruskin placed the *Book of Nonsense* first in the list of a hundred delectable volumes of contemporary literature, a judgment endorsed by English-speaking children all over the world. (F. L*.)

Leavenworth, a city of Kansas, U.S.A., capital of Leavenworth county, on the west bank of the Missouri river, at an altitude of 765 feet. It is laid out regularly in the bottom-lands of the river, and is divided into six wards. It is the fourth city of the state in population, and one of the most important railway centres west of the Mississippi river, no fewer than nine railways entering it. These, with the steamboats on the river, give the city a large trade. Its manufactures are also prominent, and are varied in character. Two miles north of the city is Fort Leavenworth, a United States military post, associated with which is a military prison and a well-known military school. Population (1890), 19,768; (1900), 20,735, of whom 3402 were foreign-born and 2925 were negroes.

Lebanon.—Since 1875 great progress has been made in that part of the Lebanon which was made an independent sanjak under a Christian governor in 1861. The population has almost doubled, villages have largely increased in size, nearly all available ground has been brought under cultivation, roads have been made, the Beirút–Damascus railway, opened in 1895, crosses the district, and a short line runs northwards along the coast from Beirút to Mameltein. The steady growth of prosperity has been accompanied by a rapid increase of population, and this of late years has become larger than the land can support. The result has been emigration, which the Porte has vainly attempted to stop, of Druses to the Haurán, and of Christians to the United States and Egypt. It has been estimated that the annual number of emigrants, chiefly from the sanjak, is 10,000, and that of these one-fifth settle abroad. The others return to their homes after having earned enough for their simple requirements. Since the British occupation of Egypt the emigration to that country has assumed large proportions. There the Syrians fill many of the minor posts in the ministries and local governments, are employed as interpreters to the army, and work on the staffs of the Arabic newspapers published at Cairo and Alexandria. Population, about 400,000—Christians (including 230,000 Maronites and 54,000 Orthodox Greeks), 320,000; Druses, 50,000; Moslems, Sunni, and Metawile, 30,000.

See Cuinet. *Syrie, Liban, et Palestine.* Paris, 1896.—Von Oppenheim. *Vom Mittelmeer zum Persischen Golf.* Berlin, 1900.—Post. *Flora of Syria, Palestine, and Sinai*, 1896.
(c. w. w.)

Lebanon, a city of Pennsylvania, U.S.A., capital of Lebanon county, on Swatara Creek, in Cumberland Valley, south of Blue Mountain, at an altitude of 464 feet. Its site is rolling and its plan regular. It has three railways, the Philadelphia and Reading, the Cornwall, and the Cornwall and Lebanon. It is an iron manufacturing city, containing blast-furnaces, rolling-mills, and foundries. Population (1890), 14,664; (1900), 17,628, of whom 618 were foreign-born.

Lebœuf, Edmond (1809–1888), French soldier, was born at Paris on the 5th of November 1809, and received his military training at the Artillery School at Metz, becoming colonel in 1852. He commanded the artillery of the 1st French corps at the siege of Sebastopol, and was promoted in 1855 to the rank of general, and in 1857 to that of general of division. In the Franco-Italian war of 1859 he commanded the artillery, and by his action at Solferino materially assisted in the victory. In September 1866 he was despatched to Venetia to hand over that province, which had been ceded by Austria, to Victor Emmanuel. In 1869, on the death of Marshal Niel, General Lebœuf became Minister of War, and earned public approbation by his vigorous reorganization of the War Office and the civil departments of the service. In the spring of the fateful year 1870 he received the field-marshal's baton. On the declaration of war with Germany Marshal Lebœuf delivered himself in the Corps Législatif of the historical saying, "So ready are we, that if the war lasts two years, not a gaiter button would be found wanting." He took part in the campaign as major-general of the army of the Rhine, but after the reverses at Weissembourg and Woerth was deprived of this command and placed at the head of the 3rd corps, distinguishing himself by his personal bravery at the battles of Noiseville and St Privat. Shut up with Bazaine in Metz, on its fall he was confined as a prisoner in Germany. On the conclusion of peace he returned to France and gave evidence before the commission of inquiry into the surrender of that stronghold, when he strongly denounced Bazaine. After this he retired into private life to the Château du Moncel near Argentan, where he died on the 7th of June 1888.

Le Caron, Henri (whose real name was Thomas Miller Beach) (1841–1894), British secret service agent, was born at Colchester, 26th September 1841. He was of an adventurous character, and when nineteen years old went to Paris, where he found employment in business connected with America. Infected with the excitement of the American Civil War, he crossed the Atlantic in 1861 and enlisted in the Northern army, taking the name of Henri Le Caron when he did so. In 1864 he married a young lady who had helped him to escape from some Confederate marauders; and by the end of the war he rose to be major. In 1865, through a companion in arms named O'Neill, he was brought into contact with Fenianism, and having learnt of the Fenian plot against Canada, he mentioned the designs when writing home to his father. Mr Beach told his local M.P., who in turn told the Home Secretary, and the latter asked Mr Beach to arrange for further information. Le Caron, inspired (as all the evidence shows) by genuinely patriotic feeling, from that time till 1889 acted for the British Government as a paid military spy. He was a proficient in medicine, among other qualifications for this post, and he remained for years on intimate terms with the most extreme men in the Fenian organization under all its forms. His services enabled the British Government to take measures which led to the fiasco of the Canadian invasion of 1870 and Riel's surrender in 1871, and he supplied full details concerning the various Irish-American associations, in which he himself was a prominent member. He was in the secrets of the "new departure" in 1879–81, and in the latter year had an interview with Parnell at the House of Commons, in the course of which the Irish leader spoke sympathetically of an armed revolution in Ireland. For twenty-five years he lived at Detroit and other places in America, paying occasional visits to Europe, and all the time carrying his life in his hand. The Parnell Commission of 1889 put an end to this. Le Caron was subpœnaed by *The Times*, and in the witness-box the whole story came out, all the efforts of Sir Charles Russell in cross-examination failing to shake his testimony or to impair the impression of iron tenacity and absolute truthfulness which his bearing conveyed. His career, however, for good or evil, was at an end. He published the story of his life, *Twenty-five Years in the Secret Service*, and it had an immense circulation. But he had to be constantly guarded, his acquaintances were hampered from seeing him, and he was the victim of a painful disease, of which he died on 1st April 1894. The report of the Parnell Commission is his monument.

Lecce, a town, episcopal see, and capital of the province of Lecce, Apulia, Italy, 24 miles south-east of Brindisi by rail. In the prefecture there are collections of antique vases, coins, inscriptions, &c. In 1889 a monument of Victor Emmanuel II. by Maccagni was unveiled. The staple industry is the manufacture of tobacco. In 1900 Lecce was connected by electric tramway with San Cataldo, on the coast 6 miles to the east, where a small fishing port has been made. Population (1881), 22,051; (1901), 32,485.

Lecco, a town of the province of Como, Lombardy, Italy, on the east side of the south-east extension of Lake Como, and 27 miles north by east of Milan by rail. There are statues to Garibaldi (1881) and Manzoni (1891), whose house is called Galeotto, not Caleotto. Besides the silk, cotton, and iron industries, there are copper works, and factories for wax candles and tin boxes; also a school of the industrial arts and sciences. Population (1881), 7775; (1897), 6100.

Lech, a river of Bavaria, rising in the Vorarlberg Alps, at an altitude of 6120 feet. It winds out of the gloomy limestone mountains in a north-north-easterly direction, and enters the plains at Füssen (2580 feet), where it forms rapids and a fall, then pursues a northerly course past Augsburg (where it receives the Wertach), and joins the Danube from the right just below Donauwörth (1330 feet). Its total length is 177 miles. Its drainage basin has an area of 2550 square miles. It is not navigable, owing to its torrential character and the gravel beds which choke its channel. More than once great historic events have been decided upon its banks. On the Lechfeld, a stony waste some miles long, between the Lech and the Wertach, the Emperor Otho I. defeated the Hungarians in 955. Tilly, in attempting to defend the passage of the stream at Rain against the forces of Gustavus Adolphus, was fatally wounded, on 5th April 1632.

Lecky, William Edward Hartpole (1838–——), Irish historian and publicist, was born at Newtown Park, near Dublin, on 26th March 1838, being the eldest son of John Hartpole Lecky, whose family have for many generations been landowners in Ireland. He was educated at Kingstown, Armagh, and Cheltenham College, and at Trinity College, Dublin, where he graduated B.A. in 1859 and M.A. in 1863, and where, with a view to becoming a clergyman in the Irish Protestant Church, he also went through a course of divinity. In 1860 he published anonymously a small book entitled *The Religious Tendencies of the Age*, but on leaving college he soon abandoned his first intention and turned to historical work. In 1861 he published *The Leaders of Public Opinion in Ireland*, a brief sketch of the lives and work of Swift, Flood, Grattan, and O'Connell, which gave decided promise of his later admirable work in the same field. This book, originally published anonymously, was republished in 1871; and the essay on Swift, rewritten and amplified, appeared again in 1897 as an introduction to a new edition of Swift's works. Two learned surveys of certain aspects of European history followed: *A History of the Rise and Influence of Rationalism in Europe* (2 vols., 1865), and *A History of European Morals from Augustus to Charlemagne* (2 vols., 1869). Some criticism was aroused by these books, especially by the last named, with its opening dissertation on "the natural history of morals," but both have been generally accepted as acute and suggestive commentaries upon a wide range of facts. Lecky then devoted himself to the chief work of his life, *A History of England during the Eighteenth Century*, vols. i. and ii. of which appeared in 1878, and vols. vii. and viii. (completing the work) in 1890. His object was "to disengage from the great mass of facts those which relate to the permanent forces of the nation, or which indicate some of the more enduring features of national life," and there can be no doubt that in the carrying out of this task Lecky displays many of the qualities of a great historian. The work is distinguished by the lucidity of its style, by the fulness and extent of the authorities referred to, and, above all, by the judicial impartiality maintained by the author throughout. These qualities are perhaps most conspicuous and most valuable in the chapters which deal with the history of Ireland, and in the cabinet edition of 1892, in 12 vols. (frequently reprinted) this part of the work is separated from the rest, and occupies five volumes under the title of *A History of Ireland in the Eighteenth Century*. A volume of *Poems*, published in 1891, was characterized by a certain frigidity and by occasional lapses into commonplace, objections which may also be fairly urged against much of Lecky's prose-writing. In 1896 he published two volumes on contemporary politics, entitled *Democracy and Liberty*, in which he considered, with special reference to Great Britain, France, and America, some of the tendencies of modern democracies. The somewhat gloomy conclusions at which he arrived provoked much criticism both in Great Britain and America, which was renewed when he published in a new edition (1899) an elaborate and very depreciatory estimate of Gladstone, then recently deceased. This work, though essentially different from the author's purely historical writings, has many of their merits, though it was inevitable that other minds should take a different view of the evidence. In *The Map of Life* (1900) he discussed in a popular style some of the ethical problems which arise in everyday life. Though always a keen sympathizer with the Irish people in their misfortunes and aspirations, and though he had criticized severely the methods by which the Act of Union was passed, Lecky was from the first strenuously opposed to Gladstone's policy of Home Rule, and in 1895 he was returned to Parliament as Unionist member for Dublin University. In 1897 he was made a privy councillor; and among the Coronation Honours in 1902 he was nominated an original member of the new Order of Merit. His university honours include the degree of LL.D. from Dublin, St Andrews, and Glasgow, the degree of D.C.L. from Oxford, and the degree of Litt.D. from Cambridge. In 1894 he was elected corresponding member of the Institute of France. He contributed occasionally to periodical literature, and two of his addresses, *The Political Value of History* (1892) and *The Empire, its Value and its Growth* (1893), were published. He married in 1871 Elizabeth, baroness de Dedem, daughter of baron de Dedem, a general in the Dutch service. Mrs Lecky has contributed to various reviews a number of articles, chiefly on historical and political subjects.

Lecocq, Alexandre Charles (1832–——), French musical composer, was born in Paris, 3rd June 1832. He was admitted into the Conservatoire in 1849, being already an accomplished pianist. He studied under Bazin, Halévy, and Benoist, winning the first prize for harmony in 1850, and the second prize for fugue in 1852. He first gained notice by dividing with Bizet the first prize in a competition for an operetta instituted by Offenbach. His operetta, *Le Docteur Miracle*, was performed at the Bouffes Parisiens in 1857. After that he wrote constantly for theatres, but produced nothing worthy of mention until *Fleur de Thé* (1868), which ran for more than a hundred nights. *Les Cent Vierges* (1872) was favourably received also, but all his previous successes were cast into the shade by *La Fille de Madame Angot* (Paris, 1873; London, 1873), which was performed for 400 nights consecutively, and has since gained and retained enormous popularity all over the civilized world. Since 1873 Lecocq has produced a large number of comic operas, though he has never equalled his early triumph in *La Fille de Madame Angot*. Among the best of his pieces are *Giroflé-Girofla* (Paris and London, 1874); *Les Prés Saint Gervais* (Paris and London, 1874); *La Petite Mariée* (Paris, 1875; London, 1876, revived as *The Scarlet Feather*, 1897); *Le Petit Duc* (Paris, 1878; London, as *The Little Duke*, 1878); *La Petite Mademoiselle* (Paris, 1879; London, 1880); *Le Jour et la Nuit* (Paris, 1881; London, as *Manola*, 1882); *Le Cœur et la Main* (Paris, 1882; London, as *Incognita*, 1893); *La Princesse des Canaries* (Paris, 1883; London, as *Pepita*, 1888). In 1899 a ballet by M. Lecocq, entitled *Le Cygne*, was produced at the Opéra Comique in Paris. Of late years his compositions, though produced somewhat less rapidly, have not equalled the success of his earlier works. His works have a finish, both as regards the vocal writing and the instrumentation, which it would be vain to seek in the productions of most of his contemporaries.

Leconte de Lisle, Charles Marie René (1818–1894), the most scholarly of modern French poets, was born in the island of Réunion, 23rd October 1818; he died at Paris, 17th July 1894. Most of his life, from at least his thirtieth year, was spent in Paris, where he lived a quiet life among books. In 1873 he was made librarian at the Luxembourg; in 1887 he was elected to the Academy in succession to Victor Hugo. His *Poèmes Antiques* appeared in 1852; the *Poèmes Barbares*, in their first form, in 1862; *Les Erinnyes*, a tragedy after the Greek model, in 1873; the *Poèmes Tragiques* in 1884; *L'Apollonide*, another classical tragedy, in 1888; and *Derniers Poèmes*, after his death, in 1899. In addition to his original work in verse, he published a series of admirable prose translations of Homer, Hesiod, Æschylus, Sophocles, Euripides, Virgil, Horace. In Leconte de Lisle the Parnassian movement seems to crystallize. His verse is clear, sonorous, dignified, deliberate in movement, classically correct in rhythm, full of exotic local colour, of savage names, of realistic rhetoric. It has its own kind of romance, in its "legend of the ages," so different from Hugo's, so much fuller of scholarship and the historic sense, yet with so far less of human pity. Coldness cultivated as a kind of artistic distinction seems to turn all his poetry to marble, in spite of the fire at its heart. Most of Leconte de Lisle's poems are little chill epics, in which legend is fossilized. They have the lofty monotony of a single conception of life and of the universe. He sees the world as what Byron called it, "a glorious blunder," and desires only to stand a little apart from the throng, meditating scornfully. Hope, with him, becomes no more than this desperate certainty:—

> "Tu te tairas, ô voix sinistre des vivants !"

His only prayer is to Death, "divine Death," that it may gather its children to its breast:—

> "Affranchis-nous du temps, du nombre et de l'espace,
> Et rends-nous le repos que la vie a troublé !"

The interval which is his he accepts with something of the defiance of his own Cain, refusing to fill it with the triviality of happiness, waiting even upon beauty with a certain inflexible austerity. He listens and watches, throughout the world, for echoes and glimpses of great tragic passions, languid with fire in the East, a tumultuous conflagration in the Middle Ages, a sombre darkness in the heroic ages of the North. The burning emptiness of the desert attracts him, the inexplicable melancholy of the dogs that bark at the moon; he would interpret the jaguar's dreams, the sleep of the condor. He sees nature with the same wrathful impatience as man, praising it for its destructive energies, its haste to crush out human life before the stars fall into chaos, and the world with them, as one of the least of stars. He sings the "Dies Iræ" exultingly; only seeming to desire an end of God as well as of man, universal nothingness. He conceives that he does well to be angry, and this anger is indeed the personal note of his pessimism; but it leaves him somewhat apart from the philosophical poets, too fierce for wisdom and not rapturous enough for poetry. (A. SY.)

Leech.—The group of leeches, Hirudinea, are now certainly known to be related to the Oligochæta, and not, as was formerly thought, to the Platyhelminths. They share with the Oligochæta the following characters, the greater part of which are most pronounced in the genus *Acanthobdella.* The body is regularly segmented, and two or three segments are modified into a clitellum, which secretes the cocoon in which the eggs are contained. Paired setæ are present on five of the anterior segments of *Acanthobdella* (Fig. 1), which have the form of Oligochætous setæ, and are much hooked at the tip and proportionately large, as in the tail setæ of the earthworm genus *Onychochœta.* The existence of branchiæ in *Branchiobdella* and *Cystobranchus* is paralleled in the Oligochæta, the more complex gills of the former genus being comparable to those of *Alma,* and the simpler gills of *Cystobranchus* to those of *Branchiura* and *Hesperodilus.* The universal sucker of the leeches and the chitinous jaws characteristic of many of them are to be found also in the undoubted Oligochæte family Discodrilidæ. The generative pores are median and single, the male pore being in front of the female pore. This is not so general in the Oligochæta, but is found in various genera, and in the Eudrilid *Polytoreutus* there is the same relative position of male and female pore coupled with their median position. All leeches possess a cœlom (Fig. 2) which is (in the embryo, and permanently in the case of *Acanthobdella*) arranged in a series of chambers, separated by septa, as in the Oligochætes. The large obliteration of the cœlom, in the majority of forms, led to the comparison of these animals with the Platyhelminths, where the cœlom seems to be limited to the intra-gonadial chambers, and perhaps to a few scattered lacunæ in the "mesenchyme" (though these latter spaces are possibly more comparable to a feeble and commencing vascular system). The nephridia are paired and of the same structure as in the Oligochætes. There is a complex vascular system, consisting of at any rate a dorsal and a ventral trunk, with capillary networks in the body wall and upon the walls of the gut. In general this is comparable to that of the Oligochæta. The organs of reproduction are at first sight different, and do differ in detail from those of the Oligochæta. The testes are either a number of separate pairs of round bodies or (in *Acanthobdella*) a single pair of elongated structures lying along the sides of the body (Fig. 3). They lie in chambers which are undoubtedly cœlomic, but their ducts are continuous with them. This is also the case with the ovaries

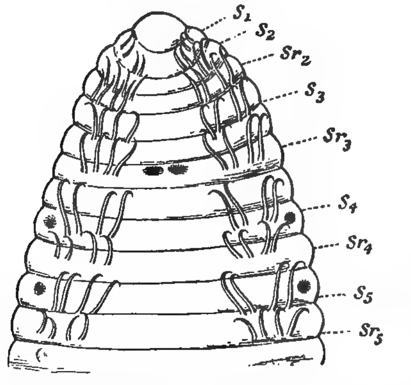


FIG. 1.—*Acanthobdella,* from the ventral surface, showing the five sets of setæ (S_1 to S_5) and the replacing setæ (Sr_1 to Sr_5) behind them. The three pairs of pigmented spots show the position of the eyes on the dorsal surface. (*After Kowalewsky.*)

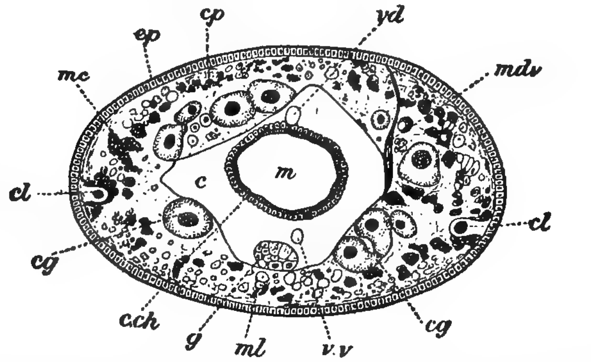


FIG. 2.—Section of *Acanthobdella* (*after Kowalewsky*). *c*, cœlom; *c.ch*, cœlomic epithelium (yellow-cells); *cy*, glandular cells; *cl*, muscle cells of lateral line; *cp*, pigment cells; *ep*, ectoderm; *g*, nerve cord; *m*, intestine; *mc*, circular muscle; *ml*, longitudinal muscle; *vd*, dorsal vessel; *vv*, ventral vessel.

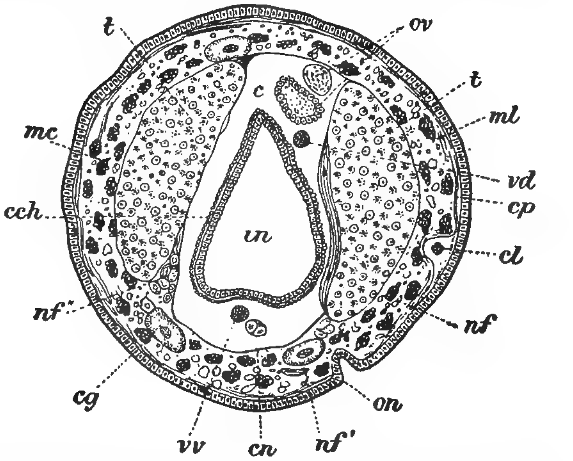


FIG. 3.—Section of *Acanthobdella* (*after Kowalewsky*). Identical letters as in Fig. 2; in addition, *cn*, nerve cord; *in*, intestine; *nf*, parts of nephridium; *on*, external opening of nephridium; *ov*, ova; *t*, testis.

and oviducts. It seems to be possible that we have here to do with a state of affairs which is different from that of most earthworms, but comparable to what is found in the Eudrilidæ. There is, in short, no salient feature which distinguishes all leeches from all earthworms. Indeed, even in the smallest particulars unexpected resemblances occur. Thus in both groups the epidermis may be invaded by blood capillaries, and the structure of the muscle fibres once regarded as peculiar to the leeches is also characteristic of earthworms. In the limited clitellum, which generally occupies segments ix., x., xi., in the forward position of the gonads, and the external apertures of their ducts, tenth and eleventh (seventh and eighth in *Acanthobdella*), and in the limited number of segments of which the body is composed (not more than thirty-three), the leeches seem to be particularly like certain of the lower aquatic Oligochæta.

The leeches are characterized by their form, which is generally somewhat or very much flattened, and wider at the posterior than at the anterior end. There are an anterior and a posterior sucker as a rule. The anus opens dorsally to the posterior sucker; the mouth is in the middle of the anterior sucker. The characteristic form of the body is lost in *Lumbricobdella,* which lives in the soil and which has no posterior sucker at all.

The anterior end of the body is provided with eyes, which appear to be simply specializations of sense-organs found upon other segments of the body, and arranged with accurate reference to the segmentation. In the majority of leeches the body cavity is much modified, and reduced by the abundant growth of connective tissue in the body-wall to the state of a complex system of tubes. It has been asserted, denied, and reasserted, that this system of tubes which represents the cœlom is in communication with the vessels of the vascular system. The observations of Goodrich appear to have conclusively shown that this connexion exists. The leeches possess paired and metamerically-disposed nephridia. In *Pontobdella* alone, so far as is known, the nephridial system forms a network from segment to segment. It is interesting to note that in *Branchiobdella* the nephridia lie behind the limits of the cœlom between the testes and the cœlom. In the Capitellidæ the nephridia are in the same way retroperitoneal. A pervious funnel may or may not exist; in *Hirudo* the representative of the funnel is a "cabbage-head-like mass" of cells which has not a cœlomic orifice at all. In the more simple organized *Glossiphonia* there is a plain internal aperture.

The mouth cavity has or has not sharp-edged chitinous jaws; the canal which follows is either more simple or complicated by lateral diverticula; in *Aulastoma* there is but one pair of these diverticula. The gonads, as already mentioned, are hollow and continuous with their ducts. Generally there are six to ten pairs of globular and metamerically-arranged testes, whose products are collected by means of a branch apiece into a longitudinal sperm duct which opens anteriorly into a muscular penis. A remarkable fact concerning the spermatophores has been discovered by Whitman. It appears that in *Glossiphonia plana* the spermatophore is attached anywhere to the body of another individual, and that the spermatozoa issuing therefrom find their way through the body-wall into the interior of the body. Like the Oligochæta, leeches are hermaphrodite; the ovaries are small rounded bodies or long masses of germinal tissue, and they are contained in a sac which communicates with a duct which becomes muscular before the external orifice, and constitutes a vagina. There are no structures corresponding to the spermathecæ of Oligochæta. A cocoon is not always, but is often, formed. Some leeches carry their eggs about with them, and others deposit them upon stones and such like places.

The Hirudinea may be divided into three families:—

(1) **Rhynchobdellidæ.**—A protrusible proboscis exists, but there are no jaws. The blood is colourless. Marine and fresh-water forms. *Pontobdella*, *Piscicola*, *Glossiphonia*, *Branchellion*, *Batrachobdella*, &c.

(2) **Gnathobdellidæ.**—Hirudinea with no proboscis, but with well-developed or vestigial jaws. The blood is red. Fresh-water or terrestrial. *Trocheta Hirudo*, *Aulastomum*, *Nephelis*, *Hæmadipsa*, &c.

(3) **Acanthobdellidæ.**—A protrusible proboscis present, but short. On five anterior segments setæ of the oligochætous pattern are present, accompanied by reserve setæ. Male and female pores more anterior in position than in other families. Cœlom divided into twenty compartments by septa. Testes form a pair of continuous tubes. *Acanthobdella*, &c. (F. E. B.)

Leeds, a city (1893), municipal, county (1888), and parliamentary borough of Yorkshire, England, on the Aire, 25½ miles by rail south-west of York, 185 miles by rail north-north-west of London; station on the Great Northern, Midland, North-Eastern, North-Western, and Lancashire and Yorkshire railways. In 1885 the parliamentary borough was parcelled out into five divisions, returning each one member. In 1897 the chief magistrate was raised to the dignity of Lord Mayor. The city is practically cut into halves by the river Aire, over which there are now eight bridges. There are more than 60 Established and 7 Roman Catholic churches, and about 150 Dissenting places of worship. Yorkshire College, erected on its new site of 3½ acres in 1885 at a cost of £150,000 became in 1887 one of the constituent colleges of the Victoria University, Manchester. Important additions, as well in its buildings as in its departments and equipments of study, include a hall of residence, an engineering department (1886), a central hall and library (1894), a medical department (1894), and a textile department. The attendance at the college during the session 1900–01 numbered 795 day and 339 evening students. Other educational institutions are a day training college (1891), as a branch of the Yorkshire College; the Yorkshire Ladies' Council of Education, for the promotion of female education and the instruction of girls and women of the artisan class of domestic economy, &c. The School Board has 64 schools and 4 industrial schools under its control, with a number on roll of 54,750 and an average attendance of 49,100. There are also 39 National and 10 Catholic schools. Amongst newer buildings may be mentioned the municipal offices (1884), costing £120,000; the city art gallery (1888); the Coliseum (1885); five sets of corporation baths (1895); corporation Turkish baths (1898); general post office (1896); extension of general infirmary (1892), costing £48,671; Manston Hall (97 acres), for fever patients, purchased 1896; cattle market (1886); meat market (1899), costing £42,000. The corporation has expended large sums of money on street improvements, clearing of insanitary areas, electrical equipment of tramways, and provision of additional parks and recreation grounds in various parts of the city. The city fever and smallpox hospitals are being extended at a cost of upwards of £200,000. New general markets are also being built at the estimated cost of £100,000. Leeds is the largest producer of leather in England, though no sole leather is tanned. The largest source of supply of hides is British India, from which some 20,000 arrive every week half-tanned in India and finished in Leeds, and about 15,000 every week raw or "arsenic-cured." Other industries include machine-made clothing, hats and caps, boots and shoes, nails, and artificial silk. In 1891 there were 9208 persons engaged in the making of machinery; 7615 males and 9152 females in the manufacture of wool and worsted fabrics; 1398 males and 784 females in the production of mixed materials; 3204 persons in furriery, tannery, and curriery; 9229 persons in the iron and steel manufactures; and 2520 in coal-mining. There are 5 daily newspapers. The rateable value of the city amounted (31st March 1901) to £1,741,373; and the income derived from the city rate, £174,457; from other sources, £84,423. The debt of the Urban District Council amounted (31st March 1901) to £7,218,816. Area of the municipal and parliamentary borough, which are coextensive, 21,572 acres. Population (1881), 309,119; (1891), 367,505; (1901), 428,968. (C. N.)

Leek, a market town in the Leek parliamentary division of Staffordshire, England, 24 miles north by east of Stafford by rail. Modern erections are Established and Roman Catholic churches, an institute (containing free library, lecture-hall, art galleries, and school of art), a technical school, and extensive almshouses. Sewing silk, braids, buttons of silk, &c., are manufactured. Area of civil parish (an urban district), 1440 acres. Population (1881), 12,863; (1891), 14,128; (1901), 15,484.

Leeuwarden, capital of the Dutch province of Friesland, on the Ee, 31 miles west of Groningen. Of modern foundation are the museum of the Frisian Society, with its ethnographical and antiquarian collections, and a commercial school. The law courts have been restored since 1895, and now contain the provincial library and archives. Population (1900), 32,203.

Leeward Islands, a group of British West India Islands, under one Governor-General, divided into five provinces, namely, Antigua (with Barbuda and Redonda), St Kitts (with Nevis and Anguilla), Dominica, Montserrat, and the Virgin Islands. There is one Federal Executive Council nominated by the Crown, and one Federal Legislative Council—ten nominated and ten elected members. Of the latter, four are chosen by the unofficial members of the local Legislative Council of Antigua, two by those of Dominica, and four by the non-official members of the local Legislative Council of St Kitts Nevis. In Antigua and Dominica the representative element in the legislature was suppressed in 1898. The Federal Legislative Council meets once a year. For details see articles on the separate islands.

Legal Education.—In England the teaching of English law was until recent times exclusively professional in character. It was left almost entirely in the hands of members of the legal profession. It is true that from the 12th century onwards law was taught in one or both of the great English universities. But the law so taught was the Roman law or the Canon law. Until Blackstone began to lecture at Oxford in 1754, the English universities gave no assistance in the teaching or in the scientific exposition of English law. This may have been, as was suggested by Chief Justice Fortescue, because the laws of the land were to be learned in three tongues, the English, the French, and the Latin, while the universities conducted their teaching in the Latin tongue alone. It may have been because, for centuries after the reign of Edward I., the law of England was a technical and obscure craft, incapable of forming part of a scheme of liberal education. Whatever the reason, it is certain that in the craft of the law, as in other crafts, the training of students and apprentices was left to those who were themselves members of the craft. As long as there was a real corporate life among the members of the Inns of Court, the work of education was regarded as one of the most important of the duties of the fellows of the society of each Inn, and practising lawyers took part actively and personally in that work. Students came together to reside in the Inns of Court and Inns of Chancery, which were established in the regions near Holborn and Temple Bar. The convenience of this situation was remarked by Fortescue. The Inns were placed in the suburbs of the City, that the quietness of the students might not be disturbed, and near the King's Court, that students might daily have access thereto without weariness. Inns or hostels for students were certainly in existence in this quarter as early as the reign of Edward III. When Fortescue wrote his treatise *De Laudibus Legum Angliæ* in the 15th century, the four Inns of Court and the ten Inns of Chancery were fully organized. A student entered first at an Inn of Chancery, and later, growing to ripeness, he was admitted to an Inn of Court. The Inns together constituted, according to Fortescue, "an university or schoole of all commendable qualities requisite for noblemen." At the Inns of Court readings were delivered by the benchers, generally, it is to be observed, on a statute, rather than on fundamental legal principles. Such famous names as Littleton, Coke, and Bacon are to be found among the names of the readers. At the Inns of Chancery the education of students was undertaken by barristers from the Inns of Court. Besides the readings, there were regular moots and bolts, at which the acquisition of the art of advocacy was encouraged by the arguing of fictitious legal cases.

Inns of Court.

In the 16th and 17th centuries the corporate life of the Inns of Court became less and less active. The general decay of the organization of crafts and guilds showed itself among lawyers as among other craftsmen. Successful barristers, sharing in the general prosperity of the country, became less and less able and willing to devote their time to the welfare of their profession as a whole. The Inns of Chancery, though some of their buildings still remain—picturesque survivals in their "suburbs"—have long ceased to be used as places for the education of students. The benchers of the Inns of Court, until the revival towards the middle of the 19th century, had wholly ceased to concern themselves with the systematic teaching of law.

Council of Legal Education.

The modern system of legal education may be said to date from the establishment, in 1852, of the Council of Legal Education, a body of twenty judges and barristers appointed by the four Inns of Court to control the legal education of students preparing to be called to the bar. The most important feature is the examination which a student must pass before he can be called. The examination serves the double purpose of fixing the compulsory standard which all must reach, and of guiding the reading of students who may desire, sooner or later, to carry their studies beyond this standard. The subjects in which the examination is held are divided into six groups: Roman Law; Constitutional Law and Legal History; Evidence, Procedure, and Criminal Law; Real and Personal Property; Equity; and Common Law. The subjects in the first three groups may be taken, either separately or together, earlier than the subjects in the last three groups. On each group of subjects a single paper of written questions is set, to be answered in three hours, and each candidate is also asked a few short questions *vivâ voce.* The Council of Legal Education also appoint a body of Readers and Assistant Readers, nine in number, who deliver lectures and hold classes on the subjects of the examinations. The Reader and Assistant Reader in Roman Law also give part of their time to instruction in Jurisprudence and International Law, but the time given to these subjects is necessarily limited. The Readers and Assistant Readers are all practising barristers, and the instruction given by them is intended not merely to enable their pupils to pass the examinations, but also to give them a practical preparation for actual work at the bar.

The lectures and classes, though primarily intended for students preparing for the bar, are open to persons who are not members of any Inn of Court. The Council of Legal Education also provide for occasional courses of evening lectures on special subjects, delivered by barristers who are recognized authorities on these subjects. These special courses of lectures are generally attended by large numbers of students, but they can hardly be said to form part of any definite system of education.

Reading in chambers.

It is the general opinion of English lawyers that the best education in the principles and practice of the law is not and cannot be obtained from any lectures or formal instruction. Law, like other arts and sciences, is learnt rather than taught. For any one who is capable of learning, the text-books which now cover the whole ground of legal study afford opportunities which did not exist when Littleton and Coke lectured. Still more important is the universal custom by which a student reads for a year or more as a pupil in the chambers of some practising barrister. In the 18th century it first became usual for students to read with a solicitor or attorney, and after a short time the modern practice grew up of reading in the chambers of a conveyancer, equity draftsman, or special pleader, or, in more recent times, in the chambers of a junior barrister. The value of the education so obtained varies in different cases. Sometimes the advantages gained consist only in the insight obtained into actual work and into the manner in which an experienced lawyer deals with it. Sometimes the relation between pupil and teacher gives rise to a close personal intercourse of the highest educational value. Reading in chambers is so far considered a necessary part of a barrister's education that it has been said that a barrister would no more think of beginning work at the bar without this previous training than a doctor would think of setting up in practice without having walked the hospitals. But before entering a barrister's chambers as a pupil, and still more before taking advantage of the courts themselves as a school of law, it is important that a student should have acquired a sound knowledge of the elementary principles of law, and the expression "legal education" is commonly used to signify the teaching, or the learning, of these elementary principles. It is the function of the Council of Legal Education to provide for instruction in these elementary principles. It does so almost entirely from a practical professional standpoint. It is very little concerned with instruction in what may be called non-professional law, with assisting in the philosophical study of jurisprudence, or the general principles of law as part of a liberal education. On the other hand, it takes no part in promoting the acquisition of the art of advocacy, but something is done, so far as fluent speaking is concerned, by debating societies, which carry on the traditions of the Oxford and Cambridge Unions. An attempt has been made to revive the ancient moots, and this experiment has been attended by a certain amount of success.

Incorporated Law Society.

The education of solicitors suffered from the absence of any professional organization until the Incorporated Law Society was established in 1825 and the following years. So far as any professional education is provided for solicitors or required from them, this is due to the efforts of the Law Society. As early as 1729 it was required by statute that any person applying for admission as attorney or solicitor should submit to examination by one of the judges, who was to test his fitness and capacity in consideration of a fee of one shilling. At the same time regular preliminary service under articles was required, that is to say, under a contract by which the clerk was bound to serve for five years. The examination soon became, perhaps always was, an empty form. The Law Society, however, soon showed zeal for the education of future solicitors. In 1833 lectures were instituted. In 1836 the first regular examinations were established, and in 1860 the present system of examinations—preliminary, intermediate, and final—came into effect. Of these only the last two are devoted to law, and both are of a strictly professional character. The final examination is a fairly severe test of practical acquaintance with all branches of modern English law. The Law Society makes some provision for the teaching of students, but this teaching is designed solely to assist in preparation for the examinations.

The Universities.

At the Universities of Oxford and Cambridge there has, since 1850, been an attempt to promote the study of law. The curriculum of legal subjects in which lectures are given and examinations held is calculated to give a student a sound fundamental knowledge of general principles, as well as an elementary acquaintance with the rules of modern English law. Jurisprudence, Roman Law, Constitutional Law, and International Law are taught, as well as the Law of Real and Personal Property, the Law of Contract and Tort, Criminal Law, Procedure, and Evidence. But the law tripos and the law schools do not attract a very large number of university students, and no doubt they suffer from remoteness from the law courts, and from the exclusively academical character of the teaching. Law is also taught, though not on a very large scale, at Owens College, Manchester, and at University College, Liverpool. London University has encouraged the study of law by its examinations for law degrees, at which a comparatively high standard of knowledge is required; and at University College, London, and King's College, London, some teaching is given in law and jurisprudence. In the new University of London it is hoped that one day there may be a faculty of Law in which the Inns of Court will co-operate. In this way it is possible that an adequate national system of legal education may be established, in which due attention will be given both to professional law and to non-professional law. But at present the four Inns of Court have declined to take any part in the new University, and the faculty of Law is not likely to be established in the immediate future. (A. LL. D.)

Leghorn, an Italian city, chief town of the province of the same name, seat of a bishopric and of a large naval academy—the only one in Italy—and the third largest commercial port in the kingdom, situated on the west coast, 15 miles south-west of Pisa by rail. It is built along the seashore upon a healthy and fertile tract of land, which forms, as it were, an oasis in a zone of Maremma. Several improvements were carried out in the city and port during the last two decades of the 19th century. The naval school formerly established partly at Naples and partly at Genoa has been transferred to Leghorn. Some of the navigable canals connecting the harbour with the interior of the city have been either modified or filled up. Several streets have been widened, and a road along the shore has been transformed into a promenade worthy of comparison with the Promenade des Anglais at Nice, being shaded by tamarisks, stone-pines, oleanders, aloes, and countless evergreen shrubs, and adorned with luxuriant flower-beds. For Leghorn is the principal sea-bathing resort in this part of Italy, the season lasting from the end of June to the end of August. The *octroi* circle has been enlarged, large school buildings erected, and a covered market built on a scale almost too grandiose for the needs of the city. Dredging operations have been continued, and are now proceeding in both the old and the new harbour, but still without effecting any considerable increase in the depth. The new rectilinear mole, sanctioned in 1881, has been built out into the sea for a distance of 600 yards from the old Vegliaia lighthouse, and the docking basin has been lengthened to 490 feet. Inside the breakwater the depth varies from 10 to 26 feet. In order partly to compensate the city for the losses occasioned by the abolition of the freedom of the port—a freedom which had rendered it one of the most flourishing in Italy—a bonded depôt was established in 1881. The northern part of the old port was filled in, and upon the area thus created sheds and warehouses were built. Sufficient space was, however, left between the warehouses and the old breakwater to form a wharf for the discharge of cargoes. The total trade of the port increased from £3,861,250 in 1891 to £5,191,670 in 1900, the ratio of imports to exports being as three to two. The imports consist principally of tobacco, coal, wheat, fish, and hides, and the exports of hemp, hides, olive oil, soap, coral, candied fruit, and marble and alabaster. Since the year 1885 the decrease in the number of foreign vessels, which began towards the middle of the 19th century, has continued, although there has been a slight increase in the number of Italian vessels. In 1885 the total number of vessels that entered the port was 4281 of 1,434,000 tons; of these, 1251 of 750,000 tons were foreign. 591,620 tons of merchandise were loaded and unloaded. In 1900, after considerable fluctuations during the interval, the total number that entered was 4747 vessels of 1,839,954 tons; of these, 740 of 760,830 tons were foreign. In 1899, 901,726 tons of merchandise were loaded and unloaded, an increase of more than 300,000 tons over the total of 1885. A great obstacle to the development of the port is the absence of modern mechanical appliances for loading and unloading vessels. The older shipyards have been considerably extended, and shipbuilding is actively carried on, while new industries—namely, glass-making and copper- and brass-founding—have been established. The population of the city proper has decreased, namely, from 82,976 in 1881 to 79,526 in 1901, but the population as a whole has increased: in 1881 it numbered 97,615, and in 1901, 98,505. The former British "factory" here was closed in 1825. The two villages of Ardenza and Antignano, which form part of the commune, have acquired considerable importance, the former in part for sea-bathing. (A. R*.)

Legnago, a fortified town in the province of Verona, Lombardy, Italy, on the Adige, 29 miles by rail east of Mantua, one of the famous Quadrilateral fortresses. The present fortifications were planned and made in 1815, the older defences having been destroyed by Napoleon I. in 1801. There is a school of the industrial arts and sciences. It is the birthplace of G. B. Cavalcaselle, the art historian (1827–1897). Rice is extensively grown in the vicinity. Population (1881), 5448; (1897), about 3500.

Legnano, a town in the province of Milan, Lombardy, Italy, 17 miles north-west of Milan by rail. It is the seat of important cotton and silk industries, with machine-shops, boiler-works, and dyeing and printing of woven goods, and thread. Close by the Lombard League defeated Frederick Barbarossa in 1176; a monument in commemoration of the battle was erected on the field in 1876. Population (1881), 7153; (1897), about 5400.

Legouvé, Gabriel Jean Baptiste Ernest Wilfrid (1807- ——), French dramatist, the son of the poet Gabriel Legouvé (1764–1812), was born in Paris on 5th February 1807. He was left an orphan at an early age, his mother dying in 1810, and his father almost immediately afterwards being removed to a lunatic asylum. The child, however, inherited a considerable fortune, and was very carefully educated. The celebrated Jean Nicolas Bouilly (1763–1842) was his tutor, and early instilled into the young Legouvé a passion for literature, to which, indeed, the example of his father and of his grandfather, J. B. Legouvé (1729–1783), predisposed him. As early as 1829 he carried away a prize of the French Academy for a poem on the discovery of printing; and in 1832 he published a curious little volume of verses, entitled *Les Morts Bizarres.* In those early days M. Legouvé brought out a succession of novels, of which one at least, *Edith de Falsen,* enjoyed a considerable success. In 1847 he began the work by which he will be best remembered, his contributions to the development and education of the female mind, by lecturing at the College of France on the moral history of women: these discourses were collected into a volume in 1848, and enjoyed a great success. M. Legouvé wrote considerably for the stage, and in 1849 he collaborated with Scribe in *Adrienne Lecouvreur,* one of the most admired and most widely accepted of modern French tragedies. M. Legouvé now became a prolific writer for the theatre, and in 1855 he brought out his tragedy of *Médée,* the success of which had much to do with his election to the French Academy. He succeeded to the fauteuil of Ancelot, and was received by Flourens, who dwelt on the plays of M. Legouvé as his principal claim to consideration. As time passed on, however, M. Legouvé became less and less prominent as a playwright, and more and more so as a lecturer and propagandist on woman's rights and the advanced education of children, in both of which directions he has been a pioneer in French society. His *La femme en France au XIX*^{me} *siècle* (1864), reissued, much enlarged, in 1878; his *Messieurs les enfants* (1868), his *Conférences Parisiennes* (1872), his *Nos filles et nos fils* (1877), and his *Une éducation de jeune fille* (1884) were works of wide-reaching influence in the moral order. In 1886–87 M. Legouvé published, in two volumes, his *Soixante ans de souvenirs,* an excellent specimen of autobiography. He was raised in 1887 to the highest grade of the Legion of Honour, and held for many years the post of inspector-general of female education in the national schools. M. Legouvé was always an advocate of physical training. He was long accounted one of the best shots in France, and although, from a conscientious objection, he never fought a duel, he made the art of fencing his lifelong hobby. In the beginning of 1900 M. Legouvé was knocked down by a vehicle in the streets of Paris. The worst was feared for the results of this accident on a man of ninety-three, but the veteran was soon seen walking and fencing as usual. After the death of Désiré Nisard in 1888, M. Legouvé became the "father" of the French Academy.

Legros, Alphonse (1837-——), painter and etcher, was born at Dijon on 8th May 1837. His father was an accountant, and came from the neighbouring village of Veronnes. Young Legros frequently visited the farms of his relatives, and the peasants and landscapes of that part of France are the subjects of many of his pictures and etchings. He was sent to the art school at Dijon at an early age, with a view to qualifying for a trade, and was ultimately apprenticed to Maître Nicolardo, house decorator and painter of images. In 1851 Legros left for Paris to take another situation; but passing through Lyons he worked for six months as journeyman wall-painter under the decorator Beuchot, who was painting the chapel of Cardinal Bonald in the cathedral. In Paris he studied with Cambon, scene-painter and decorator of theatres, an experience which developed a breadth of touch such as Stanfield and Cox picked up in similar circumstances. At this time he attended the drawing-school of M. Lecoq de Boisbaudran. In 1855 Legros attended the evening classes of the École des Beaux Arts, and perhaps gained there his love of drawing from the antique, some of the results of which may be seen in the Print Room of the British Museum. He sent two portraits to the Salon of 1857: one was rejected, and formed part of the exhibition of protest organized by M. Bonvin in his studio; the other, which was accepted, was a profile portrait of his father. This work was presented to the museum at Tours by the artist when his friend M. Cazin was curator. Champfleury saw the work in the Salon, and sought out the artist to enlist him in the small army of so-called "Realists," comprising (round the noisy glory of Courbet) all those who raised protest against the academical trifles of the degenerate Romantics. In 1859 Legros's "Angelus" was exhibited, the first of those quiet church interiors, with kneeling figures of patient women, by which he is best known as a painter. "Ex Voto," a work of great power and insight, painted in 1861, now in the museum at Dijon, was received by his friends with enthusiasm, but it only obtained a mention at the Salon. Legros came to England in 1863, and in 1864 married an English wife, Miss Frances Rosetta Hodgson. At first he lived by his etching and teaching as before. He then became teacher of etching at the South Kensington School of Art, and in 1876 Slade Professor at University College, London. He was naturalized as an Englishman in 1881, and remained at University College seventeen years. His influence there was exerted to encourage a certain distinction, severity, and truth of character in the work of his pupils, with a simple technique and a respect for the traditions of the old masters, until then somewhat foreign to English art. He would draw or paint a torso or a head before the students in an hour or even less, so that the attention of the pupils might not be dulled. As students had been known to take weeks and even months over a single drawing, Legros ordered the positions of the casts in the Antique School to be changed once every week. In the painting school he insisted upon a good outline, preserved by a thin rub in of umber, and then the work was to be finished in a single painting, "*premier coup.*" Experiments in all varieties of art work were practised; whenever the professor saw a fine example in the museum, or when a process interested him in a workshop, he never rested until he had mastered the technique and his students were trying their 'prentice hands at it. As he had casually picked up the art of etching by watching a comrade in Paris working at a commercial engraving, so he began the making of medals after a walk in the British Museum, studying the masterpieces of Pisanello, and a visit to the Cabinet des Médailles in Paris. Legros considered the traditional journey to Italy a very important part of artistic training, and in order that his students should have the benefit of such study he devoted a part of his salary to augment the income available for a travelling studentship. His later works, after he resigned his professorship in 1892, were more in the free and ardent manner of his early days—imaginative landscapes, castles in Spain, and farms in Burgundy, etchings like the series of "The Triumph of Death," and the sculptured fountains for the gardens of the duke of Portland at Welbeck.

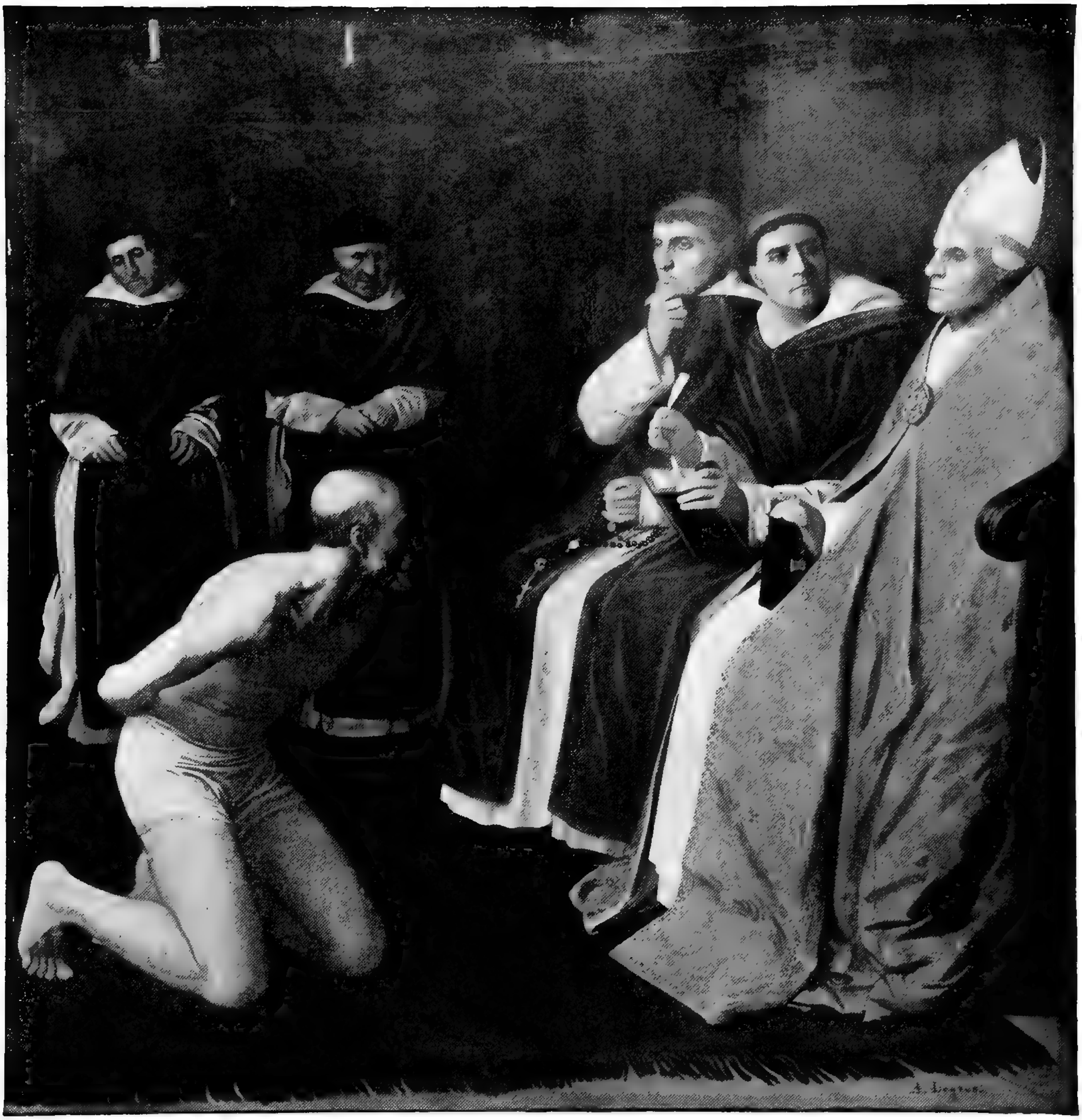
Pictures and drawings by Legros, besides those already mentioned, may be seen in the following galleries and museums. "Amende Honorable" (see Plate), "Dead Christ," bronzes, medals, and twenty-two drawings, in the Luxembourg, Paris; "Landscape," "Study of a Head," and portraits of Browning, Burne-Jones, Cassel, Huxley, and Marshall, at the Victoria and Albert Museum, Kensington; "Femmes en prière," National Gallery of British Art; "The Tinker," and six other works from the Ionides Collection, bequeathed to South Kensington; "Christening," "Barricade," "The Poor at Meat," two portraits, and several drawings and etchings, collection of Lord Carlisle; "Two Priests at the Organ," "Landscape," and etchings, collection of Rev. Stopford Brooke; "Head of a Priest," collection of Mr Vereker Hamilton; "The Weed-burner," some sculpture, and a large collection of etchings and drawings, Mr Guy Knowles; "Psyche," collection of Mr L. W. Hodson; "Snow Scene," collection of Mr G. F. Watts, R.A.; thirty-five drawings and etchings, the Print Room, British Museum; "Jacob's Dream" and twelve drawings of the antique, Cambridge; "Saint Jerome," two studies of heads, and some drawings, Manchester; "The Pilgrimage" and "Study made before the Class," Liverpool Walker Art Gallery; "Study of Heads," Peel Park Museum, Salford.

Legros had etched up to the year 1900 some 572 plates.

See Dr Hans W. Singer. "Alphonse Legros," *Die graphischen Künste* (1898).—Léonce Bénédite. "Alphonse Legros," *Revue de l'Art*. Paris, 1900.—Cosmo Monkhouse. "Professor Legros," *Magazine of Art* (1882).

Lègya, called by the Shans Lai-hka, a state in the eastern division of the southern Shan States of Burma, lying approximately between 20° 15′ and 21° 30′ N. and 97° 50′ and 98° 30′ E., with an area of 1433·15 square miles. The population was estimated at 30,000 in 1881. On the downfall of King Thibaw civil war broke out, and reduced the population to a total of only a few hundreds. In 1891 the estimated population was 8928, living in 203 villages. The population was made up as follows:—Shans, 6731; Tsungthus, 1613; Yang, 437; Shan-Chinese, 76; Burmans, 71. In 1898 the budget of the Sawbwa, or chief, showed 529 villages, with a total of 4946 houses, paying a revenue of Rs.15,845. About seven-ninths of the land under cultivation consists of wet paddy cultivation. A certain amount of upland rice is also cultivated, and cotton, sugar-cane, and garden produce make up the rest. Laihka, the capital, is noted for its iron-work, both the iron and the implements made being produced at Pang Lōng in the west of the state. This and lacquer-ware are the chief exports. The imports are chiefly cotton piece-goods and salt. The general character of the state is that of an undulating plateau, with a broad plain near the capital and along the Nam Tēng, which is the chief river, with a general altitude of a little under 3000 feet. The state was formerly very prosperous, and is rapidly recovering.

Leicester, a parliamentary, county, and municipal borough of England, capital of Leicestershire, on the river Soar, 96½ miles north-north-west of London. In 1891 the Midland Company built here a fine new station, and the Great Central Company have also built a station. Amongst the new churches, nearly all built of red brick with stone dressings, may be mentioned two chapels-of-ease to St Mary Magdalene, St Peter's, St Hilda, the church of the Oxford martyrs, and St Michael and All Angels. St Martin's was restored through several years ending with 1898. The Roman Catholics have three churches, and there are numerous Nonconformist chapels and meeting-houses. The secular buildings erected since 1881 include the post office, the fire station, the poor-law offices, the Tivoli theatre of varieties, the Cook Memorial Hall, the Knighton public hall, the buildings of the Association for the Blind, the Vestry Street and Cossington Street baths, the children's hospital, and the isolation hospital. The institutions deserving of mention are the free library, with 35,000 volumes and six branches; the small but valuable town library, founded in the 17th century; the permanent library (20,000 volumes); the Opera House (1877); the Theatre Royal; the Borough Lunatic Asylum, to which new wings were added in 1890 and 1900; the infirmary of 200 beds, first established in 1771; the Borough Isolation Hospital; the children's hospital, opened in 1889; the Leicester Literary



"L'Amende Honorable." By Alphonse Legros.

(In the Luxembourg Gallery. From a Photograph by Levy and Sons.)

and Philosophical Society (1835); the municipal technical and art schools; the Wyggeston schools, with which is incorporated Queen Elizabeth's grammar school, namely, the boys' grammar school and the girls' high school (opened in 1878); and Alderman Newton's Greencoat day school for boys. The School of Art has been adapted for municipal purposes. Roman pavements were discovered in 1882 and 1889. There are four public parks and several new recreation grounds. The town has an excellent water-supply. The main sewerage system was completed in 1887. Since 1868 very extensive changes and alterations have been made in the river Soar and the canal; the Newarke bridge was opened in 1898. Malting and brick-making should be included among the industries of the town. In 1888 the municipal borough was for certain purposes made a county borough. On 1st January 1892 its bounds were extended so as to take in the old parishes of Aylestone, Belgrave, Braunstone, and New Found Pool, and the parishes of West Humberstone and North Evington, and part of Leicester Abbey, the whole being constituted one civil parish. Thus extended, it is governed by a mayor, 16 aldermen, and 48 councillors. Area, 8586 acres. Birth-rate (1900), 28·3; death-rate (1900), 17·0. Population (1891), 174,624; (1901), 211,574.

See *Records of the Borough of Leicester*, edited by Mary Bateson (1899).

Leicestershire.—One of the north midland counties of England, bounded on the N. by Derby, Nottingham, and Lincoln, on the E. by Lincoln and Rutland, on the S. by Northampton and Warwick, and on the W. by Stafford.

Area and Population.—In 1891 the area of the ancient (geographical) county was 527,124 acres, and the population 373,584 persons, of whom 180,044 were males and 193,540 females, an increase of 52,566, or at the rate of 14 per cent., during the ten years 1881–91, as compared with an increase at the rate of 16·1 per cent. in the period 1871–81. In 1901 the population was 433,994. In 1891 there were 0·71 persons to an acre and 1·41 acre to a person. In the same year the area of the registration county was 551,845 acres, and the population 379,286 (183,003 males, 196,283 females), and in 1901, 440,907. Particulars of the birth-rate, death-rate, and the number of persons married per 1000 inhabitants, with illegitimacy rate per 1000 births, are contained in the following table:—

	1871–80.	1881–90.	1889–98.	1899.
Birth-rate . .	37·2	34·0	31·6	30·1
Death-rate . .	21·8	18·4	17·4	17·1
Illegitimacy-rate .	52·0	46·0	43·0	41·0
Marriage-rate .	16·6	14·6	15·4	16·3

In 1891 there were 497 persons of Scottish birth, 1697 of Irish birth, and 574 foreigners in the county; also 281 blind persons, 156 deaf and dumb, and 1327 insane.

Administration.—For parliamentary purposes the ancient county is divided into four divisions (Eastern or Melton, Mid or Loughborough, Western or Bosworth, Southern or Harborough), each returning one member, and the parliamentary borough of Leicester, returning two members. The administrative county includes the county borough of Leicester and the municipal borough of Loughborough. It has one court of quarter sessions, and is divided into nine petty sessional divisions. The county borough of Leicester has a separate court of quarter sessions and a separate commission of the peace. The administrative county in 1891 contained 316 entire civil parishes and part of one other, and the county borough contained 17 entire civil parishes; at the same date its area was 528,986 acres. But on 30th September 1897 the parishes of Chilcote, Donisthorpe, Measham, Stretton-en-le-Field, and Willesley, and part of the parish of Appleby, amounting in all to 7831 acres, were transferred from Derbyshire to Leicestershire, and the parishes of Over and Nether Seal and Woodville were transferred from Leicestershire to Derbyshire; whilst at the same time part of the parish of Little Bowden, amounting to 513 acres, was transferred from Northamptonshire to Leicestershire; so that the area of the administrative county is 533,078 acres. Further, owing to changes made in the county borough of Leicester, the administrative county in 1900 contained 301 entire civil parishes and parts of two others, and the county borough one civil parish. In 1891 the ancient county contained 239 entire ecclesiastical parishes or districts and parts of 13 others; it is included partly in the dioceses of Peterborough, Southwell, and Worcester.

Education.—There is a Deaf School at Leicester. The number of elementary schools in the county on 31st August 1900 was 259, of which 36 were board schools, and 223 voluntary schools, the latter including 198 national Church of England schools, 5 Wesleyan, 9 Roman Catholic, and 11 British and "other." The average attendance during the year was 34,960, out of 42,182 children on the registers. The total school board receipts for the year were £135,809, inclusive of £1399 income under the Agricultural Rates Act.

Agriculture.—Since 1885 there has been an increase in the areas of both the permanent pasture and the meadow land, and since 1880 a slight decrease in the area planted with green crops and a large decrease in the area under corn crops and fallow. In 1900 a total of 417,114 acres was farmed by tenants, and 58,491 acres by the owners; the corresponding figures for 1889 being 404,008 and 69,842 acres respectively, and for 1895, 404,984 and 67,329 acres respectively.

The table immediately following shows the areas under the different kinds of crops at the periods named:—

Year.	Area in Cultivation.	Area under Corn Crops.	Area under Green Crops.	Area of Bare Fallow.
1880	472,720	94,090	21,885	15,709
1885	473,827	79,678	23,241	10,150
1890	473,485	73,182	21,784	8,662
1895	472,313	66,798	20,992	7,005
1900	475,605	67,340	20,847	5,131

The next table shows the numbers of live stock at the periods named:—

Year.	Cows and Heifers.	Other Cattle.	Total Cattle.	Horses.	Sheep.	Pigs.
1880	32,998	93,904	126,902	17,950	357,757	21,596
1885	42,270	107,475	149,745	17,813	322,571	26,694
1890	40,380	100,539	140,919	18,422	344,572	28,537
1895	38,699	93,025	131,724	20,587	304,589	31,321
1900	40,685	101,191	141,876	20,330	321,029	24,569

Industries.—The total number of persons employed in factories and workshops in 1897 was 80,264. Of these, 24,568 or 30 per cent. were employed in the textile industries, chiefly in the manufacture of hosiery(19,238), woollens, and cottons. The industry, however, which claimed the largest number of persons was the making of clothing, namely, 33,035; then came the making of machinery, tools, &c., with 5110 persons; bleaching and dyeing, with 2304; elastic webbing, &c., with 2098; tobacco, with 1623; paper and printing, with 1550; and wood industries, with 1400. In mines and quarries there were employed in 1900 a total of 11,157 persons. The output of the granite quarries amounted in the same year to 1,109,237 tons, of the coal mines to 2,106,443 tons, of iron ore to 750,708 tons, of clays to 527,542 tons, of limestone to 160,349 tons, and of gravel and sand to 17,345 tons. The value of all the minerals mined in the county in 1900 amounted to £1,558,977 (of which coal alone represented £1,140,936). In 1900 there were three blast furnaces active in the county (see Lincolnshire).

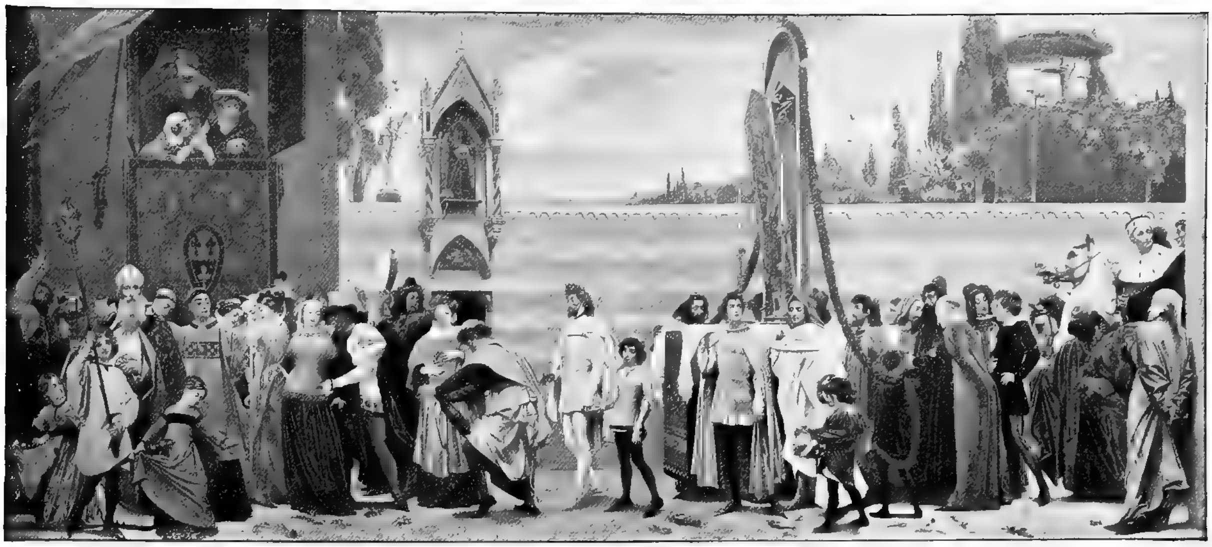
Authorities.—See *Records of the Borough of Leicester*, ed. by Mary Bateson, revised by W. H. Stevenson and J. E. Stocks. London, 1899.—A. B. Evans. *Leicestershire Words* (English Dialect Society). London, 1881. (J. T. Be.)

Leidy, Joseph (1823–1891), American naturalist, was born in Philadelphia on the 9th September 1823. He studied mineralogy and botany without an instructor, and graduated in medicine at the University of Pennsylvania in 1844. Continuing his work in anatomy and physiology, he visited Europe in 1848, but both before and after this period of foreign study lectured and taught in American medical colleges. In 1853 he was appointed professor of anatomy in the University of Pennsylvania, paying special attention to comparative anatomy. In 1884 he promoted the establishment in the same institution of the department of biology, of which he became director, and meanwhile taught natural history in Swarthmore College, near Philadelphia. His papers on biology and palæontology were very numerous, covering both fauna and flora, and he was the recipient of various American and foreign degrees and honours. His *Cretaceous Reptiles of the United States* (1865) and *Contributions to the Extinct Vertebrate Fauna of the Western Territories* (1874) were the most important of his larger works; the best known and most widely circulated was an *Elementary Treatise on Human Anatomy* (1860, afterwards revised in new editions). He died in Philadelphia on the 30th April 1891. (C. F. R.)

Leigh, a municipal borough (1899) and market town in the Leigh parliamentary division of Lancashire, England, 6 miles south-east of Wigan by rail. Modern erections are a theatre and a technical school and public library. There are a town hall and public baths. Area, 6349 acres. Population (1881), 21,733; (1891), 30,815; (1901), 40,001.

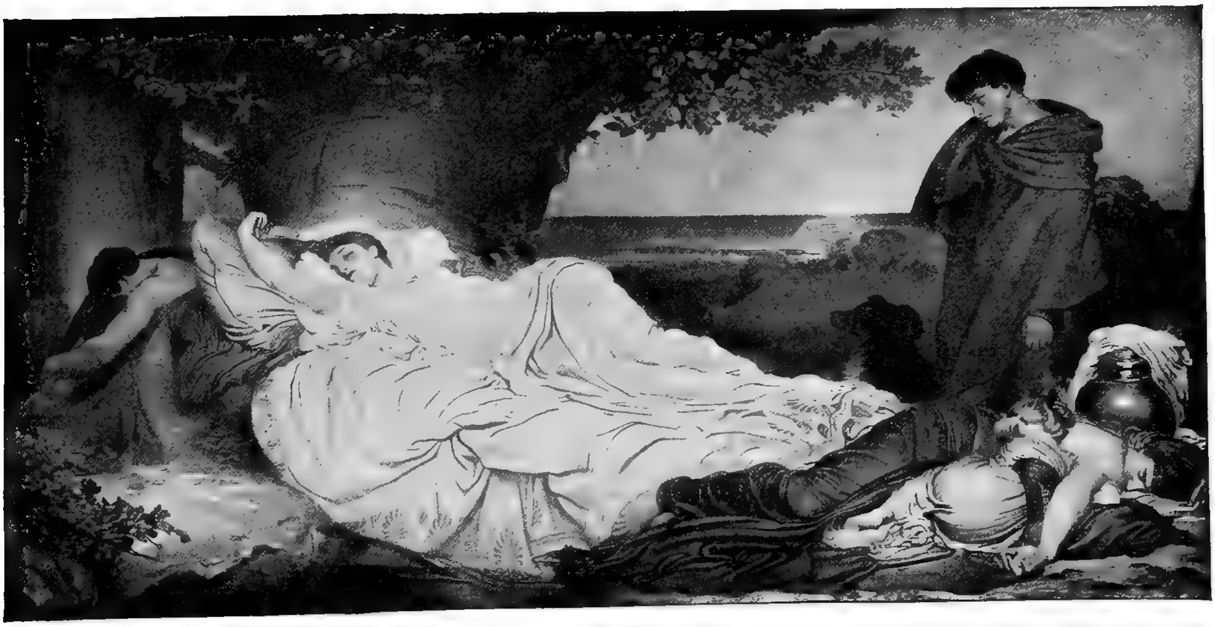
Leighton, Frederick Leighton, BARON (1830–1896), English painter and sculptor, was born at Scarborough on 3rd December 1830, the son of a physician. His grandfather, Sir James Leighton, also a physician, was long resident at the Court of St Petersburg. He was taken abroad at a very early age, and did not return to live in England till he was thirty years old. In 1840 he learnt drawing at Rome under Signor Meli. The family moved to Dresden and Berlin, where he attended classes at the Academy. In 1843 he was sent to school at Frankfort, and in the winter of 1844 accompanied his family to Florence, where his future career as an artist was decided. There he studied under Bezzuoli and Segnolini at the Accademia delle Belle Arti, and attended anatomy classes under Zanetti; but he soon returned to complete his general education at Frankfort, receiving no further direct instruction in art for five years. He went to Brussels in 1848, where he met Wiertz and Gallait, and painted some pictures, including "Cimabue finding Giotto," and a portrait of himself. In 1849 he studied for a few months in Paris, where he copied Titian and Correggio in the Louvre, and then returned to Frankfort, where he settled down to serious art work under Edward Steinle, whose pupil he declared he was "in the fullest sense of the term." Though his artistic training was mainly German, and his master belonged to the same school as Cornelius and Overbeck, he loved Italian art and Italy, and the first picture by which he became known to the British public was "Cimabue's Madonna carried in Procession through the Streets of Florence," which appeared at the Royal Academy in 1855 (see Plate). At this time the works of the Pre-Raphaelites almost absorbed public interest in art—it was the year of Holman Hunt's "Light of the World," and the "Rescue," by Millais. Yet Leighton's picture, which was painted in quite a different style, created a sensation, and was purchased by Queen Victoria. Although, since his infancy, he had only visited England once (in 1851, when he came to see the Great Exhibition), he was not quite unknown in the cultured and artistic world of London, as he had made many friends during a residence in Rome of some two years or more after he left Frankfort in 1852. Amongst these were Giovanni Costa, Robert Browning, James Knowles, George Mason, and Sir Edward Poynter, then a youth, whom he allowed to work in his studio. He also met Thackeray, who wrote from Rome to the young Millais: "Here is a versatile young dog, who will run you close for the presidentship one of these days." During these years he painted several Florentine subjects—"Tybalt and Romeo," "The Death of Brunelleschi," a cartoon of "The Pest in Florence according to Boccaccio," and "The Reconciliation of the Montagues and the Capulets." He now turned his attention to themes of classic legend, which at first he treated in a "Romantic spirit." His next picture, exhibited in 1856, was "The Triumph of Music: Orpheus by the Power of his Art redeems his Wife from Hades." It was not a success, and he did not again exhibit till 1858, when he sent a little picture of "The Fisherman and the Syren" to the Royal Academy, and "Samson and Delilah" to the Society of British Artists in Suffolk Street. He still lived abroad, but in 1858 he visited London and made the acquaintance of the leading Pre-Raphaelites—Rossetti, Holman Hunt, and Millais. In the spring of 1859 he was at Capri, always a favourite resort of his, and made many studies from nature, including a very famous drawing of a lemon tree. It was not till 1860 that he settled in London, when he took up his quarters at 2 Orme Square, Bayswater, where he stayed till, in 1866, he moved to his celebrated house in Holland Park Road, with its Arab hall decorated with Damascus tiles. There he lived till his death. He now began to fulfil the promise of his "Cimabue," and by such pictures as "Paolo e Francesca," "The Star of Bethlehem," "Jezebel and Ahab taking Possession of Naboth's Vineyard," "Michael Angelo musing over his Dying Servant," "A Girl feeding Peacocks," and "The Odalisque," all exhibited in 1861–63, rose rapidly to the head of his profession. The two latter pictures were marked by the rhythm of line and luxury of colour which are among the most constant attributes of his art, and may be regarded as his first dreams of Oriental beauty, with which he afterwards showed so great a sympathy. In 1864 he exhibited "Dante in Exile" (the greatest of his Italian pictures), "Orpheus and Eurydice," and "Golden Hours." In the winter of the same year he was elected an Associate of the Royal Academy. After this the main effort of his life was to realize visions of beauty suggested by classic myth and history. If we add to pictures of this class a few Scriptural subjects, a few Oriental dreams, one or two of tender sentiment like "Wedded" (one of the most popular of his pictures, and well known by not only an engraving, but a statuette modelled by an Italian sculptor), a number of studies of very various types of female beauty, "Teresina," "Biondina," "Bianca," "Moretta," &c., and an occasional portrait, we shall nearly exhaust the two classes into which Lord Leighton's work (as a painter) can be divided.

Amongst the finest of his classical pictures were—"Syracusan Bride leading Wild Beasts in Procession to the Temple of Diana" (1866), "Venus disrobing for the Bath" (1867), "Electra at the Tomb of Agamemnon," and "Helios and Rhodos" (1869), "Hercules wrestling with Death for the Body of Alcestis" (1871), "Clytemnestra" (1874), "The Daphnephoria" (1876), "Nausicaa" (1878), "An Idyll" (1881), two lovers under a spreading oak listening to the piping of a shepherd and gazing on the rich plain below; "Phryne" (1882), a nude figure standing in the sun; "Cymon and Iphigenia" (1884; see Plate), "Captive Andromache" (1888), now in the Manchester Art Gallery; with the "Last Watch of Hero" (1887), "The Bath of Psyche" (1890), now in the Chantrey Bequest collection; "The Garden of Hesperides" (1892), "Perseus and Andromeda" and "The Return of Persephone," now in the Leeds Gallery (1891); and "Clytie," his last work (1896). All these pictures are characterized by nobility of conception, by almost perfect draughtsmanship, by colour which, if not of the highest quality, is always original, choice, and effective. They often reach distinction and dignity of attitude and gesture, and occasionally, as in the "Hercules and Death," the "Electra," and the "Clytemnestra," a noble intensity of feeling. Perhaps, amidst the great variety of qualities which they possess, none is more universal and



"CIMABUE'S MADONNA CARRIED IN PROCESSION THROUGH THE STREETS OF FLORENCE." BY LORD LEIGHTON.

(Buckingham Palace.)

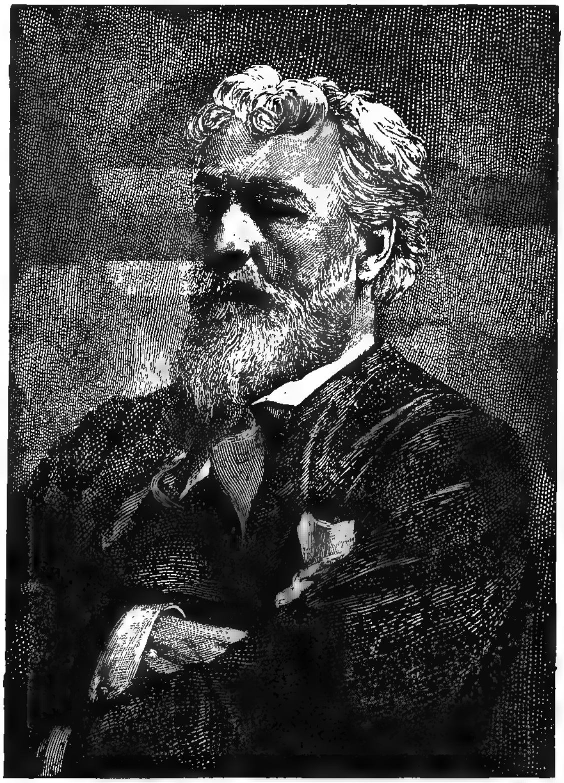


"CYMON AND IPHIGENIA." BY LORD LEIGHTON.

(Published by permission of the Fine Art Society, London.)

more characteristic than a rich elegance, combined with an almost fastidious selection of beautiful forms. It is the super-eminence of these qualities, associated with great decorative skill, that make the splendid pageant of the “Daphnephoria” the most perfect expression of his individual genius. Here we have his composition, his colour, his sense of the joy and movement of life, his love of art and nature at their purest and most spontaneous, and the result is a work without a rival of its kind in the British School.

Leighton was one of the most thorough draughtsmen of his day. His sketches and studies for his pictures are numerous and very highly esteemed. They contain the essence of his conceptions, and much of their spiritual beauty and subtlety of expression was often lost in the elaboration of the finished picture. He seldom succeeded in retaining the freshness of his first idea more completely than in his last picture—“Clytie”—which was left unfinished on his easel. He rarely painted sacred subjects. The most beautiful of his few pictures of this kind was the “David musing on the Housetop” (1865). Others were “Elijah in the Wilderness” (1879), “Elisha raising the Son of the Shunammite” (1881), and a design intended for the decoration of the dome of St Paul’s Cathedral, “And the Sea gave up the Dead which were in it” (1892), now in the Tate Gallery, and the terrible “Rizpah” of 1893. His diploma picture was “St Jerome,” exhibited in 1869. Besides these pictures of sacred subjects, he made some designs for Dalziel’s Bible, which for force of imagination excel the paintings. The finest of these are “Cain and Abel,” and “Samson with the Gates of Gaza.”



Lord Leighton.
(*From a photograph by Elliott and Fry, London.*)

Not so easily to be classed, but among the most individual and beautiful of his pictures, are a few of which the motive was purely æsthetic. Amongst these may specially be noted “The Summer Moon,” two Greek girls sleeping on a marble bench, and “The Music Lesson,” in which a lovely little girl is seated on her lovely young mother’s lap learning to play the lute. With these, as a work produced without any literary suggestion, though very different in feeling, may be associated the “Eastern Slinger scaring Birds in the Harvest-time: Moon-rise” (1875), a nude figure standing on a raised platform in a field of wheat.

Leighton also painted a few portraits, including those of Signor Costa, the Italian landscape painter, Mr F. P. Cockerell, Mrs Sutherland Orr (his sister), Amy, Lady Coleridge, Mrs Stephen Ralli, and (the finest of all) Sir Richard Burton, the traveller and Eastern scholar, which was exhibited in 1876 and is now in the National Portrait Gallery.

Like other painters of the day, notably Mr G. F. Watts, Lord Leighton executed a few pieces of sculpture. His “Athlete struggling with a Python” was exhibited at the Royal Academy in 1877, and was purchased for the Chantrey Bequest collection. An illustration of this fine work is given in the article Sculpture, *Ency. Brit.* vol. xxi. p. 562. Another statue, “The Sluggard,” of equal merit, was exhibited in 1886; and a charming statuette of a nude figure of a girl looking over her shoulder at a frog, called “Needless Alarm,” was completed in the same year, and presented by the artist to Sir John Millais in acknowledgment of the gift by the latter of his picture, “Shelling Peas.” He made the beautiful design for the reverse of the Jubilee Medal of 1887. It was also his habit to make sketch models in wax for the figures in his pictures, many of which are in the possession of the Royal Academy. As an illustrator in black and white he also deserves to be remembered, especially for the cuts to Dalziel’s Bible already mentioned, and his illustrations to George Eliot’s *Romola*, which appeared in the *Cornhill Magazine.* The latter are full of the spirit of Florence and the Florentines, and show a keen sense of humour, elsewhere excluded from his work. Of his decorative paintings, the best known are the elegant compositions (in spirit fresco) on the walls of the South Kensington Museum, representing “The Industrial Arts of War and Peace.” There, also, is the refined and spirited figure of “Cimabue” in mosaic. In Lyndhurst church are mural decorations to the memory of Mr Pepys Cockerell, illustrating “The Parable of the Wise and Foolish Virgins.”

Leighton’s life was throughout marked by distinction, artistic and social. Though not tall, he had a fine presence and manners, at once genial and courtly. He was welcomed in all societies, from the palace to the studio. He spoke German, Italian, and French, as well as English. He had much taste and love for music, and considerable gifts as an orator of a florid type. His Presidential Discourses were full of elegance and culture (published, London, 1896). For seven years (1876–83) he commanded the 20th Middlesex (Artists) Rifle Volunteers, retiring with the rank of honorary colonel, and subsequently receiving the Volunteer Decoration. Yet no social attractions or successes diverted him from his devotion to his profession, the welfare of his brethren in art, or of the Royal Academy. As president he was punctilious in the discharge of his duties, ready to give help and encouragement to artists young and old, and his tenure of the office was marked by some wise and liberal reforms. He frequently went abroad, generally to Italy, where he was well known and appreciated. He visited Spain in 1866, Egypt in 1868, when he went up the Nile with Ferdinand de Lesseps in a steamer lent by the Khedive. He was at Damascus for a short time in 1873. It was his custom on all these trips to make little lively sketches of landscape and buildings. These fresh little flowers of his leisure used to decorate the walls of his studio, and at the sale of its contents after his death realized considerable prices. It was when he was in the full tide of his popularity and success, and apparently in the full tide of his personal vigour also, that he was struck with *angina pectoris.* For a long time he struggled bravely with this cruel disease, never omitting except from absolute necessity any of his official duties except during a brief period of rest abroad, which failed to produce the desired effect. His death occurred on 25th January 1896.

Leighton was elected an Academician in 1868, and succeeded Sir Francis Grant as President in 1878, when he was knighted. He was created a baronet in 1886, and was raised to the peerage in 1896, a few days only before his death. He held honorary degrees at the Universities of Oxford, Cambridge, Dublin, Edinburgh, and Durham, was an Associate of the Institute of France; a Commander of the Legion of Honour, and of the Order of Leopold. He was a Knight of the Coburg Order, "Dein Verdienste," and of the Prussian Order "Pour le Mérite," and a member of at least ten foreign Academies. In 1859 he won a medal of the second class at the Paris Salon, and at the Exposition Universelle of 1889 a gold medal. As a sculptor he was awarded a medal of the first class in 1878 and the Grand Prix in 1889.

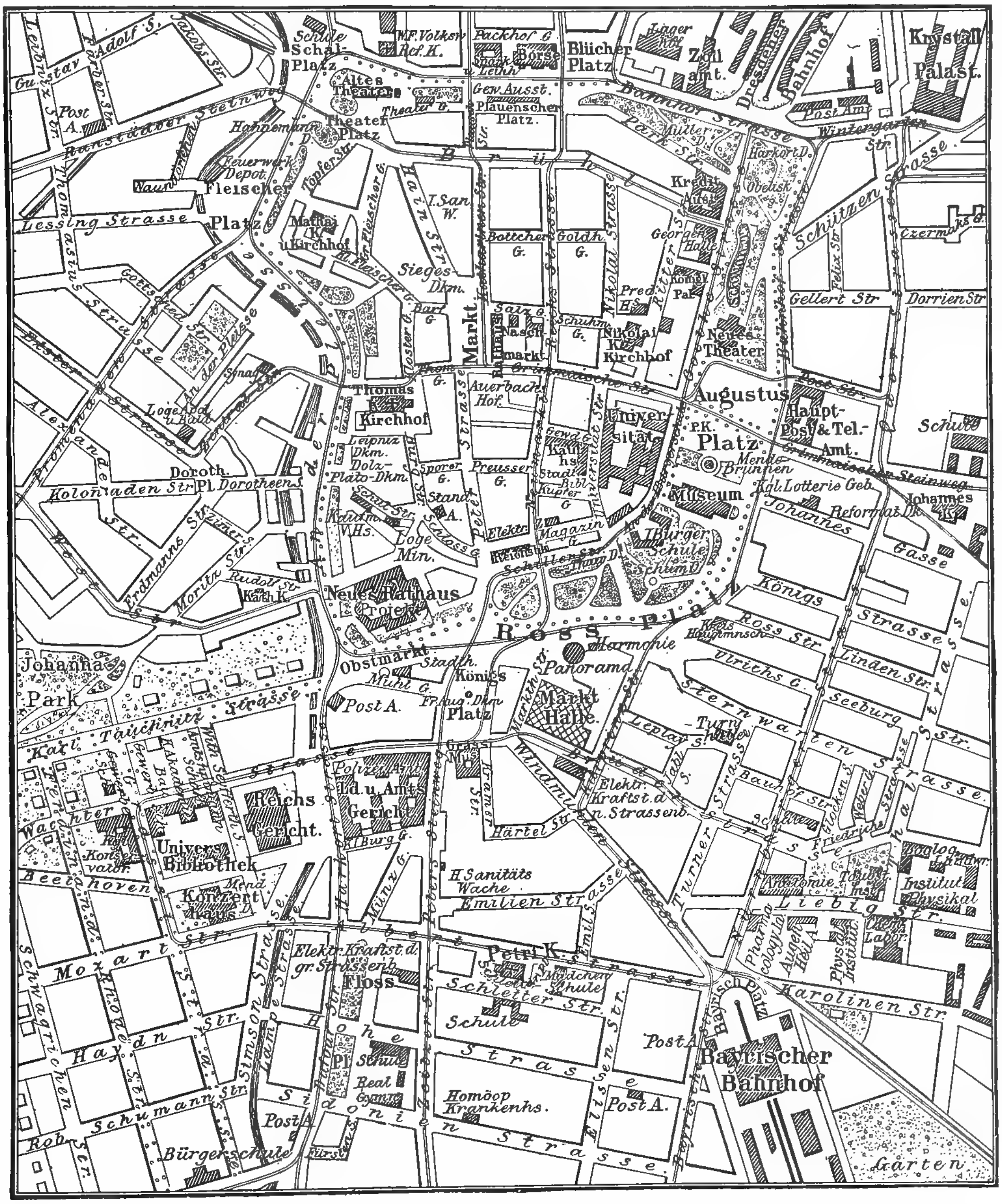
See *Art Annual* (MRS A. LANG), 1884. Royal Academy Catalogue, Winter Exhibition, 1897. National Gallery of British Art Catalogue.—C. MONKHOUSE. *British Contemporary Artists.* London, 1899.—ERNEST RHYS. *Frederick, Lord Leighton.* London, 1898, 1900. (C. MO.)

Leipa. See BÖHMISCH-LEIPA.

Leipzig, a town of the kingdom of Saxony, Germany, situated 101 miles by rail south-south-west of Berlin, one of the most important commercial centres of Germany, a town of very considerable and growing industrial enterprise, the seat of the Supreme Court of the empire and of one of the oldest and most influential of its universities. During the last twenty years of the 19th century an unusual number of new public buildings were erected. On Augustus Platz are the museum, to which two spacious wings were added in 1883–86; the post office, rebuilt in 1883; the university buildings, reconstructed in 1894–97; the Pauliner Kirche, also rebuilt in 1897–99; and the monumental Mende fountain (1886). The museum contains a fine picture gallery and a collection of sculpture. The university was in 1900 attended by 3269 students, a number exceeded by only Berlin and Munich; the number of professors was 220. In 1896 the old Gewandhaus or concert hall was converted into a kind of market hall for use at the fairs, a new Gewandhaus having been built, to the south-west of the old town, in 1880–84. Immediately opposite to it is the new university library (1891), which now contains some 500,000 volumes and 5000 MSS. Behind that again is the Academy of Art, one wing of which accommodates the industrial art school; and close beside it are the industrial school and the conservatory of music. Between the university library and the new Gewandhaus stands a monument of Mendelssohn (1892). Immediately to the east of the industrial art school rises the supreme court of justice of the empire (Reichsgericht), a pile which compares with the great and monumental edifice of the Reichstag in Berlin. It was built in 1888–95 from plans by Ludwig Hoffmann, and is distinguished for the symmetry and harmony of its proportions. It bears an imposing dome, 225 feet high, crowned by a bronze figure of Truth by O. Lessing, 18 feet high. In the same quarter stands the Grassi Museum (1893–96) for industrial art and ethnology, and south from it the Gothic Petri Kirche (1885). Farther towards the north come St Thomas's church (1496; rebuilt by Lipsius in 1885–89), with a lofty roof; the historical musical museum; and a bronze statue of Leibnitz (1883). A short distance away is the Renaissance building of the Imperial Bank (1885); and the Markt Platz is adorned by a fine monument of Victory (war of 1870–71), designed by Siemering and put up in 1888. On the north side of the old town the new exchange (1884–86) and the Reformed church (1896–99) stand close together. On the east the church of St John, in which is the tomb of J. S. Bach, and outside it the tomb of Gellert, was restored in 1894–97. Opposite its main entrance is a bronze group of Luther and Melanchthon, by Schilling, unveiled in 1883 as a monument of the Reformation. A little farther to the east stand close together the German Booksellers' House, a German Renaissance structure (1886–1888), and the Book-trade House (opened in 1900). The former contains a booksellers' museum, with several fine specimens of early printing. South-west of these buildings, on the other side of the Johannisthal Park, are clustered together the medical institutes and hospitals of the university—the infirmary, women's and other hospitals, physico-chemical institute, pathological institute, physiological institute, ophthalmic hospital, pharmacological institute, the anatomy schools, chemical laboratory, the zoological institute, the physico-mineralogical institute, the botanical garden, and also the veterinary schools, deaf and dumb asylum, agricultural college, and astronomical observatory (12° 23′ 30″ E., 51° 20′ 6″ N.). In the Johanna Park are the Luther church (1883–86) and a bronze statue of Bismarck (1897); in the large park of Rosenthal (north of town) are the zoological gardens and monuments to Fechner (1897) and Gellert. It should also be mentioned that in 1897 the citadel of Pleissenburg (1213) was pulled down, with the exception of the tower, which is to be used in the construction of a projected town hall. The first commercial high school in Germany was opened here in 1898 (250 students in 1900). Since 1878 Leipzig has grown into an industrial town of the first rank. The book trades still maintain their preeminence, and in 1895 gave employment to over 15,000 persons. The iron and machinery trades employed 4500 persons in the same year; the textile industries (cotton- and yarn-spinning, hosiery), nearly 6000; and the making of scientific and musical instruments, including pianos, 2650. Other industries, the manufacture of artificial flowers, wax-cloth, chemicals, ethereal oils and essences, beer, mineral water, tobacco and cigars, lace, india-rubber wares, rush-work, paper, the preparation of furs, and numerous other branches. These industries are mostly carried on in the suburbs of Plagwitz, Reudnitz, Lindenau, and Gohlis, all of which, along with Eutritzsch and Konnewitz, were incorporated with Leipzig in 1889–91. In respect of its commerce Leipzig ranks after Hamburg, and probably after Berlin also, but not after any other German town. The chief objects of traffic remain unaltered, but to them there have been added paper and tobacco. The annual turnover of the fur trade is estimated at 3 to 3½ million pounds sterling. Population (1885), 251,224; (1890), 295,025, or, including half a dozen suburban communes (1885), 354,899; (1895), 399,963; (1900), 455,089. (For *Plan* see p. 191.)

Leith, a municipal and parliamentary burgh, seaport, fishing port, and commercial centre, Midlothian, Scotland, on the Firth of Forth. Up till near the middle of the 19th century Leith was separated from Edinburgh by nearly two miles of open country, but in the vicinity of the main thoroughfares the ground is now built over. A considerable area in the centre of the town in the

South Leith division, which contained many antique houses and tenements, has been cleared under an Improvement Scheme authorized by the Artisans' Dwellings Act. Open spaces for playgrounds, grass plots, shrubs, and trees were railed off, and an undoubted improvement was effected, at a cost of about £120,000 Leith Links, one of the homes of golf in Scotland, has under a Provisional Order been enclosed by railings and laid out as a public park. The old Leith High School, erected in 1806 on the south side of the links, has been demolished, and on its site the Leith School Board have erected the new Leith Academy. It is a handsome building. It has basement and three upper floors, and comprises physical, mechanical, and chemical laboratories. To the academy are drafted senior pupils from the other schools under the board for free instruction in the higher branches of education. The accommodation is for 946 pupils, exclusive of the science and art departments. The work of the Leith Technical College, which in 1899 had enrolled 759 individual students in its numerous evening classes, is also carried on in the academy. The Leith School Board has under its care twelve schools, affording accommodation for a total of 13,428 pupils. Secondary education is given in Craighall Road School as in the academy. Engineering, shipbuilding, wood-sawing, twine, rope, sailcloth, hosiery, soap and chemical manure manufactures, flour-milling, biscuit-baking, are some of the industries that have made noteworthy progress; but it is as a distributing centre that the town holds the more important position. Imports of grain, flour, butter, cheese, eggs, wines, brandies, fruits, and timber increase from year to year. Exports of coal reach from seven to eight hundred thousand tons yearly. Leith is the largest centre of the whisky trade in Great Britain, and many wholesale houses have built up an export trade to the British colonies, the Continent, the United States, Canada, and



Plan of Central Leipzig.

India. With the completion of the Edinburgh Dock in 1881, the dock accommodation of the port had reached nearly 43 acres, with ample quayage adjoining. The steady increase of the shipping trade, and the larger tonnage of steamers trading with the Baltic, the United States, and the British colonies, made it incumbent on the Dock Commission to anticipate in good time the varied requirements of the port. It has been found practicable to make substantial reductions in the rates or port dues from time to time, and for this reason the dock revenues are an inexact index of the progress of the port. An additional dock was projected in 1890, involving the reclamation from the sea on the east side of the piers of 75 acres of the beach. The cost of the new works, including the construction of two additional graving docks, is expected to be close upon one million sterling. New works by the Leith Dock Commission have also been carried out at Newhaven, the well-known fishing village. On ground reclaimed from the sea a commodious fish market has been erected, and it is intended to carry the existing pier seawards into deep water, so that trawler steamers may have quay conveniences at any state of the tide. The value of fish landed at Newhaven and sold for the most part by auction in the early morning exceeds £40,000 yearly. The tonnage of the port of Leith in 1881 consisted of 189 vessels of 86,509 tons gross; in 1899 it was 207 vessels of 193,749 tons gross. The number and tonnage of vessels entering and leaving the port with cargoes and in ballast during the year ending 15th May 1881 was 8797 vessels of 1,946,052 tons. For the year ending at same date in 1899 the figures were 12,676 vessels of 3,743,140 tons. The customs revenue collected at the port in 1881 was £479,805, and in 1900, £1,096,438. The dock rates on shipping for the year to 15th May 1899 yielded £30,066; on imported goods, £35,840; and on exported goods, £15,709; total, £81,615. The Dock Commission had also a revenue from graving docks, cranes, rails, bridges, ballast, rents, feus, &c., amounting to £27,860. In 1900 the imports amounted to £12,931,781, and the exports to £5,297,990. Population (1881), 59,485; (1891), 68,707; (1901), 76,667.

Leitmeritz, an episcopal see and chief town of a district of the same name in Bohemia, Austria. Steam navigation on the Elbe begins at this town, which has an important transit trade, as well as in the products (corn, fruits, hops, and wines) of an exceptionally fertile agricultural district. The principal industries are brewing and the manufacture of malt, leather, tiles, straw hats, and flour. Population (1890), 11,342; (1900), 13,075.

Leitomischl, the chief town of a government district, Bohemia, Austria, on the right bank of the Louchna, near the Moravian frontier. It has a Renaissance château of the 16th century, and the oldest Piarist college in Bohemia. Its manufactures include linen, cloth, sugar, shoes, pianos, flour, and beer, and it has a trade in corn and flax as well as in those products. Population (1900), 8075, chiefly Czech.

Leitrim, a maritime county of Ireland, province of Connaught.

Population.—The area of the administrative county in 1900 was 376,510 acres, of which 76,879 were tillage, 216,457 pasture, 44 fallow, 3074 plantation, 20,488 turf-bog, 4070 marsh, 30,159 barren mountain, and 25,339 water, roads, fences, &c. The new administrative county, under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 90,372, and in 1891, 78,618, of whom 39,715 were males and 38,903 females, divided as follows among the different religions:—Roman Catholics, 71,098; Protestant Episcopalians, 6447; Presbyterians, 246; Methodists, 784; and other denominations, 43. The decrease of population between 1881 and 1891 was 13·00 per cent. The average number of persons to an acre was ·20, and 172 to each square mile under crops and pasture. The population in 1901 was 69,201 (Roman Catholics, 62,604; Protestant Episcopalians, 5668; Presbyterians, 224; Methodists, 685; others, 20), being a decrease of 12·0 per cent. The following table gives the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R.C.	Pr.Ep.	Presb.	Meth.
Read and write	25,829	24,262	50,091	69·4	86·1	89·4	93·5
Read only	3,946	4,862	8,808	13·0	7·8	6·9	4·6
Illiterate	5,835	5,736	11,571	17·6	6·1	3·7	1·9

The percentage of illiterates among Roman Catholics in 1881 was 24·1. In 1891 there were 3 superior schools with 67 pupils (Roman Catholics 55, and Protestants 12), and 193 primary schools with 13,570 pupils (Roman Catholics 12,145, and Protestants 1425). The number of pupils on the rolls of the National schools on 31st December 1900 was 14,153, of whom 12,747 were Roman Catholics and 1406 Protestants.

The following table gives the number of births, deaths, and marriages in various years:—

Year.	Births.	Deaths.	Marriages.
1881	1951	1084	245
1891	1776	1194	302
1900	1397	1668	275

In 1900 the birth-rate per 1000 was 20·2, and the death-rate 15·4; the rate of illegitimacy was ·5 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 74,250, of whom 36,788 were males and 37,462 females. The only towns in the county which in 1891 had populations of over 1000 were Carrick-on-Shannon (1177) and Manor Hamilton (1061).

Administration.—The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1901 being respectively 6561 and 7181. The rateable value in 1900 was £137,953, the smallest amount of any Irish county. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 5 rural sanitary districts.

Agriculture.—The following tables give the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900:—

Year.	Wheat.	Oats.	Barley, Rye, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	306	13,750	369	19,323	943	1668	46,338	82,697
1891	37	11,687	530	16,302	1490	2376	50,113	82,535
1895	7	10,214	422	14,801	1304	1871	52,485	81,104
1900	13	8,254	389	13,441	879	2041	51,862	76,879

For 1900 the total value of the cereal and other crops was estimated at £496,762. The number of acres under pasture in 1881 was 208,644, in 1891, 209,711, and in 1900, 216,457.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	4191	7984	84,914	11,347	19,302	6228	311,920
1891	4910	9042	95,769	20,037	27,321	9407	344,922
1895	4985	9050	91,956	17,882	27,335	9672	378,105
1900	4349	9825	93,210	17,521	25,854	9315	423,322

The number of milch cows in 1891 was 37,092, and in 1900 36,116. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £1,243,741. In 1900 the number of holdings not exceeding 1 acre was 803, between 1 and 5, 883; between 5 and 15, 5154; between 15 and 30, 5229; between 30 and 50, 1817; between 50 and 100, 669; between 100 and 200, 163; between 200 and 500, 44; and above 500, 6; total, 14,768. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 1649, amounting to £254,614. The number of loans for agricultural improvements, sanctioned under sec. 31 of the Land Act, 1881, between 1882 and 1901, was 625, and the amount issued was £35,084. The total amount issued on loan for all classes of works, under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £76,506.

(W. H. Po.)

Leixões, a seaport and harbour of refuge of Portugal, 3 miles north of the mouth of the Douro, being the outer port of Oporto. The harbour, which is of artificial construction, has an area of over 220 acres, and admits vessels of 5000 tons, the depth at the entrance being nearly 50 feet. The port is in the commune of Matosinhos, which in 1900 had a population of 7680.

Leland, Charles Godfrey (1824——), American author, son of a merchant, was born at Philadelphia, 15th August 1824, and educated at Princeton, where he graduated in 1846. He went to Europe, and studied at Heidelberg, Munich, and Paris. He was at Paris during the revolution of 1848, and took an active part in it. He then returned to Philadelphia, and after being admitted to the bar in 1851, devoted himself to contributing to periodicals, editing various magazines, and writing books. At the opening of the Civil War he started at Boston the *Continental Magazine*, which advocated the emancipation of the slaves. In 1868 he became known as the humorous author of *Hans Breitmann's Ballads* (1867–70), the work with which his name will be substantially associated. These dialect poems, burlesquing the German American, at once became popular. In 1869 he left America for Europe, and till 1880 was occupied, chiefly in London, with literary work, and after returning to Philadelphia for six years in 1880, he again made his home in Europe, chiefly at Florence. Though his humorous verses were most attractive to the public, Leland interspersed his lighter work with the serious study of folk-lore, particularly of the gypsies, his writings on the latter (*English Gypsies*, 1872; *The Gypsies*, 1883; *Gypsy Sorcery*, 1891, &c.) being recognized as invaluable contributions to the literature of the subject.

Lemberg (Polish *Lwów*), the capital of the Austrian crownland of Galicia, and now, according to its population, the fifth city of the Dual Monarchy (after Vienna, Budapest, Prague, and Trieste) and the fourth of Austria. The population in 1890 was 127,943; in 1900, 159,618 (Poles estimated at 82 per cent., Germans 10 per cent., and Ruthenians 8 per cent.; 52·6 per cent. Roman Catholic, 17 per cent. Greek Catholic, 28·4 per cent. Jewish, and 2 per cent. Protestant). Its garrison comprises 10,326 men. It is the seat of a Roman Catholic, a Greek, and an Armenian archbishop, and has 14 Roman Catholic churches, a Greek church, an Armenian church, and a Protestant church, two synagogues and 11 Hebrew houses of prayer, together with numerous Catholic and Greek religious communities, including 11 convents. In addition to the university (with over 100 professors and 2058 students in 1901), in which Polish has been the language of instruction since 1871, educational requirements are provided for by a polytechnic (711 students in 1901), a Roman Catholic, and a Greek Catholic theological seminary, 5 gymnasia, a *realschule*, 2 training colleges, and 5 other technical and special schools. Its industries now include the manufacture of machinery and iron wares, matches, stearin candles and naphtha, arrack and liqueurs, chocolate, chicory, leather, and plaster of Paris, as well as brewing, corn-milling, and brick and tile making. It has important commerce in linen, flax, hemp, wool, and seeds, and a considerable transit trade. It appears, from the statistics published by the municipal authorities, that the Jewish element is chiefly responsible for the large proportion of illegitimate births. In 1892 there were 1944 legitimate and 585 illegitimate Roman Catholic births, as compared with 489 legitimate and 938 illegitimate Jewish births, a ratio which roughly agrees with that prevailing at Cracow. From 350 to 400 children are annually legitimized.

Lemgo, a town of Germany, principality of Lippe, 58 miles by rail south-west of Hanover. It has several old gable-ended houses of the 15th century, a church rebuilt in 1290, a town hall (1589), and several religious and philanthropic institutions, as well as production of meerschaum pipes, cigars, and woollens. Lemgo once belonged to the Hanseatic League. Population (1885), 6443; (1900), 8840.

Lemnos, a historic island of the Ægean Sea, chief town of a sanjak of Turkey and the seat of a Greek bishop with jurisdiction over Lemnos and Aghios Strati. The valleys are fertile, and on the heights there is good grazing for sheep and goats. The chief exports are barley, sesame, cheese, and wool. Population, 27,079, mostly Greeks.

Lemoinne, John (1815–1892), French journalist, was born, of French parents, in London, 17th October 1815, and educated first at an English school and then in France. In 1846 he began writing for the *Journal des Débats* on English and other foreign questions, and under the Empire his brilliant pen was actively employed in holding up to admiration the free institutions of England by contrast with Imperial methods. He became one of the most influential writers in Paris. After 1871 he supported Thiers, but his sympathies rather tended towards a Liberalized monarchy, until the comte de Chambord's policy made such a development an impossibility, and he then ranged himself with the Moderate Republicans. In 1875 John Lemoinne was elected to the French Academy, and in 1880 he was nominated a life senator. Distinguished though he was for a real knowledge of England among the French journalists who wrote on foreign affairs, his tone towards English policy greatly changed in later days, and though he never shared the extreme French bitterness against England as regards Egypt, he maintained a critical attitude towards Great Britain which served to stimulate French Anglophobia. He was a frequent contributor to the *Revuè des Deux Mondes*, and published several books, the best known of which is his *Études Critiques* (1862). He died in Paris 14th December 1892.

Lemur.—Important advances in our knowledge of the extinct members of this group have been made. In the first place, the French *Necrolemur* (*Ency. Brit.* vol. xiv. p. 444) has been identified generically with *Microchœrus* of the Hampshire Tertiaries. Secondly, *Adapis* (*l.c.*) has been proved to be a true lemur, closely related in the structure of the tympanic region of the skull to the Malagasy lemurs, and thereby different from the African galagos. In the North American Eocene lemurs are represented by *Anaptomorphus*, now known to have large eye-sockets and triangular upper molars of the tritubercular type. But the most important discoveries have been made in the superficial deposits of Madagascar. *Megaladapis*, of which two species are known, is the largest of all lemurs. The skull is distinguished by its elongation and the small size of the eye-sockets, the upper molars approximating to the tritubercular type, and presenting considerable resemblance to those of the living *Lepidolemur*. The brain is of a remarkably low type. In one species the approximate length of the skull is 250, and in the second 330 millimetres. Even more interesting are the two large species of *Nesopithecus*, which are likewise from Madagascar, and one of which was at first described as *Globilemur*. They show a very complicated type of brain, and were at first regarded as indicating Malagasy representatives of the Anthropoidea. In regard to the character of the tympanic region of the skull, this genus shows several features characteristic of the more typical Malagasy lemuroids; and the eye-sockets are open behind, while the dentition is numerically the same as in some of the latter. On the other hand, in several features *Nesopithecus* resembles the Anthropoidea; the upper incisors are not separated in the middle line, and the upper molars present the pattern found in the *Cercopithecidœ.* The resemblances to apes are not confined to the skull, but are found in almost all the bones. Probably the genus may be regarded as a specialized lemuroid.

Lenbach, Franz von (1836–——), German painter, was born at Schrobenhausen, in Bavaria, on 13th December 1836. His father was a mason, and the boy was intended to follow his father's trade or be a builder. With this view he was sent to school at Landsberg, and then to the polytechnic at Augsburg. But after seeing one day Hofner, the animal painter, executing some studies, he made various attempts at painting, which his father's orders interrupted. However, when he had seen the galleries of Augsburg and Munich, he finally obtained his father's permission to become an artist, and worked for a short time in the studio of Gräfle, the painter; after this he devoted much time to copying. Thus he was already accomplished in technique when he became the pupil of Piloty, with whom he set out for Italy in 1858. A few interesting works remain as the outcome of this first journey—"A Peasant seeking Shelter from Bad Weather" (1855), "The Goatherd" (1860, in the Schack Gallery, Munich), and "The Arch of Titus" (in the Palfy collection, Budapest). On returning to Munich, he was at once called to Weimar to take the appointment of professor at the Academy, and there he became the friend of Begas, the sculptor, and of Böcklin. But he did not hold it long, having made the acquaintance of Count Schack, who commissioned him to paint a great number of copies for his collection. Lenbach returned to Italy the same year, and there copied Titian's "Sacred and Profane Love," his "Venus" in the Tribuna, and many other famous pictures. After copying, at Munich, Van Dyck's "Lady playing the Violoncello," he set out in 1867 for Spain. There he copied not only the famous pictures by Velasquez in the Prado, but also some landscapes in the museums of Granada and the Alhambra (1868), now in the Schack Gallery. In the previous year he had exhibited at the great Exhibition at Paris several portraits, one of which took a third-class medal. In 1878 he exhibited the "Portrait of Canon Döllinger." Lenbach exhibited frequently both at Munich and at Vienna, and in 1900 at the Paris Exhibition was awarded a Grand Prix for painting. He has painted many of the most remarkable personages of his time; for instance, the king of Bavaria, the empress of Austria, the queen of Italy, the Emperor William I., Frederick III., the Emperor William II., Bismarck (*q.v.*), Moltke, Gladstone, Böcklin, Stuck, Liszt, Wagner, Bülow, Andrassy, Count Schack (1870 and 1875), and Pope Leo XIII.

See BERLEPSCH. "Lenbach," *Velhagen und Klasings Monatshefte.* Munich, 1891.—BÉGOUEN. *Les Portraits de Lenbach è l'Exposition de Munich.* Paris, 1899.—K. KNACKFUSS. *Lenbach.* Leipzig.—*Franz von Lenbach Bildnisse.* Munich, 1900.

Lenormant, François (1837–1883), Assyriologist and archæologist, was born in Paris on 17th January 1837. His father, Charles Lenormant, distinguished as an archæologist, numismatist, and Egyptologist, was anxious that his son should follow in his steps. He made him begin Greek at the age of six, and the child responded so well to this precocious scheme of instruction, that when he was only fourteen an essay of his, on the Greek tablets found at Memphis, appeared in the *Revue Archéologique.* In 1856 he won the numismatic prize of the Académie des Inscriptions with an essay entitled *Classification des Monnaies des Lagides.* In 1862 he became sub-librarian of the Institute. In 1859 he accompanied his father on a journey of exploration to Greece, an expedition destined to end sadly, for Charles Lenormant succumbed to fever at Athens (24th November). In spite of this unhappy event, Lenormant returned to Greece three times during the next six years, and gave up all the time he could spare from his official work to archæological research. These peaceful labours were rudely broken into by the war of 1870, when Lenormant served with the army and was wounded in the siege of Paris. In 1874 he was appointed professor of archæology at the National Library, and in the following year he collaborated with Baron de Witte in founding the *Gazette Archéologique.* As early as 1867 he had turned his attention to Assyrian studies, and was among the first to recognize in the cuneiform inscriptions the existence of a non-Semitic language, now known as Accadian. Lenormant's knowledge was of encyclopædic extent, ranging over an immense number of subjects, and at the same time thorough, though somewhat lacking perhaps in the strict accuracy of the modern school. Most of his varied studies were directed towards tracing the origins of the two great civilizations of the ancient world, which were to be sought in Mesopotamia and on the shores of the Mediterranean. He had a perfect passion for exploration. Besides his early expeditions to Greece, he visited the south of Italy three times with this object, and it was while exploring in Calabria that he met with an accident which ended fatally in Paris on 9th December 1883, after a long illness. The amount and variety of Lenormant's work is truly amazing when it is remembered that he died at the early age of forty-six. Probably the best known of his books are *Les Origines de l'histoire d'après la Bible,* and his ancient history of the East and account of Chaldean magic. For breadth of view, combined with extraordinary subtlety of intuition, he was probably unrivalled. (A. Z.)

Lenox, a town of Berkshire county, Massachusetts, U.S.A., containing an area of 22 square miles of hill country. The principal village in the town, of the same name as the town, is at an altitude of 1200 feet, and about it are high hills—Yokun Seat (2080 feet), South Mountain (1870 feet), Bald Head (1583 feet), and Rattlesnake Hill (1540 feet). Lenox contains the summer houses of many wealthy and prominent persons. The village is principally built along the main street, but the villas are scattered over the surrounding hills in all directions, with fine carriage roads to and among them. The season is in the fall of the year, when outdoor amusements, such as horse-racing, golf, tennis, and polo, are rife. Population (1880), 2043; (1890), 2889; (1900), 2942.

Lens, town, arrondissement of Béthune, department of Pas-de-Calais, France, 12 miles south-east of Béthune by rail, on the Lens canal. It has important iron and steel foundries and forges, and manufactories of steel cables, and occupies a central position in the coalfields of the department, which produced in 1900, 14,594,575 tons of coal. Population (1881), 10,487; (1891), 13,730; (1901), 24,370. Two and a half miles west-south-west lies LIÉVIN, likewise a centre of the coalfield, with a traffic in 1900 of 289,721 tons. Population (1881), 8281; (1891), 11,704; (1901), 17,600.

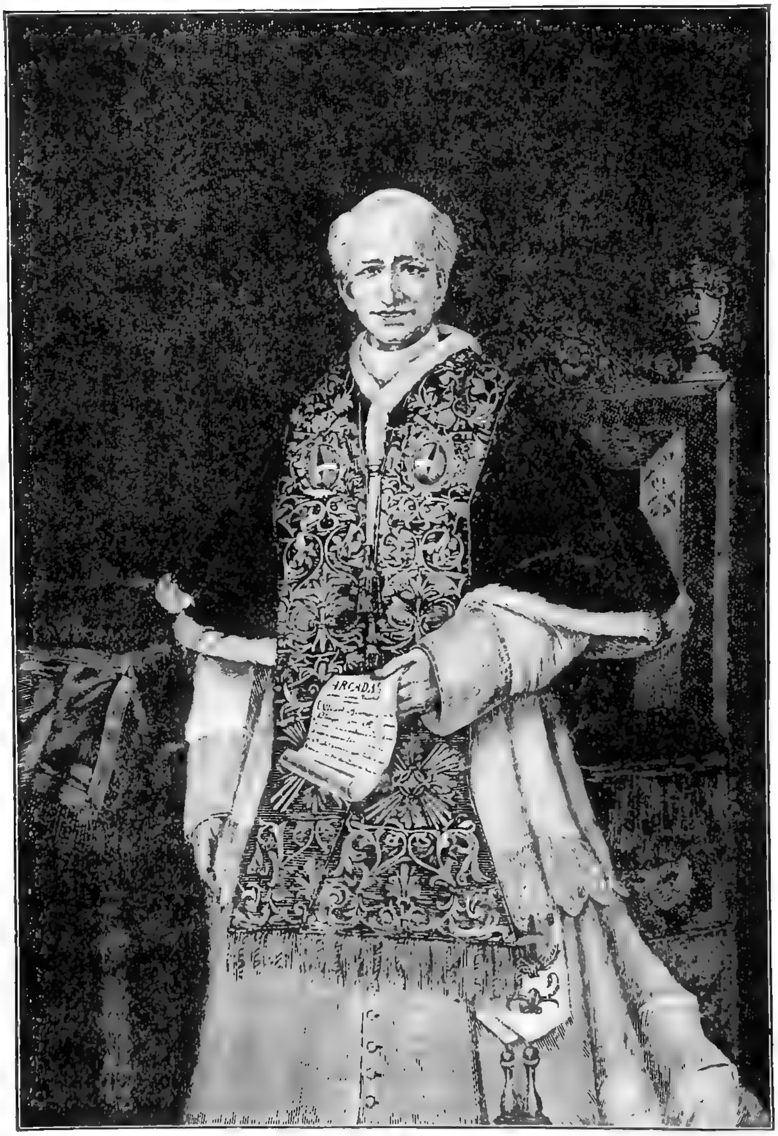
Lentini (the ancient *Leontini*), a town of the province of Syracuse, Sicily, Italy, 36 miles by rail north-north-west of Syracuse, on a hill 1½ miles south-east of the marshy lake Lentini or Biviere. This lake is about 20 miles in circumference, and generally thronged with water-birds, and full of eels, mullet, &c. The town manufactures pottery, and produces cheese, lime, and olive oil, and has a technical school. Lentini and its citadel were almost entirely destroyed by an earthquake in 1693. Population (1881), 12,740; (1899), 11,000. About one mile to the south-east and higher up lies the town of CARLENTINI, founded by Charles V., but greatly injured by the earthquake of 1693. Population (1881), 6530; (1897), 5500.

Leo XIII. [VINCENT JOACHIM RAPHAEL LEWIS PECCI] (1810–——), Pope, reckoned the 257th successor of St Peter, was born at Carpineto, 2nd March 1810. His family was Sienese in origin, and his father had served in the army of Napoleon. His earliest education he received from the Jesuits at Viterbo and in Rome. In the jubilee year 1825 he was selected by his fellow-students to head a deputation to Pope Leo XII., whose memory he subsequently cherished and whose name he assumed in 1878. Weak health, consequent on over-study, prevented him from obtaining the highest academical honours, but he graduated as doctor in theology at the age of twenty-two, and then entered the "Accademia," a college in which clergy of aristocratic birth are trained for the diplomatic service of the Roman Church. Two years later Gregory XVI. appointed him a domestic prelate, and bestowed on him, by way of apprenticeship, various minor administrative offices in the pontifical State. He was ordained priest 31st December 1837, and a few weeks later was made governor of Benevento, where he had to deal with brigands and smugglers, who enjoyed the protection of some of the noble families of the district. His success here led to his appointment in 1841 as governor of Perugia, which was at that time a centre of anti-papal secret societies. This post he held for eighteen months only, but in that brief period he obtained a reputation as a social and municipal reformer. In 1843 he was sent as Nuncio to Brussels, being first consecrated a bishop (19th February), with the title of archbishop of Damietta. During his three years' residence at the Belgian capital he gained the esteem of Leopold I. and was presented to Queen Victoria of England and the Prince Consort. He also made the acquaintance of many Englishmen, Archbishop Whately among them. In January 1846, at the request of the magistrates and people of Perugia, he was appointed bishop of that city; but before returning to Italy he spent the month of February in London (where he was present at one of Lord Palmerston's receptions), and the months of March and April in Paris. On his arrival in Rome he would, at the request of King Leopold, have been created cardinal but for the death of Gregory XVI. Seven years later, 19th December 1853, he received the red hat from Pius IX. Meanwhile, and throughout his long episcopate of thirty-two years, he foreshadowed the zeal and the enlightened policy later to be displayed in the prolonged period of his pontificate, building and restoring many churches, striving to elevate the intellectual as well as the spiritual tone of his clergy, and showing in his pastoral letters an unusual regard for learning and for social reform. His position in Italy was similar to that of Bishop Dupanloup in France; and, as but a moderate supporter of the policy enunciated in the Syllabus, he was not altogether *persona grata* to Pius IX. But he protested energetically against the loss of the Pope's temporal power in 1870, against the confiscation of the property of the religious orders, and against the law of civil marriage established by the Italian Government, and he refused to welcome Victor Emmanuel in his diocese. Nevertheless, he remained in the comparative obscurity of his episcopal see until the death of Cardinal Antonelli; but in 1877, when the important papal office of Camerlengo became vacant, Pius IX. appointed to it Cardinal Pecci, who thus returned to reside in Rome, with the prospect of having shortly responsible functions to perform during the vacancy of the Holy See, though the Camerlengo was traditionally regarded as disqualified by his office from succeeding to the papal throne.

When Pius IX. died (7th February 1878) Cardinal Pecci was elected Pope at the subsequent Conclave with comparative unanimity, obtaining at the third scrutiny (20th February) forty-four out of sixty-one votes, or more than the requisite two-thirds majority. The Conclave was remarkably free from political influences, the attention of Europe being at the time engrossed by the presence of a Russian army at the gates of Constantinople. It was said that the long pontificate of Pius IX. led some of the cardinals to vote for Pecci, since his age (within a few days of sixty-eight) and health warranted the expectation that his reign would be comparatively brief; but he had for years been known as one of the few "Papable" cardinals; and although his long seclusion at Perugia had caused his name to be little known outside Italy, there was a general belief that the Conclave had selected a man who was a prudent statesman as well as a devout churchman; and Newman (whom he created a cardinal in the year following) is reported to have said, "In the successor of Pius I recognize a depth of thought, a tenderness of heart, a winning simplicity, and a power answering to the name of Leo which prevent me from lamenting that Pius is no longer here."

The second day after his election Pope Leo XIII. crossed the Tiber *incognito* to his former residence in the Falconieri Palace to collect his papers, returning at once to the Vatican, where he continued to regard himself as "imprisoned" so long as the Italian Government occupied the city of Rome. He was crowned in the Sistine Chapel 3rd March 1878, and at once began a reform of the papal household on austere and economic lines which found little favour with the *entourage* of the former Pope. To fill posts near his own person he summoned certain of the Perugian clergy who had been trained under his own eye, and from the first he was less accessible than his predecessor had been, either in public or private audience. Externally uneventful as his life henceforth necessarily was, it was marked chiefly by the reception of distinguished personages and of numerous pilgrimages, often on a large scale, from all parts of the world, and by the issue of encyclical letters. The stricter theological training of the Roman Catholic clergy throughout the world on the lines laid down by St Thomas Aquinas was his first care, and to this end he founded in Rome and endowed an academy bearing the great schoolman's name, further devoting about £12,000 to the publication of a new and splendid edition of his works, the idea being that on this basis the later teaching of Catholic theologians and many of the speculations of modern thinkers could best be harmonized and brought into line. The study of Church history was next encouraged, and in August 1883 the Pope addressed a letter to Cardinals De Luca, Pitra, and Hergenröther, in which he made the remarkable concession that the Vatican archives and library might be placed at the disposal of persons qualified to compile manuals of history. His belief was that the Church would not suffer by the publication of documents. A man of literary taste and culture, familiar with the classics, a facile writer of Latin verses as well as of Ciceronian prose, he was as anxious that the Roman clergy should unite human science and literature with their theological studies as that the laity should be educated in the principles of religion; and to this end he established in Rome a kind of voluntary School Board, with members both lay and clerical; and the rivalry of the schools thus founded ultimately obliged the State to include religious teaching in their curriculum. The numerous encyclicals by which the pontificate of Leo XIII.

will always be distinguished were prepared and written by himself, but were submitted to the customary revision. His first (4th August 1879) was on the scholastic philosophy. In later ones, working on the principle that the Christian Church should superintend and direct every form of civil life, he dealt with the Christian Constitution of States (1st November 1895), with Human Liberty (20th June 1888), and with the Condition of the Working Classes (15th May 1891). This last, entitled *Rerum novarum*, was slightly tinged with modern socialism; it was described as "the social Magna Charta of Catholicism," and it won for him the name of "the workingman's Pope." Translated into the chief modern languages, many thousands of copies were circulated among the working classes in Catholic countries. Other encyclicals, such as those on Christian Marriage (10th February 1880), on the Rosary (1st September 1883, and again 5th September 1898), and on Freemasonry (20th April 1884), dealt with subjects on which his predecessor had been accustomed to pronounce allocutions, and were on similar lines. It was the knowledge that in all points of religious faith and practice Leo XIII. stood precisely where Pius IX. had stood that served to render ineffectual others of his encyclicals, in which he dealt earnestly and effectively with matters in which orthodox Protestants had a sympathetic interest with him and might otherwise have lent an ear to his counsels. Such were the letters on the Study of Holy Scripture (18th November 1893), and on the Reunion of Christendom (20th June 1894). He showed special anxiety for the return of England to the Roman Catholic fold, and addressed a letter *ad Anglos*, dated 14th April 1894. This he followed up by an encyclical entitled *Satis Cognitum*, on the Unity of the Church (29th June 1896); and the question of the validity of Anglican ordinations from the Roman Catholic point of view having been raised in Rome by Viscount Halifax, with whom the Abbé Duchesne and one or two other French priests were in sympathy, a commission was appointed to consider the subject, and on 15th September 1896 a condemnation of the Anglican form as theologically insufficient was issued, and was directed to be taken as final.



Pope Leo XIII.

The establishment of a diocesan hierarchy in Scotland had been decided upon before the death of Pius IX., but the actual announcement of it was made by Leo XIII. On 25th July 1898 he addressed to the Scottish Catholic bishops a letter, in the course of which he said that "many of the Scottish people who do not agree with us in faith sincerely love the name of Christ and strive to ascertain His doctrine and to imitate His most holy example." The Irish and American bishops he summoned to Rome to confer with him on the subjects of Home Rule and of "Americanism" respectively. In India he established a diocesan hierarchy, with seven archbishoprics, the archbishop of Goa taking precedence with the rank of Patriarch.

With the Government of Italy his general policy was to be as conciliatory as was consistent with his oath as Pope never to surrender the "patrimony of St Peter"; but a moderate attitude was rendered difficult by partisans on either side in the press, each of whom claimed to represent his views. In 1879, addressing a congress of Catholic journalists in Rome, he exhorted them to uphold the necessity of the temporal power, and to proclaim to the world that the affairs of Italy would never prosper until it was restored; in 1887 he found it necessary to deprecate the violence with which this doctrine was advocated in certain journals. A similar counsel of moderation was given to the Canadian press in connexion with the Manitoba school question in December 1897. The less conciliatory attitude towards the Italian Government was resumed in an encyclical addressed to the Italian clergy (5th August 1898), in which he insisted on the duty of Italian Catholics to abstain from political life while the Papacy remained in its "painful, precarious, and intolerable position." And in January 1902, reversing the policy which had its inception in the encyclical, *Rerum novarum*, of 1891, and had further been developed ten years later in a letter to the Italian bishops entitled *Graves de communi*, the "Sacred Congregation of Extraordinary Ecclesiastical Affairs" issued instructions concerning "Christian Democracy in Italy," directing that the popular Christian movement, which embraced in its programme a number of social reforms, such as factory laws for children, old-age pensions, a minimum wage in agricultural industries, an eight-hours' day, the revival of trade guilds, and the encouragement of Sunday rest, should divert its attention from all such things as savoured of novelty and devote its energies to the restoration of the temporal power. The reactionary policy thus indicated gave the impression that a similar aim underlay the appointment about the same date of a commission to inquire into Biblical studies; and in other minor matters Leo XIII. disappointed those who had looked to him for certain reforms in the devotional system of the Church. A revision of the breviary, which would have involved the omission of some of the less credible legends, came to nothing, while the recitation of the office in honour of the Santa Casa at Loreto was imposed on all the clergy. The worship of Mary, largely developed during the reign of Pius IX., received further stimulus from Leo; nor did he do anything during his pontificate to correct the superstitions connected with popular beliefs concerning relics and indulgences.

His policy towards all governments outside Italy was to support them wherever they represented social order; and it was with difficulty that he persuaded French Catholics to be united in defence of the Republic. In 1885 he successfully arbitrated between Germany and Spain in a dispute concerning the Caroline Islands. In Ireland he condemned the "Plan of Campaign," but he conciliated the Nationalists by appointing Dr Walsh archbishop of Dublin. His hope that his support of the British Government in Ireland would be met by the establishment of formal diplomatic relations between the Court of St James's and the Vatican was disappointed. But the jubilee of Queen Victoria in 1887 and the Pope's priestly jubilee a few months later were the occasion of friendly intercourse between Rome and Windsor, Mgr. Ruffo Scilla coming to London as special papal envoy, and the duke of Norfolk being received at the Vatican as the bearer of the congratulations of the queen of England. Similar courtesies were exchanged during the jubilee of 1897, and again in March 1902, when Edward VII. sent the Earl of Denbigh to Rome to congratulate Leo XIII. on reaching his ninety-third year and the twenty-fifth year of his pontificate.

The elevation of Newman to the College of Cardinals in 1879 was regarded with approval throughout the English-speaking world, both on Newman's account and also as evidence that Leo XIII. had a wider horizon than his predecessor; and his similar recognition of two of the most distinguished "inopportunist" members of the Vatican Council, Haynald, archbishop of Kalocsa, and Prince Fürstenberg, archbishop of Olmütz, was even more noteworthy. Dupanloup would doubtless have received the same honour had he not died shortly after Leo's accession. Döllinger he attempted to reconcile, but failed. An Armenian schism was healed by him, and he laboured much to bring about the reunion of the Oriental Churches with the see of Rome, establishing Catholic educational centres in Athens and in Constantinople with that end in view. He used his influence with the Tsar, as also with the emperors of China and Japan and with the shah of Persia, to secure the free practice of their religion for Roman Catholics within their respective dominions. Among the canonizations and beatifications of his pontificate that of Sir Thomas More, author of the *Utopia*, is memorable. His encyclical issued at Easter 1902, and described by himself as a kind of will, was mainly a reiteration of earlier condemnations of the Reformation, and of modern philosophical systems, which by their atheism and materialism are responsible for all existing moral and political disorders. Society, he earnestly pleaded, can only find salvation by a return to Christianity and to the fold of the Roman Catholic Church.

The personal appearance of Leo XIII. in his later years is thus described by Mr Thaddeus, who painted his portrait:—"Pope Leo XIII. is of medium height. His attenuated figure is bent by study and the weight of years, but in every movement he is astonishingly quick and energetic. His head is a most remarkable one, once seen never to be forgotten, with its every feature out of strict proportion, yet with the harmony of the whole. The small, bright, rapid eyes, set close together, denote the man who is ever on the search; the largely developed aquiline nose a capacity for domination. The mouth, when under a pleasing influence, forms into an exceedingly wide, sweet smile, its benevolent expression brightening the whole face, and supplying the benignity which is less observable in the eyes. . . . The skin is so thin that a perfect network of blue veins is visible over all the white ascetic face. He is gifted with the fire and the impulses of youth, without its accompanying physical strength." Grave and serious in manner, speaking slowly, but with energetic gestures, simple and abstemious in his life,—his daily bill of fare being reckoned as hardly costing a couple of francs,—he distributed large sums in charity, and at his own charges placed costly astronomical instruments in the Vatican Observatory, providing also accommodation and endowment for a staff of officials. He always showed the greatest interest in science and in literature, and he would have taken a position as a statesman of the first rank had he held office in any secular government. He may be reckoned the most illustrious Pope since Benedict XIV., and under him the papacy acquired a prestige unknown since the Middle Ages.

Leoben, an old mining town, situated on a peninsula formed by the Mur river in Styria, Austria. Part of its old walls and towers still remain. It has a well-known academy of mining and a number of technical schools. Its extensive iron-works and trade in iron are a consequence of its position on the verge of the important lignite deposits of Upper Styria and in the neighbourhood of the iron mines and furnaces of Vordernberg and Eisenerz, with which it is connected by railway. The preliminary peace concluded at Leoben between Austria and France on the 18th of April 1797 is commemorated by a monument. Population (1890), 8127; (1900), 10,204.

Leominster, a municipal borough and market town in the Leominster parliamentary division (since 1885) of Herefordshire, England, 12 miles north of Hereford by rail. A free library has been erected. The district is rich in orchards, hop gardens, and agricultural land, and there are cider works in the town. Area of borough, 8284 acres. Population (1891), 5675; (1901), 5826.

Leominster, a town of Worcester county, Massachusetts, U.S.A., in a broken, hilly region, crossed by the New York, New Haven, and Hartford railroad. The principal village in the town bears the same name as the town, and is on the Nashua river. It has some manufactures of various kinds. Population (1880), 5772; (1890), 7269; (1900), 12,392, of whom 2827 were foreign-born.

Leon, an inland province in the north-west of Spain.

It is divided into 10 administrative districts and 234 parishes, covering 6166 square miles. The population was 384,197 in 1897, the average birth-rate being 3·89 per cent., the death-rate 3·11 per cent., and the proportion of illegitimate births 4·69 per cent. The main railway line from Madrid to Corunna passes through the province. From Leon City a branch runs to Oviedo, and to Gijon on the north coast, with a sub-branch to Vierzo. The chief exports are cattle, mules, iron, leather, coal, and butter.

The province is very rich in mines, but only 53 (51 coal) are worked, while 418 are unproductive. The coal-mines developed considerably towards the end of the 19th century, and employ more than a thousand hands. Five companies had an output in 1898 of 144,700 tons of coal and 29,230 tons of coke, besides 40,500 tons of anthracite. In 1898 the live stock included 9623 horses, 3056 mules, 16,220 asses, 159,604 cattle, 452,320 sheep, 26,584 pigs, and 108,127 goats. Agriculture is important, 136,135 acres being devoted to wheat, 312,552 to rye, oats, barley, and maize, 9200 to pod fruit, 51,407 to vines, and 3500 to garbanzos or chick-pea.

Leon, the capital of the above province, had a population of 15,300 in 1897. About the middle of the 19th century it seemed to be decaying fast, but a revival has set in. The churches and convents have been repaired, especially the noble cathedral, the restoration of which took ten years. The local industries, particularly those connected with chemicals, leather, foundries, machinery, and railway rolling and fixed stock, have much developed, as has also the trade in agricultural products. The new town has spread beyond the dilapidated walls of the Roman and mediæval boundaries. Leon has an institute, seminaries, and handsome municipal buildings and hospitals.

Leon, chief town of a province of Nicaragua, Central America, on the railway from Corinto to Lake Managua, 50 miles north-west of Managua. Until 1855 Leon was the capital of Nicaragua, and suffered severely in the civil wars; but owing largely to the advantage of railway communication, it has recovered much of its prosperity. Besides a large general trade, it has several extensive tanneries, which supply cheap leather for export. Population, about 34,000, or including that of the large Indian suburb of Subtiaba, from which the modern town had its origin, about 45,000.

Léonard, Hubert (1819–1890), Belgian violinist and teacher, was born at Bellaine on 7th April 1819. He studied under Habeneck at the Paris Conservatoire, gave concerts in the principal towns of Europe, and succeeded de Bériot as professor of the violin at the Brussels Conservatoire in 1851. It is especially as a teacher that Léonard acquired fame. He wrote a great deal for his instrument, and his published works include six concertos, studies, fantasias, &c., besides many duets in collaboration with Litolff, Grégoire, and Servais. He died in Paris, 6th May 1890.

Leonforte, a town of the province of Catania, Sicily, Italy, 52 miles west by north of Catania (49 miles by rail). It has sulphur-mines and flour mills. Altitude, 3400 feet above sea-level. Population (1881), 15,645; (1897), 15,000.

Leopold II. (LEOPOLD LOUIS PHILIPPE MARIE VICTOR), king of the Belgians (1835– ——), son of King Leopold I. and Princess Louise, daughter of Louis Philippe, king of the French, was born at Brussels, 9th April 1835. In 1846 he was created duke of Brabant and appointed a sub-lieutenant in the army, in which he served until his accession, by which time he had reached the rank of lieutenant-general. On attaining full age he was made a member of the Senate, and distinguished himself by the keen interest he took in its proceedings, and especially in those which concerned the development of Belgium and its trade. On 22nd August 1853 he married Marie Henrietta, daughter of the late Archduke Joseph of Austria, and after making a tour round the chief towns of Belgium, the young duke and duchess travelled, in 1854–55, through Italy and Austria to Egypt, Palestine, and Greece. In 1860 the duke visited Constantinople, which, owing to the Crimean war, had necessarily been omitted from the programme in 1855; and two years later he went to Spain and Morocco, after spending a few days on the south coast of England. In the autumn of the same year he paid a second visit to Egypt, this time *vià* Algiers and Tunis, and, proceeding to Mount Sinai, did not return to Brussels until June 1863. In the following year he made the most distant and most notable of his numerous journeys, visiting China and India. He returned in 1865 through London, in order to tender special thanks to Queen Victoria and the British Government for the courtesies received throughout the British dominions in Asia. On the death of his father, 10th December 1865, he succeeded to the crown as Leopold II., and on 28th January 1869 their majesties lost their only son, the Crown Prince Leopold, whereupon the king's brother, Philip, count of Flanders, became heir to the throne. During the Franco-Prussian war King Leopold preserved a strict and honourable neutrality in a period of unusual difficulty and danger. But the most notable and far-reaching event in his career was the foundation of the Congo Free State. While still duke of Brabant, Leopold II. was the first to call the attention of the Belgians to the need of enlarging their horizon beyond sea, and as king he gave the first impulse towards the development of this idea, by founding in 1876 the Association Internationale Africaine. This was followed in 1878 by the formation of the Comité d'Études du Haut-Congo, which in its turn developed into the Congo Free State. The history of these transactions, from 1878 to 1884, is given by Sir H. M. Stanley in *The Congo and the Founding of its Free State* (1885), which contains a full account of Stanley's explorations made under commission from King Leopold, who contributed £50,000 from his privy purse towards the expenses. It was in this connexion that King Leopold sought an interview with General Gordon in 1880, and obtained his promise, subject to the approval of the War Office, to enter the Belgian service on the Congo. Three years later his majesty claimed fulfilment of the promise, and Gordon was about to proceed to the Congo when the British Government claimed his services for the Sudan. An excellent linguist, King Leopold was also an ardent traveller, and a patron of art, literature, and science; he founded in 1874 a yearly prize of 25,000 francs for the best work on a given subject announced five years in advance. As duke of Brabant he held aloof from politics, and after his accession he followed the strict constitutional line to which his father always adhered.

Leprosy is now included among the parasitic diseases. The cause is believed to be infection by the bacillus lepræ, a specific microbe discovered by Hansen in 1871. This organism, which closely resembles the tubercle bacillus, is always found associated with leprosy, but all attempts to cultivate it and to produce the disease by experimental inoculation have failed or met with doubtful success. The proof of causation is, therefore, still incomplete. It is worthy of note that tuberculosis is very common among lepers, and especially attacks the serous membranes. The essential character of leprosy is a great multiplication of cells, resembling the "granulation cells" of lupus and syphilis, in the tissues affected, which become infiltrated and thickened, with degeneration and destruction of their normal elements. The new cells vary in size from ordinary leucocytes to giant cells three or four times larger. The bacilli are found in these cells, sometimes in small numbers, sometimes in masses. The structures most affected are the skin, nerves, mucous membranes, and lymphatic glands.

The symptoms arise from the anatomical changes indicated, and they vary according to the parts attacked. Three types of disease are usually described—(1) nodular, (2) smooth or anæsthetic, (3) mixed. In the first the skin is chiefly affected, in the second the nerves; the third combines the features of both. It should be understood that this classification is purely a matter of convenience, and is based on the relative prominence of symptoms, which may be combined in all degrees. The incubation period of leprosy—assuming it to be due to infection—is unknown, but cases are on record which can only be explained on the hypothesis that it may be many years. The invasion is usually slow and intermittent. There are occasional feverish attacks, with the usual constitutional disturbance and other slight premonitory signs, such as changes in the colour of the skin and in its sensibility. Sometimes, but rarely, the onset is acute and the characteristic symptoms develop rapidly. These begin with an eruption which differs markedly according to the type of disease. In the nodular form dark red or coppery patches appear on the face, backs of the hands, and feet, or on the body; they are generally symmetrical, and vary from the size of a shilling upwards. They come with one of the feverish attacks and fade away when it has gone, but only to return. After a time infiltration and thickening of the skin become noticeable, and the nodules appear. They are lumpy excrescences, at first pink but changing to brown. Thickening of the skin of the face produces a highly characteristic appearance, recalling the aspect of a lion. The tissues of the eye undergo degenerative changes; the mucous membrane of the nose and throat is thickened, impairing the breathing and the voice; the eyebrows fall off; the ears and nose become thickened and enlarged. As the disease progresses the nodules tend to break down and ulcerate, leaving open sores. The patient, whose condition is extremely wretched, gradually becomes weaker, and eventually succumbs to exhaustion or is carried off by some intercurrent disease, usually inflammation of the kidneys or tuberculosis. A severe case may end fatally in two years, but as a rule when patients are well cared for the illness lasts several years. There is often temporary improvement, but complete recovery from this form of leprosy rarely or never occurs. The smooth type is less severe and more chronic. The eruption consists of patches of dry, slightly discoloured skin, not elevated above the surface. These patches are the result of morbid changes affecting the cutaneous nerves, and are accompanied by diminished sensibility over the areas of skin affected. At the same time certain nerve trunks in the arm and leg, and particularly the ulnar nerve, are found to be thickened. In the further stages the symptoms are those of increasing degeneration of the nerves. Bullæ form on the skin, and the discoloured patches become enlarged; sensation is lost, muscular power diminished, with wasting, contraction of tendons, and all the signs of impaired nutrition. The nails become hard and clawed; perforating ulcers of the feet are common; portions of the extremities, including whole fingers and toes, die and drop off. Later, paralysis becomes more marked, affecting the muscles of the face and limbs. The disease runs a very chronic course, and may last twenty or thirty years. Recovery occasionally occurs. In the mixed form, which is probably the most common, the symptoms described are combined in varying degrees. Leprosy may be mistaken for syphilis, tuberculosis, ainhum (an obscure disease affecting negroes, in which the little toe drops off), and several affections of the skin. Diagnosis is established by the presence of the bacillus lepræ in the nodules or bullæ, and by the signs of nerve degeneration exhibited in the anæsthetic patches of skin and the thickened nerve trunks.

In former times leprosy was often confounded with other skin diseases, especially psoriasis and leucoderma; the white leprosy of the Old Testament was probably a form of the latter. But there is no doubt that true leprosy has existed from time immemorial. Prescriptions for treating it have been found in Egypt, to which a date of about 4600 B.C. is assigned. The disease is described by Aristotle and by later Greek writers, but not by Hippocrates, though leprosy derives its name from his "lepra" or "scaly" disease, which was no doubt psoriasis. In ancient times it was widely prevalent throughout Asia as well as in Egypt, and among the Greeks and Romans. In the Middle Ages it became extensively diffused in Europe, and in some countries—France, England, Germany, and Spain—every considerable town had its leper-house, in which the patients were segregated. The total number of such houses has been reckoned at 19,000. The earliest one in England was established at Canterbury in 1096, and the latest at Highgate in 1472. At one time there were at least 95 religious hospitals for lepers in Great Britain and 14 in Ireland (Sir James Simpson). During the 15th century the disease underwent a remarkable diminution. It practically disappeared in the civilized parts of Europe, and the leper-houses were given up. It is a singular fact that this diminution was coincident with the great extension of syphilis (see PROSTITUTION). The general disappearance of leprosy at this time is the more unintelligible because it did not take effect everywhere. In Scotland the disease lingered until the 19th century, and in some other parts it has never died out at all. At the present time it still exists in Norway, Iceland, along the shores of the Baltic, in South Russia, Greece, Turkey, several Mediterranean islands, the Riviera, Spain, and Portugal. Isolated cases occasionally occur elsewhere, but they are usually imported. The Teutonic races seem to be especially free from the taint. Leper asylums are maintained in Norway and at two or three places in the Baltic, San Remo, Cyprus, Constantinople, Alicante, and Lisbon. Except in Spain, where some increase has taken place, the disease is dying out. The number of lepers in Norway was 3000 in 1856, but has now dwindled to a few hundred. They are no longer numerous in any part of Europe. On the other hand, leprosy prevails extensively throughout Asia, from the Mediterranean to Japan, and from Arabia to Siberia. It is also found in nearly all parts of Africa, particularly on the east and west coasts near the equator. In South Africa it has greatly increased, and attacks the Dutch as well as natives. Leper asylums have been established at Robben Island near Cape Town, and in Tembuland. In Australia, where it was introduced by Chinese, it has also spread to Europeans. In New Zealand the Maoris are affected; but the amount of leprosy is not large in either country. A much more remarkable case is that of the Sandwich Islands, where the disease is believed to have been imported by Chinese. It was unknown before 1848, but in 1866 the number of lepers had risen to 230 and in 1882 to 4000 (Liveing). All attempts to stop it by segregating lepers in the settlement of Molokai appear to have been fruitless. In the West Indies and on the American continent, again, leprosy has a wide distribution. It is found in nearly all parts of South and Central America, and in certain parts of North America—namely, Louisiana, California (among Chinese), Minnesota, Wisconsin and Dakota (Norwegians), New Brunswick (French Canadians).

It is difficult to find any explanation of the geographical distribution and behaviour of leprosy. It seems to affect islands and the sea-coast more than the interior, and to some extent this gives colour to the old belief that it is caused or fostered by a fish diet, which has been revived by Mr Hutchinson, but is not generally accepted. Leprosy is found in interiors where fish is not an article of diet. Climate, again, has obviously little, if any, influence. The theory of heredity is equally at fault, whether it be applied to account for the spread of the disease by transmission or for its disappearance by the elimination of susceptible persons. The latter is the manner in which heredity might be expected to act, if at all, for lepers are remarkably sterile. But we see it persisting among the Eastern races, who have been continuously exposed to its selective influence from the earliest times, while it has disappeared among the Europeans, who were affected very much later. The opposite theory of hereditary transmission from parents to offspring is also at variance with many observed facts. Leprosy is very rarely congenital, and no cases have occurred among the descendants to the third generation of 160 Norwegian lepers settled in the United States. Again, if hereditary transmission were an effective influence, the disease could hardly have died down so rapidly as it did in Europe in the 15th century. Then we have the theory of contagion. There is no doubt that human beings are inoculable with leprosy, and that the disease may be communicated by close contact. Cases have been recorded which prove it conclusively; for instance, that of a man who had never been out of the British islands, but developed leprosy after sharing for a time the bed and clothes of his brother, who had contracted the disease in the West Indies. Other single cases of communication from person to person have been established; and on a larger scale, the spread of the disease when introduced into countries by immigrants has been already noted. But a great number of observations go to show that the contagiousness of leprosy is very slight and quite personal. It seems, at any rate, insufficient to account for the rapid increase which has taken place in the Sandwich Islands in spite of the segregation. This case and some of the other facts noted, such as the extensive dissemination of the disease in Europe during the Middle Ages, and its subsequent rapid decline, suggest the existence of some unknown epidemic factor. Poverty and insanitation are said to go with the prevalence of leprosy, but they go with every malady, and there is nothing to show that they have any special influence. Vaccination has been blamed for spreading it, and a few cases of communication by arm-to-arm inoculation are recorded. The influence of this factor, however, can only be trifling. Vaccination is a new thing, leprosy a very old one; where there is most vaccination there is no leprosy, and where there is most leprosy there is little or no vaccination. In India 78 per cent. of the lepers are unvaccinated, and in Canton since vaccination was introduced leprosy has declined (Cantlie). On the whole we must conclude that there is still much to be learnt about the conditions which govern the prevalence of leprosy.

With regard to prevention, the isolation of patients is obviously desirable, especially in the later stages, when open sores may disseminate the bacilli; but complete segregation, which has been urged, is regarded as impracticable by those who have had most experience in leprous districts. Scrupulous cleanliness should be exercised by persons attending on lepers or brought into close contact with them. In treatment the most essential thing is general care of the health, with good food and clothing. The tendency of modern therapeutics to attach increasing importance to nutrition in various morbid states, and notably in diseases of degeneration, such as tuberculosis and affections of the nervous system, is borne out by experience in leprosy, which has affinities to both; and this suggests the application to it of modern methods for improving local as well as general nutrition by physical means. A large number of internal remedies have been tried with varying results; those most recommended are chaulmoogra oil, arsenic, salicylate of soda, salol, and chlorate of potash. In the later stages of the disease there is a wide field for surgery, which is able to give much relief to sufferers.

Lepsius, Carl Richard (1810–1884), Egyptologist, was born at Naumburg-am-Saale, 23rd December 1810, and in 1823 was sent to the "Schulpforte" school near Naumburg, where he came under the influence of Professor Lange. In 1829 he entered the University of Leipzig, and one year later that of Göttingen, where, under the influence of Otfried Müller, he finally decided to devote himself to the archæological side of philology. From Göttingen he went to Berlin in 1832, where he graduated as doctor with the thesis *De tabulis Eugubinis.* In the same year he proceeded to study in Paris, and was commissioned by the duc de Luynes to collect material from the Greek and Latin writers for his work on the weapons of the ancients. In 1834 he took the Volney prize with his *Paläographie als Mittel der Sprachforschung.* Befriended by Bunsen and Humboldt, Lepsius threw himself with great ardour into Egyptological studies, and in 1835 presented to the Berlin Academy two dissertations on the Egyptian alphabet and numerals. Having greatly advanced his knowledge of hieroglyphics, he proceeded to Turin at the end of 1835. Here his meditative studies laid the foundation for his future splendid edition of the *Book of the Dead* (1842). It was by his advice that the Drovetti collection at Livorno was afterwards acquired for the Berlin Museum. In May 1836 he went to Rome, where Bunsen, who was engaged on his great work *Aegypten's Stelle in der Weltgeschichte,* had his collaboration. In 1837 Lepsius addressed a remarkable letter to Rosellini on the hieroglyphic alphabet, and in the following year left Rome to study the Egyptian collections at Leyden and to visit England. He then returned to Germany, where Humboldt and Bunsen united their influence to make his projected visit to Egypt a scientific expedition with royal support. A prolonged stay at Memphis gave Lepsius the opportunity of deep researches into early Egyptian history and chronology. At the end of 1845 he returned home, and the results of the expedition, consisting of some 1500 specimens and casts, far surpassed expectations. On 5th July 1846 he married Elisabeth Klein, and his appointment to a professorship in the Berlin University in the following August afforded him the leisure necessary for the completion of his work. In 1856 the twelve volumes of his vast *Denkmäler aus Aegypten und Aethiopien* were finished; they comprise the entire archæological, palæographical, and historical results of the Egyptian expedition, and their wealth of lithographed inscriptions renders them an indispensable corpus for the study of Egyptology. In the same year Lepsius detected the forgery of the lost work of Stephanus of Byzantium, Αἰγυπτίων βασιλέων ἀναγραφῶν βίβλοι τρεῖς, which Simonides attempted to palm off upon the Berlin Academy for 2500 thalers. The next subject that engaged his attention was metrology, but here the results of his investigations were warmly contested by Oppert and the younger school of Assyriologists. His editorship of the *Zeitung für Aegyptische Sprache und Alterthumskunde* soon raised that journal to the rank of an international organ. In 1866 Lepsius again went to Egypt, and brought back with him the famous Decree of Tanis or Table of Canopus, which was found among the ruins of Sān, one of the most important finds since the Rosetta Stone. In 1869 Lepsius visited Egypt for the third and last time, and in 1873 he succeeded Pertz as keeper of the Royal Library, Berlin, which, like the Berlin Museum, owes much to his care. About ten years later he was appointed Geheimer Oberregierungsrath. He died at Berlin, 10th July 1884. Lepsius was a fine specimen of the best type of German scholar, modest, patient, simple, and enthusiastic. (G. F. B.)

Lercara, a town of the province of Palermo, Sicily, Italy, 49 miles south by west of Termini by rail, 2166 feet above sea-level. It has important sulphur mines and manufactures of macaroni and lime. Population (1881), 13,324; (1897), 14,000.

Lerici, a small seaport town and summer resort of the province of Genoa, Liguria, Italy, on the east side of the entrance to the Gulf of Spezia, 4 miles south-east of Spezia. It has an old castle and three churches, and is a place of some industry, chiefly lead and silver refining (at Pertusola, but in the commune), shipbuilding, foundries, machine shops, macaroni factories, and olive-oil presses. Within its commune is San Terenzo, where Shelley lived. Population (1881), 5575; (1897), 6000.

Lérida, a province of Spain, on the French frontier. It has an area of 4772 square miles, and is divided into eight administrative districts and 325 parishes. The population decreased somewhat between 1887 and 1897, namely, from 285,417 in the former year to 284,693 in 1897. The birth-rate is 3·07 per cent., the death-rate 2·74 per cent., and the proportion of illegitimate births only 0·90 per cent., the lowest provincial average in Spain. The railway from Saragossa to Barcelona runs across the province for 65 miles. The Spanish Government has entered into an agreement with France to carry another line, putting Lérida into communication with Tarragona and the Mediterranean coasts, to the mouth of an international tunnel through the Pyrenees. Industries are in a more backward condition than in any other province of Catalonia, though there is abundant water power, and excellent wool is obtained. There are, however, 20 cotton and linen factories, 60 flour mills, 70 alcohol or liqueur manufactories, 18 paper mills, 16 soap works, 70 sawmills, and a few oil and leather factories. The local trade is active in wine, oil, wool, timber, cattle, mules, horses, and sheep. In 1898 the live stock included 2580 horses, 17,263 mules, 23,049 asses, 21,865 cattle, 158,915 sheep, 15,621 goats, and 16,815 pigs. Despite the backward state of agriculture, 129,735 acres were in 1898 devoted to the cultivation of wheat, 77,847 acres to barley, rye, oats, maize; 10,900 acres to chick-peas and beans; 103,000 acres to vines; and 135,627 acres to olive plantations. Mining is as yet unimportant, only four mines being worked, but there are 68 registered (chiefly lignite), though unproductive. LÉRIDA, the capital of the province, had a population of 21,337 in 1897. The aspect of the place has changed considerably since 1880, an extensive new suburb having sprung up on the left bank of the Segré, with broad, regular streets, squares, and promenades, forming a marked contrast to the old town on the right bank. There are good schools, hospitals, public libraries, and some trade in the products of local industries and agriculture.

Leroy-Beaulieu, Henry Jean Baptiste Anatole (1842– ——), French publicist, was born at Lisieux in 1842. In 1866 he published *Une troupe de comédiens*, and afterwards *Essai sur la restauration de nos monuments historiques devant l'art et devant le budget*, which deals particularly with the restoration of the cathedral of Evreux. He visited Russia in order to collect documents on the political and economic organization of the Slav nations, and on his return published in the *Revue des Deux Mondes* (1882–89) a series of articles with the title "L'Empire des Tsars et les Russes." The work entitled *Un Empereur, un Roi, un Pape, une Restauration*, published in 1879, was an analysis and criticism of the politics of the Second Empire. *Un homme d'état russe* (1884) gave the history of the emancipation of the serfs by Alexander II. Other works are *Les Catholiques Libéraux, l'Église et le Libéralisme* (1890), *La Papauté, le Socialisme et la Démocratie* (1892). In 1881 M. Leroy-Beaulieu was elected professor of contemporary history and Eastern affairs at the École Libre des Sciences Politiques, and in 1887 he became a member of the Académie de Sciences Morales et Politiques. From 1883 to 1891 he represented Auberive in the Conseil-Général of the Haute-Marne.

Leroy-Beaulieu, Pierre Paul (1843– ——), French economist, brother of the preceding, was born at Saumur on 9th December 1843, and educated in Paris at the Lycée Bonaparte and the École de Droit. He afterwards studied at Bonn and Berlin, and on his return to Paris began to write for *Le Temps*, *Revue Nationale*, and *Revue Contemporaine*. In 1867 he won a prize offered by the Academy of Moral Science with an essay entitled "L'influence de l'état moral et intellectuel des populations ouvrières sur le taux des salaires." In 1870 he gained three prizes for essays on "La colonization chez les peuples modernes," "L'administration en France et en Angleterre," and "L'impôt foncier et ses conséquences économiques." In 1872 Leroy-Beaulieu became professor of finance at the newly-founded École Libre des Sciences Politiques, and in 1880 he succeeded his father-in-law, Michel Chevalier, in the chair of political economy in the Collège de France. Professor Leroy-Beaulieu is the author of several works which have made their mark beyond the borders of his own country. Among these may be mentioned his *Recherches économiques, historiques et statistiques sur les guerres contemporaines*, a series of studies published between 1863 and 1869, in which he calculated the loss of men and capital caused by the great European conflicts. Other works by him are—*La question monnaie au dix-neuvième siècle* (1861), *Le travail des femmes au dix-neuvième siècle* (1873), *Traité de la science des finances* (1877), *Essai sur la repartition des richesses* (1882), *L'Algérie et la Tunisie* (1888), *Précis d'économie politique* (1888), and *L'état moderne et ses fonctions* (1889). He also founded the *Économiste Français*, on the model of the English *Economist*. Leroy-Beaulieu may be regarded as the leading representative in France of orthodox political economy, and the most pronounced opponent of protectionist and collectivist doctrines. He has stood several times for election on the Municipal Council of Paris and the Chamber of Deputies, but always without success.

Lerwick, a burgh of barony, police burgh, and county town of Shetland, Scotland, on Bressay Sound, on the eastern shore of Mainland (or Pomona), the principal island of the group. It consists of one narrow street a mile long, and is 115 miles north-east of Kirkwall and 340 miles from

Leith by steamer. There are county buildings and a new town hall, which has a Queen Victoria Jubilee commemoration clock and chime of bells. Lerwick is an important fishing centre. (For statistics, see SHETLAND.) The other industries are connected with the retail trade among the islands and the knitting of woollen goods. There is steamer communication with Aberdeen, Leith, and Kirkwall. A new harbour has been built, giving 12 feet of water beside the pier at low tide. At the end of 1900, 38 vessels of 2111 tons were registered at the port. In 1888, 525 vessels of 85,826 tons entered; in 1900, 851 vessels of 135,180 tons. Exports were valued at £98,432 in 1888 and £449,746 in 1900. There is a secondary school with an elementary department. Population (1881), 4045; (1901), 4061.

Lesbos, or MITYLENE (Turkish, *Midüllü*), a Turkish island in the Ægean Sea, separated by a strait from 7 to 10 miles wide from the coast of Asia Minor, north of the Gulf of Smyrna, and a sanjak of the Archipelago vilayet. This beautiful island, surrounded by a sea teeming with fish, is rugged and mountainous, its highest point, Mount Olympus (*Hagios Elias*), rising to 3080 feet. The coast-line is broken on the south-east by Porto Iero or Olivieri, and on the south-west by the deeper inlet of Porto Kallone. The crops are almost exclusively olives, but figs, grapes, lemons, and oranges are also grown. Antimony, good marble, and a little coal are found in the island. The climate is healthy and temperate; the annual average rainfall is 26·6 inches, and the death-rate only 11 per 1000 inhabitants. The principal exports are olive oil, soap, and valonea. The total trade averages about £700,000 annually, the imports exceeding the exports by about £10,000. The population is about 130,000, of whom 13,000 are Turks and Moslems, and 117,000 Greeks.

Lesina (Slavonic, *Hvar*), an Austrian island in the Adriatic, off the Dalmatian coast, between the islands of Brazza in the north and Curzola in the south, and divided from the peninsula of Sabbioncello by the Narenta channel. It is about 42 miles long, with a maximum breadth of less than 4 miles. It has a steep, rocky coast with a chain of thinly wooded limestone hills, of which the highest point, Monte San Nicolo, is about 2070 feet above the level of the sea. The climate is mild, and not only the grape and olive, but dates, figs, and the carob or locust-bean flourish. The cultivation of these fruits, boatbuilding, fishing, and the preparation of rosemary essence and liqueurs are the principal resources of the inhabitants. The chief town and harbour of the same name is the seat of the government district (which includes Cittavecchia, Lissa, and some small neighbouring islands, with a total population of 27,928) and a bishop. It is a station of the Austrian Lloyd, and contains an arsenal, an observatory, and some interesting old buildings of the 16th century. Population, 3828.

Leskovatz, a town in Servia, between Nish and Vranya, on the railway line from Nish to Salonica, 3½ miles to the east of the river Morava. It is the centre of the Servian hemp industry, the extensive plain in which the town lies growing the best flax and hemp in all the Balkan peninsula. The plain is not only the most fertile portion of Servia, but also the best cultivated. Besides flax and hemp, excellent tobacco is grown. Five valleys converge on the plain from different directions, and the inhabitants of the villages in these valleys are all occupied in growing flax and hemp, which they send to Leskovatz to be stored or manufactured into ropes. After Belgrade and Nish, Leskovatz is the most prosperous town in Servia. Population (1895), 12,989.

Leslie, Fred [FREDERICK HOBSON] (1855–1892), English actor, was born at Woolwich, 1st April 1855. He began a connexion with the stage as an amateur in early life, and first appeared at a London theatre in 1878. He had a good voice, and gradually came to the front in light opera, and in 1882 made a great hit as Rip van Winkle in Planquette's piece of that name at the Comedy Theatre. In 1885 he appeared at the Gaiety as Jonathan Wild in the burlesque *Little Jack Sheppard*. His extraordinary success in this part determined his subsequent career, and thereafter he and Miss Nelly Farren were the pillars of Gaiety burlesque. Fred Leslie's Don Cæsar de Bazan in *Ruy Blas, or the Blasé Roué*, was perhaps the most popular of his later parts. In all of them it was his own versatility and entertaining personality which formed the attraction; whether he sang, danced, whistled, or "gagged," his performance was an unending flow of high spirits and ludicrous charm. Under the pseudonym of "A. C. Torr" he was acknowledged on the programmes as part-author of these burlesques, and their success at the Gaiety Theatre owed everything to him and Miss Farren, with whom he played in perfect association. Leslie acted on occasion in more serious comedy, for which he had undoubted capacity; but his fame rests on his connexion with the Gaiety burlesque of the 'eighties. In spite of such clever imitators of his methods as E. J. Lonnen and others, Fred Leslie's death on 7th December 1892 really involved the transition of "Gaiety burlesque" into the "musical comedy" of the 'nineties—a form of entertainment depending much less on genuine originality.

Lesseps, Ferdinand de (1805–1894).—Few lives have had greater vicissitudes than, or experienced such a manifold succession of triumphs and misfortunes as, that of Ferdinand de Lesseps. His French compatriots treated him by turns as a demi-god and a criminal, although he had never been other than a great man, nor had ever merited the trials that overwhelmed him during his closing years. History will give him a place of honour, for all his acts were dominated by an extraordinary zeal for the welfare of his fellow-men. The origin of his family has been traced back as far as the end of the 14th century. His ancestors, it is believed, came from Scotland, and settled at Bayonne when that region was occupied by the English. One of his great-grandfathers was town clerk and at the same time secretary to Queen Anne of Neuberg, widow of Charles II. of Spain, exiled to Bayonne after the accession of Philip V. From the middle of the 18th century the ancestors of Ferdinand de Lesseps followed the diplomatic career, and he himself occupied with real distinction several posts in the same calling from 1825 to 1849. His uncle was ennobled by King Louis XVI., and his father was made a count by Napoleon I.

Ferdinand de Lesseps was born at Versailles on the 19th of November 1805. His father, Mathieu de Lesseps, was a consul; his mother, Catherine de Grivégnée, was Spanish, and aunt of the countess of Montijo, mother of the Empress Eugénie. His first years were spent in Italy, where his father was occupied with his consular duties. He was educated at the College of Henry IV. in Paris. From the age of 18 years to 20 he was employed in the commissary department of the army. From 1825 to 1827 he acted as assistant vice-consul at Lisbon, where his uncle, Barthélemy de Lesseps, was the French chargé d'affaires. This uncle was an old companion of La Pérouse and a survivor of the expedition in which that navigator perished. In 1828 Ferdinand was sent as an assistant vice-consul to Tunis, where his father was consul-general. He courageously aided the escape of Youssouff, pursued by the soldiers of the Bey, of whom he was one of the officers, for violation of the seraglio law. Youssouff acknowledged this protection given by a Frenchman by distinguishing himself in the ranks of the French army at the time of the conquest of Algeria. Ferdinand de Lesseps was also entrusted by his father with missions to Marshal Count Clausel, general-in-chief of the army of occupation in Algeria. The marshal wrote to Mathieu de Lesseps on the 18th of December 1830: "I have had the pleasure of meeting your son, who gives promise of sustaining with great credit the name he bears." In 1832 Ferdinand de Lesseps was appointed vice-consul at Alexandria. To the placing in quarantine of the vessel which took him to Egypt is due the origin of the great conception of a canal across the isthmus of Suez. In order to help him to while away the time at the lazaretto, M. Mimaut, consul-general of France at Alexandria, sent him several books, among which was the memoir written upon the Suez Canal, according to Bonaparte's instructions, by the civil engineer Lapère, one of the scientific members of the French expedition. This work struck de Lesseps's imagination, and gave him the idea of piercing the African isthmus. This idea, moreover, was conceived in circumstances that were to prepare the way for its realization. Mehemet Ali, who was the viceroy of Egypt, owed his position, to a certain extent, to the recommendations made in his behalf to the French Government by Mathieu de Lesseps, who was consul-general in Egypt when Mehemet Ali was a simple colonel. The Viceroy therefore welcomed Ferdinand affectionately, while Said Pacha, Mehemet's son, began those friendly relations that he did not forget later, when he gave him the concession for making the Suez Canal. In 1833 Ferdinand de Lesseps was sent as consul to Cairo, and soon afterwards given the management of the consulate-general at Alexandria, a post that he held until 1837. While he was there a terrible epidemic of the plague broke out and lasted for two years, carrying off more than a third of the inhabitants of Cairo and Alexandria. During this time he went from one city to the other, according as the danger was more pressing, and constantly displayed an admirable zeal and an imperturbable energy. Towards the close of the year 1837 he returned to France, and on the 21st of December married Mlle. Agathe Delamalle, daughter of the Government prosecuting attorney at the court of Angers. By this marriage M. de Lesseps became the father of five sons. In 1839 he was appointed consul at Rotterdam, and in the following year transferred to Malaga, the place of origin of his mother's family. In 1842 he was sent to Barcelona, and soon afterwards promoted to the grade of consul-general. In the course of a bloody insurrection in Catalonia, which ended in the bombardment of Barcelona, Ferdinand de Lesseps showed the most persistent bravery, rescuing from death, without distinction, the men belonging to the rival factions, and protecting and sending away not only the Frenchmen who were in danger, but foreigners of all nationalities. From 1848 to 1849 he was minister of France at Madrid. In the latter year the Government of the French Republic confided to him a mission to Rome at the moment when it was a question whether the expelled Pope would return to the Vatican with or without bloodshed. Following his interpretation of the instructions he had received, de Lesseps began negotiations with the existing Government at Rome, according to which Pius IX. should peacefully re-enter the Vatican and the independence of the Romans be assured at the same time. But while he was negotiating, the elections in France had caused a change in the foreign policy of the Government. His course was disapproved; he was recalled and brought before the Council of State, which blamed his conduct without giving him a chance to justify himself. Rome, attacked by the French army, was taken by assault after a month's sanguinary siege. M. de Lesseps then retired from the diplomatic service, and never afterwards occupied any public office. In 1853 he lost his wife and daughter at a few days' interval. Perhaps his energy would not have been sufficient to sustain him against these repeated blows of destiny if, in 1854, the accession to the viceroyalty of Egypt of his old friend, Said Pacha, had not given a new impulse to the ideas that had haunted him for the last twenty-two years concerning the Suez Canal. Said Pacha invited M. de Lesseps to pay him a visit, and on the 7th of November 1854 he landed at Alexandria; on the 30th of the same month Said Pacha signed the concession authorizing M. de Lesseps to pierce the isthmus of Suez.

Ferdinand de Lesseps.

(From a photograph by Elliott and Fry, London.)

A first scheme, indicated by him, was immediately drawn out by two French engineers who were in the Egyptian service, MM. Linant Bey and Mougel Bey. This project, differing from others that had been previously presented or that were in opposition to it, provided for a direct communication between the Mediterranean and the Red Sea. After being slightly modified, the plan was adopted in 1856 by an international commission of civil engineers to which it had been submitted. Encouraged by this approval, de Lesseps no longer allowed anything to stop him. He listened to no adverse criticism and receded before no obstacle. Neither the opposition of Lord Palmerston, who considered the projected disturbance as too radical not to endanger the commercial position of Great Britain, nor the opinions entertained, in France as well as in England, that the sea in front of Port Said was full of mud which would obstruct the entrance to the canal, that the sands from the desert would fill the trenches, that the two seas were not of the same level—no adverse argument, in a word, could dishearten Ferdinand de Lesseps. His faith made him believe that his adversaries were in the wrong; but how great must have been this faith, which permitted him to undertake the work at a time when mechanical appliances for the execution of such an undertaking did not exist, and when for the utilization of the proposed canal there was as yet no steam mercantile marine!

Impelled by his convictions and talent, supported by the Emperor Napoleon III. and the Empress Eugénie, he succeeded in rousing the patriotism of the French and obtaining by their subscriptions more than half of the capital of two hundred millions of francs which he needed in order to form a company. The Egyptian Government subscribed for eighty millions' worth of shares. The company was organized at the end of 1858. In 1859 the first blow of the pickaxe was given at Port Said, and on the 17th of November 1869 the canal was officially opened by the Khedive, Ismail Pacha. The machinery for digging it had been invented. Great Britain gave to steam navigation an impulse that transformed into a colossal success the work that had been so much discussed, and the Port Said mud, the sands of the desert, and the difference in the level of the two seas became legends of the past. Great Britain showed her powerful vitality in preserving her supremacy upon the sea, although at first sight the new water-way would have seemed to favour, to her detriment, the peoples whose shores are washed by the Mediterranean. As soon as the Suez Canal was finished, the British nation, with its characteristic energy and inexhaustible resources, derived from this enterprise advantages that no other nation on the globe would have succeeded in securing, and this new route, so ardently opposed, gave to British commerce an impetus unequalled in the past and probably not to be rivalled in the future. The opening of the Canal constitutes for the man who conceived and realized it an imperishable title to glory, and this was not forgotten when Ferdinand de Lesseps afterwards suffered so calamitously from the scheme for constructing a canal across the isthmus of Panama. Moreover, while in the interests of his canal he resisted the opposition of British diplomacy, he acted loyally towards Great Britain after Lord Beaconsfield had acquired the Suez shares belonging to the Khedive, by frankly admitting to the board of directors of the company three representatives of the British Government. The consolidation of interests which resulted, and which has been developed by the addition in 1884 of seven other British directors, chosen from among shipping merchants and business men, has augmented, for the benefit of all concerned, the commercial character of the enterprise.

Ferdinand de Lesseps steadily endeavoured to keep out of politics. If in 1869 he appeared to deviate from this principle by being a candidate at Marseilles for the Corps Législatif, it was because he yielded to the entreaties of the Imperial Government in order to strengthen its goodwill for the Suez Canal. Once this good-will had been shown, he bore no malice towards those who rendered him his liberty by preferring Gambetta. He afterwards declined the other candidatures that were offered him: for the Senate in 1876, and for the Chamber in 1877. In 1873 he became interested in a project for uniting Europe and Asia by a railway to Bombay, with a branch to Peking. He subsequently encouraged Major Roudaire, who wished to transform the Sahara desert into an inland sea. The king of the Belgians having formed an International African Society, de Lesseps accepted the presidency of the French committee, facilitated M. de Brazza's explorations, and acquired stations that he subsequently abandoned to the French Government. These stations were the starting-point of French Congo. This function of acting as a patron of conceptions for bringing peoples together, by diminishing distances, improving their position, and rendering more easily attainable all articles of food, was a sufficiently noble employment to have satisfied his ambition. The extraordinary popularity that he had acquired was, to his mind, a force that should be employed for the world's progress. Might he not, therefore, have been able to accomplish his mission without exposing himself to the misfortunes that befell him? *Dis aliter visum.* In 1879 a congress assembled in the rooms of the Geographical Society at Paris, under the presidency of Admiral de la Roncière le Noury, and voted in favour of the making of the Panama Canal. Public opinion, it may be declared, designated Ferdinand de Lesseps as the head of the enterprise. It was upon that occasion that Gambetta bestowed upon him the title of *Le Grand Français.* He was not a man to shirk responsibility, and notwithstanding that he had reached the age of 74, he undertook to carry out the Panama Canal project. The history of this enterprise is too recent, too complicated, is bound up with too many disasters and has roused too much anger, to be fully treated here. Politics, which de Lesseps had always avoided, was his greatest enemy in this matter. The winding-up of the Panama Company having been declared in the month of December 1888, the adversaries of the French Republic, seeking for a scandal that would imperil the Government, hoped to bring about the prosecution of the directors of the Panama Company. Their attacks were so vigorously made that the Government was obliged, in self-defence, to have judicial proceedings taken against Ferdinand de Lesseps, his son Charles, and his co-workers Fontane and Cottu. Charles de Lesseps, a victim offered to the fury of the politicians, tried to divert the storm upon his head and prevent it from reaching his father. He managed to draw down upon himself alone the burden of the condemnations pronounced. One of the consequences of the persecutions of which he was the object was to oblige him to spend three years, from 1896 to 1899, in England, where his participation in the management of the Suez Canal had won for him some strong friendships, and where he was able to see the great respect in which the memory and name of his father were held by Englishmen.

As for the work executed at Panama, Sir William Russell has given an interesting appreciation of its value in the following letter, addressed to Ferdinand de Lesseps:

> New York, *9th July* 1889.
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> Since visiting the work of the Panama Canal, and having mourned over it, being here on the way from the Pacific coast of South America, I have always desired to write to you. I was astounded by what I saw. I was angry at the idea that such false reports about the nature and progress of the work should have been spread abroad. Naturally, I am not an engineer, but the progress of the work appeared clearly before my eyes and free from the difficulties that I saw you overcome at the Salt Lakes, for example. I was surprised to find the work so far advanced. The surprise, however, was mingled with sorrow and pity in considering that the vast enterprise was in suspense. So many unproductive millions! Silence and solitude where there should be active life and the utilization of so much capital, industry, and thought! I cannot believe that this waste will last. It would be a dishonour for France and a loss for the whole world if the canal were not cut. For my own part, I am sure that it must be finished. I have heard repeated *ad nauseam* the old story about the lack of traffic, and about catastrophes and natural obstacles. I have replied to those who relate these stories that I had already heard the same objections made with even more force and upon greater authority before you accomplished the opening of the Suez Canal. I was told a great deal about the peculation of the contractors, the prodigalities and thoughtless expenditures, and negligence in the supervision. I could not form an opinion as to the value of these reports, but I was able to see that there was, from one end of the canal to the other, a wealth of machinery of all kinds—elevators, drags, lighters, steamboats—in short, a complete flotilla ready to start at the first sign, except what had been destroyed by bad usage or negligence. I cannot help writing to you to tell you of my sympathy and hopes. I pray that you may live to see finished and accomplished the *opus maximum* of your existence, so fertile in great works.

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Ferdinand de Lesseps died at La Chenaie on the 7th of December 1894. He had contracted a second marriage in 1869 with Mlle Autard de Bragard, daughter of a former magistrate of Mauritius; and eleven out of twelve children of this marriage survived him. M. de Lesseps was a member of the French Academy, of the Academy of Sciences, of numerous scientific societies, Grand Cross of the Legion of Honour and of the Star of India, and had received the freedom of the City of London. According to some accounts, he was unconscious of the disastrous events that took place during the closing months of his life. Others report that, feeling himself powerless to scatter the gathered clouds, and aware of his physical feebleness, he had had the moral courage to pass in the eyes of his family, which he did not wish to afflict, as the dupe of the efforts they employed to conceal the truth from him. This last version would not be surprising if we relied upon the following portrait, sketched by a person who knew him intimately:—"Simple in his tastes, never thinking of himself, constantly preoccupied about others, supremely kind, he did not and would not recognize such a thing as evil. Of a confiding nature, he was inclined to judge others by himself. This naturally affectionate abandonment that every one felt in him had procured him profound attachments and rare devotions. He showed, while making the Suez Canal, what a gift he possessed for levying the pacific armies he conducted. He set duty above everything, had in the highest degree a reverence for honour, and placed his indomitable courage at the service of everything that was beneficial with an abnegation that nothing could tire. His marvellous physical and moral equilibrium gave him an evenness of temper which always rendered his society charming. Whatever his cares, his work, or his troubles, I have never noticed in him aught but generous impulses and a love of humanity carried even to those heroic imprudences of which they alone are capable who devote themselves to the amelioration of humanity." No doubt this eulogy requires some reservations. The striking and universal success which crowned his work on the Suez Canal gave him an absoluteness of thought which brooked no contradiction, a despotic temper before which every one must bow, and against which, when he had once taken a resolution, nothing could prevail, not even the most authoritative opposition or the most legitimate entreaties. He had resolved to construct the Panama Canal without locks, to make it an uninterrupted navigable way. All attempts to dissuade him from this resolution failed before his tenacious will. At his advanced age he went with his youngest child to Panama to see with his own eyes the field of his new enterprise. He there beheld the Culebra and the Chagres; he saw the mountain and the stream, those two greatest obstacles of nature that sought to bar his route. He paid no heed to them, but began the struggle against the Culebra and the Chagres. It was against them that was broken his invincible will, sweeping away in the defeat the work of Panama, his own fortune, his fame, and almost an atom of his honour. But this atom, only grazed by calumny, has already been restored to him by posterity, for he died poor, having been the first to suffer by the disaster to his illusions. Political agitators, in order to sap the power of the Opportunist party, did not hesitate to drag in the mud one of the greatest citizens of France. But when the Panama "scandal" has been forgotten, for centuries to come the traveller in saluting the statue of Ferdinand de Lesseps at the entrance of the Suez Canal will pay homage to one of the most powerful embodiments of the creative genius of the 19th century. (DE B.)

Letters Patent.—It is a rule alike of common law and sound policy that grants of freehold interests, franchises, liberties, &c., by the sovereign to a subject should be made only after due consideration, and in a form readily accessible to the public. These ends are attained through the agency of that piece of constitutional machinery known as "letters patent." It is here proposed to consider only the characteristics of letters patent generally. The law relating to letters patent for inventions is dealt with under the heading PATENTS.

Letters patent (*litteræ patentes*) are letters addressed by the sovereign "to all to whom these presents shall come," reciting the grant of some dignity, office, monopoly, franchise, or other privilege to the patentee. They are not sealed up, but are left open (hence the term "patent"), and are recorded in the Patent Rolls in the Record Office, or in the case of very recent grants, in the Chancery Enrolment Office, so that all subjects of the realm may read and be bound by their contents. In this respect they differ from certain other letters of the sovereign directed to particular persons and for particular purposes, which, not being proper for public inspection, are closed up and sealed on the outside, and are thereupon called *writs close* (*litteræ clausæ*), and are recorded in the Close Rolls. Among grants made by letters patent the following may be enumerated: offices in the Heralds' College; the dignities of knight bachelor, a peerage, or a baronetcy; the appointments of lord-lieutenant, custos rotulorum of counties, justices of the High Court, king's counsel, Crown livings; the offices of attorney- and solicitor-general, commander-in-chief, master of the horse, keeper of the privy seal, postmaster-general, king's printer; grants of separate courts of quarter sessions, royal charters, royal pardons (which may now be granted under the sign-manual), and patents for inventions. Formerly letters patent were always granted under the Great Seal. But now under the Crown Office Act, 1877, and the Orders in Council made under it, many letters patent are sealed with the wafer great seal. Letters patent for inventions are issued under the seal of the Patent Office. The procedure by which letters patent are obtained is as follows:—A warrant for the issue of letters is drawn up, and is signed by the Lord Chancellor; this is submitted to the law officers of the Crown, who countersign it; finally, the warrant thus signed and countersigned is submitted to His Majesty, who affixes his signature. The warrant is then sent to the Crown Office and is filed, after it has been acted upon by the issue of letters patent under the great or under the wafer seal as the case may be. The letters patent are then delivered into the custody of those in whose favour they are granted.

The construction of letters patent differs from that of other grants in certain particulars; (i.) Letters patent, contrary to the ordinary rule, are construed in a sense favourable to the grantor (viz., the Crown), rather than to the grantee; although this rule is said not to apply so strictly where the grant is made for consideration, or where it purports to be made *ex certâ scientiâ et mero motu*. (ii.) When it appears from the face of the grant that the sovereign has been mistaken or deceived, either in matter of fact or in matter of law, as, *e.g.*, by false suggestion on the part of the patentee, or by misrecital of former grants, or if the grant is contrary to law or uncertain, the letters patent are absolutely void, and may be cancelled (except as regards letters patent for inventions, which are revoked by a special procedure, regulated by § 26 of the Patents Act, 1883) still, it would appear, by the procedure known as *scire facias*, an action brought against the patentee in the name of the Crown with the fiat of the Attorney-General.

A word should be added on patents of precedence. A patent of precedence is a grant to an individual by letters patent of a higher social or professional position than the precedence to which his ordinary rank entitles him. The principal instance in modern times of patents of grants of this description has been the grant of precedence to members of the bar. In the days when acceptance of the rank of king's counsel not only precluded a barrister from appearing against the Crown, but, if he was a member of Parliament, vacated his seat, a patent of precedence was resorted to as a means of conferring similar marks of honour on distinguished counsel without any such disability attached to it. The patents obtained by Mansfield, Erskine, Scott, and Brougham were granted on this ground. After the order of the Coif lost its exclusive right of audience in the Court of Common Pleas, it became customary to grant patents of precedence to a number of the serjeants-at-law, giving them rank immediately after counsel of the Crown already created and before those of subsequent creation. Mr Justice Phillimore was, on his appointment as a judge of the Queen's Bench Division (1897), the only holder of a patent of precedence at the bar, except Serjeant Simon, who died in that year, and who was the last of the serjeants who held such a patent.

Under the Revised Statutes of Ontario, 1897 (c. 173, § 9), the Lieutenant-Governor is empowered to confer on any member of the bar a grant of precedence in the courts by letters patent under the great seal of Canada; and it was recently held by the Privy Council that this statutory provision was *intra vires* the provincial legislature.

As to letters patent generally, see BACON'S *Abridgment* ("Prerogative," F); CHITTY'S *Prerogative*; HINDMARSH on *Patents*. As to patents of precedence, see PULLING'S *Order of the Coif.*

(A. W. R.)

Leven, a police burgh of Fifeshire, Scotland, on the Firth of Forth, at the mouth of the river Leven, 6 miles east of Thornton Junction by rail. A town hall was erected in 1892. A costly attempt to construct a wet dock has proved a failure, owing to the accumulation of sand. Flax-spinning and linen-weaving are carried on, and there are breweries, foundries, brick-works, and rope-works. In the immediate neighbourhood are large collieries. There is a fine golf course, and the town is much frequented by summer visitors. Population (1881), 3568; (1891), 4577; (1901), 5577.

Leven, Loch.—1. A lake in Kinross county, Scotland, $3\frac{5}{8}$ miles in extreme length and 2 miles in extreme breadth. The depth varies from 10 to 90 feet, the mean height above sea is 353 feet, and the area 3406 acres. It drains Kinross-shire by four streams, and the river Leven drains its surplus. There are seven islands, of which the largest, St Serf's, was the site of a Culdee settlement, and contains the ruins of a priory. On the Castle island, connected with the land by a submerged causeway, are the ruins of the castle in which Queen Mary of Scotland was imprisoned in 1567. The loch is noted for its trout. The fishings are controlled by an Angling Association, and the average annual catch for the years 1895–99 was 16,746 trout of 11,421 pounds weight. 2. LOCH LEVEN is also the name of an arm of the sea opening east off Loch Linnhe, at the north of Argyllshire and the south of Inverness-shire. North and South Ballachulish, on opposite shores of the loch, are well-known villages. The latter is famed for its slate quarries, and is also the point of call for steamers conveying tourists to or from Glencoe.

Levi, Hermann (1839–1900), German orchestral conductor, was born at Giessen on 7th November 1839, and was the son of a rabbi. He was educated at Giessen and Mannheim, and came under Vincenz Lachner's notice. From 1855 to 1858 Levi studied at the Leipzig Conservatorium, and after a series of travels which took him to Paris, he obtained his first post as music director at Saarbrücken, which post he exchanged for that at Mannheim in 1861. From 1862 to 1864 he was chief conductor of the German Opera in Rotterdam; then till 1872 at Carlsruhe, when he went to Munich, a post he held until 1896, when ill-health compelled him to resign. Levi's name is indissolubly connected with the propagation of the knowledge of Wagner's music. He conducted the first performance of *Parsifal* at Bayreuth in 1882, and was connected with the musical life of that place during the remainder of his career. He created a great impression as a concert conductor on the occasion of his visit to London in 1895.

Levi, Leone (1821–1888), English jurist and statistician, was born of Jewish parents on 6th June 1821, at Ancona, Italy. After receiving an early training in a business house in his native town, he came to Liverpool in 1844 in pursuit of commerce, became naturalized, and changing his faith, joined the Presbyterian Church. Perceiving the necessity, in view of the unsystematic condition of the English law on the subject, for the establishment of chambers and tribunals of commerce in England, he warmly advocated their institution in numerous pamphlets; and as a result of his strenuous labours the Liverpool Chamber of Commerce, of which Levi was made secretary, was founded in 1849. In 1850 Levi published his *Commercial Law of the World*, being an exhaustive and comparative treatise upon the laws and codes of mercantile countries. Appointed in 1852 to the chair of commercial law in King's College, London, he proved himself a highly competent and popular instructor, and his evening classes were a most successful innovation. He was called to the bar at Lincoln's Inn in 1859, and received from the University of Tübingen the degree of Doctor of Political Science. His *magnum opus—History of British Commerce and of the Economic Progress of the British Nation, 1763–1870*, is perhaps a rather too partisan account of British economic development, being a eulogy upon the blessings of Free Trade, but its value as a work of reference cannot be gainsaid. Among his other works are: *Work and Pay; Wages and Earnings of the Working Classes; International Law, with Materials for a Code.* He died on 7th May 1888.

Lévis, the chief town of Lévis county, Quebec, Canada, situated on the south bank of the St Lawrence, opposite Quebec city. It is the landing-place for transatlantic passengers, is on the Intercolonial railway, and is the eastern terminus of the Grand Trunk and Quebec Central railways. It contains a Dominion Government graving dock, 445 feet long, 100 feet wide, with a depth on the sill of $26\frac{1}{2}$ and $20\frac{1}{2}$ feet at high water spring and neap tide respectively. Population (1881), 7597; (1891), 7301; (1901), 7783.

Lewes, a municipal borough (1881), market town and county town, in the Lewes parliamentary division (since 1885) of Sussex, England, on the Ouse, 50 miles south of London by rail. St Michael's and St John's churches have been restored, and the county hall enlarged. Modern erections are the town hall, the corn exchange, and the public library. Area, 1024 acres. Population (1881), 11,199; (1901), 11,249.

Lewis and **Harris** form together the Long Island of the Outer Hebrides, Scotland, the former being in Ross-shire and the latter in Inverness-shire. Its area is 770 square miles, and it embraces in its civil parish St Kilda and a number of smaller islands. Though rents have been largely reduced by the Crofters' Commission, and considerable sums expended on improvements by Government, the bulk of the crofters still live in miserable huts, and show little enterprise in the development of the fisheries; but the fishermen on the east side have of late years secured good boats of the newest type fitted with beam trawling gear. (For statistics, see STORNOWAY.) The making of kelp is no longer followed. A harbour has been built at Carloway and a pier at Bracadale; the harbour at Port Ness has been extended, and a road from Stornoway to Carloway was begun, but abandoned half-made. There are some good sheep farms in Harris. There are six parishes. Population of Lewis (1881), 24,876; (1891), 27,045, of whom 24,747 were Gaelic-speaking; (1901), 28,949: of the parish of Harris (1881), 4814; (1891), 5024, of whom 4195 were Gaelic-speaking; (1901), 5275.

Lewiston, a city of Androscoggin county, Maine, U.S.A., on the left bank of the Androscoggin river, at an altitude of 138 feet, on the Maine Central, the Grand Trunk, and the Portland and Rumford Falls railways. It has a fairly regular plan, is divided into seven wards, has a good water-supply obtained from Lake Auburn, and is also well sewered. By virtue of its fine water-power, it has great prominence in manufacturing, especially of cotton goods. In 1900 the total number of manufacturing establishments was 282, with a capital of $10,984,871. They employed an average number of 7159 wage-earners, and their products were valued at $8,581,354; of this sum more than one-half ($4,638,115) represented cotton goods. Bates College, a Baptist institution situated here, had in 1899 a faculty of 24, and was attended by 307 students, more than one-third of whom were women. Population (1890), 21,701; (1900), 23,761, of whom 9316 were foreign-born.

Lexington, a city of Kentucky, U.S.A., capital of Fayette county, at an altitude of 946 feet. It is the meeting-place of five railways, the Chesapeake and Ohio, the Lexington and Eastern, the Louisville and Nashville, the Queen and Crescent Route, and the Southern. It is in the Blue Grass region, the home of Henry Clay, famous for its blooded horses and fine tobacco. In 1900 its manufactures were carried on by 271 establishments, with a capital of $1,532,378. They employed an average number of 1441 wage-earners, and their products were valued at $2,925,697. Lexington is the seat of Kentucky University, a Christian institution, founded in 1836. In 1899 this had a faculty of 35 and was attended by 425 students. The State Agricultural and Mechanical College is also situated here; in the same year it had a faculty of 25 and an attendance of 480 students. There are also two collegiate institutions for women, the Hamilton Female College and the Sayre Female Institute. Population (1890), 21,567; (1900), 26,369, of whom 924 were foreign-born and 10,130 were negroes.

Lexington, a town of Middlesex county, Massachusetts, U.S.A., 11 miles north-west of Boston. Its area comprises some 17 square miles, mainly level, but with occasional hills. It contains three villages, Lexington, East Lexington, and North Lexington. The village of Lexington was the scene of the first armed conflict of the Revolution. A British command, sent from Boston to destroy military stores collected at Concord by the colonists, was met, 18th April 1775, at Lexington by a small body of colonial militia. The latter were fired upon, and several were killed and wounded by the British soldiers, who then proceeded to Concord and destroyed the stores. On their return to Boston they were severely handled by the militia, who dogged their steps and picked them off as opportunity offered. Population (1880), 2460; (1890), 3197; (1900), 3831, of whom 959 were foreign-born.

Lexington, a city of Missouri, U.S.A., capital of Lafayette county, on the south bank of the Missouri river, and the Atchison, Topeka, and Santa Fé, and the Missouri Pacific railways, at an altitude of 813 feet. Its site is the face and summit of the river bluffs, and it has a regular plan. It is the seat of two colleges for women. During the Civil War it was the scene of several minor military operations. Population (1880), 3906; (1890), 4537; (1900), 4190, of whom 283 were foreign-born and 1170 were negroes.

Leyden, or LEIDEN, a city of the Netherlands, in the province of South Holland, 10 miles north-north-east of The Hague. The highways along the dunes and the Rhine here cross each other. Steam tramways have been laid to Katwyk, a watering-place 5 miles to the north-west on the North Sea, to Haarlem, and to The Hague. There is also steamboat communication with Katwyk, Amsterdam, and Gouda. Among modern erections are the anatomical and pathological laboratories of the university, and the museum for geology and mineralogy has been restored; a monument (1884) to Burgomaster Van der Werf, who defended the town during the Spanish siege of 1574, raised in the "Ruine," lately transformed into Van der Werf's Park; and a new post office (1897). A seamen's training school is also of recent foundation. The local transit trade is still important, amounting annually to an average of 490 tons of butter and 590 tons of cheese. The woollen and linen manufactures employ about 1500 workmen. Population (1899), 53,658.

Lhasa.—The sources of information as to Lhasa which existed in 1875 were those derived from the records of Manning, who visited the city in 1811, and of the Jesuit fathers Huc and Gabet, who were there in 1844–46. In 1874 the Indian pundit Nain Singh paid his second visit, and his account of the city formed a most substantial addition to previous authorities. In 1879 the explorer A. K. (Kishen Singh), on his way to Koko Nor, remained for some time in Lhasa; and since then several European explorers have essayed to reach it, notably Bower in 1891, de Rhins in 1893, and Littledale in 1895. Littledale reached the Goring Tang valley after crossing the Goring La from the north, and was then within fifty miles of the walls of the sacred city. He probably approached closer than de Rhins or Bonvalot, who (with Prince Henri d'Orleans) had also adopted the northern route in 1890. All of them were equally unsuccessful. Neither Chinese passports nor English gold have availed to open the gates of that stronghold of Tibetan exclusiveness, and for half a century no European visitor has been seen in the streets of Lhasa. But where Europeans have failed native Indian explorers have again been successful. Sarat Chandra Das, of the Bengal Educational Department, who was accompanied by a trained explorer, the Lama Ugyen, after crossing the Kanglachen pass on the western borders of Sikkim into Tibet, made his way to Tashilunpo (Shigatsi) in the autumn of 1881, and there remained for some months. During the summer of 1882 he paid a visit to Lhasa, travelling over the route which had been previously followed by Nain Singh, *viâ* Gyantsi and the Yamdok uplands, to the Chushul ferry across the Tsanpo. Thenceforward the track passes up the Ky-i-chu valley, which is described as the worst part of the journey. A mile and a half of very difficult passage (called Gaglam) follows along the river banks, in no way resembling the Gyantsi section of the route, which is classed by Chandra Das as equal to an ordinary unmetalled Indian road. Over the Gaglam, however, two elephants which had been presented by the Sikkim Raja to the Grand Lama of Tibet had already passed, before Chandra Das bent his steps that way. Much of the Ky-i-chu valley route consists of open plain, with an occasional spread of highly irrigated country covered with crops and trees, and this again is varied with marsh land and bogs. At the last stage before reaching Lhasa, accommodation is to be found in the Gyakhang, or Chinese Amban's circuit house, which Chandra Das compares to the residence of a Calcutta native gentleman, with its wide verandah bedecked with flowers in pots.

In the month of May the Nehusing—the plain on which Lhasa stands—is gay with grass and flowers, and the scattered groves of poplar and willow afford a refreshing shade from the rays of the early summer sun. Lhasa is then at its best. The western gate (the Pargo Kaling) leads straight under the shadow of the royal Potala, the hill palace of Lhasa, to a small bridge and a second gateway called the Yutog Sampa, whereon is a guard-house, where the Korchaghas, headed by a monk sergeant, keep watch and ward. This is the real entrance to the city, and it is here that the chief difficulty lies with doubtful visitors. On the right of the road, before entering the city gates, on a low pedestal, stands the Doring monolith, eight to ten feet high, bearing an inscription in Chinese and Tibetan. The inscription is still legible, although it is nearly 1000 years old. The suburbs of Lhasa between the Potala palace and the city walls abound in picturesque detail. The broad straight road flanked by ancient trees and the scattered groups of stone-built houses following the fashion of Chinese architecture with "prismoidal" windows, painted cornices, and bluish-gray tiled roofs and turrets, the festoons of inscribed and painted bannerets stretching from turret to turret—all in the clear atmosphere and under the blue sky of the Tibetan early summer, make up a pretty picture enough, apart from the grandeur and glitter of gilded domes and spires where the palace of Potala crowns the hill. Within the city walls the streets are lined with shops of Tibetan, Nepalese, and Chinese merchants, the Chinese especially making a brave show with ornamental ware, although the Nepalese shops, built in three storeys, appear to be the most imposing. In front of all shops are small pyramids of clay, on which dried juniper and cones are burnt, wafting through the air sweet fumes of incense, which apparently are much wanted in remoter parts of the town. Apart from the principal streets, Chandra Das confirms the reports of other visitors that the backways and alleys are indescribably filthy, and the jostling crowd of persistent beggars is probably not to be rivalled for loud aggressiveness anywhere in the Eastern world. Next to the Potala, the chief feature of religious interest is the Kilkhording (also called Cho Kang), the sacred shrine where stands the image of Buddha, said to have been constructed in Magadha during his lifetime. According to Chandra Das, five sacred metals were used to form the alloy of which the figure (which represents Buddha as a prince—not as a priest) is made. The image is life size, well modelled and properly gilt. Four dragon pillars, silver gilt, support the canopy above his sacred head, and the bronze images of Matreya and Manjusi stand on guard on either side. Beyond are images innumerable, including the twelve Bodhisattras and a host of minor saints. The shrine itself is a lofty three-storeyed edifice with a flat roof, exhibiting no trace of Chinese influence in its design. The shrine is situated about the centre of the city.

The palace of the Dalai Lama—the far-famed Potala, which covers with its imposing building a hill to the west of the city (see vol. xiv. p. 500)—proved to be a toilsome and difficult place of approach owing to the innumerable steps and staircases which lead up to it. The ceremony of a divine service in honour of a departed Lama served as an opportunity for the introduction of Chandra Das to the Dalai Lama, the incarnate head of Buddhism in Tibet. He is described as a child of eight, seated on a peat altar resembling an Oriental throne, borne by lions carved in wood. "A yellow mitre hat covered the Grand Lama's head, the pendent bands of which veiled his ears, a yellow mantle covered his person, and he sat cross-legged with the palms of his hands joined together to bless us." His complexion was bright and fair, with rosy cheeks, his eyes were large and penetrating, and his features remarkably Aryan in spite of the obliquity of his eyes. He was emaciated, and looked fatigued and weary. The Grand Lamas of Tibet traditionally die young. The reception hall is spacious—40 feet by 30 by 15 high—lit by an open skylight. The roof is supported by three rows of wooden pillars, each row containing four pillars. Such in brief is the nature of that central light which illumines the mystic faith of Buddhism, the "holiest of all living holies."

Incidentally we have some new and interesting glimpses of the inner domestic life of the citizens from these latest explorers. The genial warmth of hospitality to strangers and the genuine character of the friendly interest which is taken in those who stand in the position of old friends; the rigid asceticism of the monks, their devotion to study and their simple and frugal habits—all these things, combined with courtly formalities and the stately etiquette which governs the social relations of the higher classes, are in welcome contrast to the weird tales of the ghastly surroundings of the enchanted city—the filthy outcast ragyabas (dagyeba of Kishen Singh), the loathsome corpse-eating swine, the gaunt and mangy dogs, and all the paraphernalia of misery, crime, and filth which seem inseparable from the villages and towns of all delectable mountains north of India.

On the whole the visits of these travellers fully support, if they do not largely increase, the information previously obtained, which has been so well epitomized in Sir H. Yule's article in the earlier volumes of this work. We have a more varied view of the inner life of Tibet, especially as connected with its sanctuaries, and some excellent geographical work executed by the Lama Ugyen (U. G.), though all visits have been of too ephemeral a character to add much to our stock of detailed knowledge. (T. H. H*.)

Libau, a seaport of Russia, on the Baltic Sea, in the government of Courland, 143 miles by rail south-west of Riga. Its population has more than doubled since 1881 (30,000), and attained 64,505 in 1897. New Libau, which is the centre of the industries, possesses several large factories for the making of colours, explosives, transmission belts in paper-pulp, sails and ropes, tobacco, furniture, matches, as well as several iron works, agricultural machinery works, tin-plate works, soap works, saw-mills, and flour mills. The number of ships yearly entering the port remains at about 1900 to 2000, but the exports have reached the annual value of from £3,600,000 to £4,000,000, oats being the chief item of export, while wheat is exported as flour. Flax, hay, spirit, eggs (from 45,000,000 to 56,000,000 a year), and swine meat are also important articles of foreign trade. Shipbuilding, including steamers for open-sea navigation, is also on the increase.

Libel.—Since the publication of the article on libel and slander in vol. xiv. of the *Encyclopædia Britannica* (9th edition) important legislation has been enacted relating to the question of privilege as applied to newspaper reports. It was there shown that certain classes of defamatory statements exist which are called "privileged," *i.e.*, made on occasions when it is a man's duty to speak or write freely. This privilege may be either absolute or qualified. An absolute privilege arises in cases where for the public good the fullest liberty of expression is allowed by the law, *e.g.*, papers published under the authority of Parliament. A qualified or partial privilege arises on occasions where the law considers it for the public benefit that freedom of publication should be permitted, provided that freedom is only used for the purpose for which it was given, *e.g.*, an answer to an inquiry as to the character of a servant. For the plaintiff to succeed in an action where it is apparent that publication is under this qualified privilege, it is necessary that he should prove express malice or an intention to injure, departing from the general rule in ordinary libels, where the absence of express or actual malice is no defence save in mitigation of damages. To constitute express malice there must be something in the act of the person to show that he published the libel, not with a view of doing that which was right or to punish a person because he deserved to be punished as an act of justice, but dishonourably and with a bye-motive of doing him an injury (*Capital and Counties Bank* v. *Henty*, Grove, J., 5 C.P.D.).

Both absolute and qualified privilege are given to newspaper reports under certain conditions by the Law of Libel Amendment Act, 1888. The reports must, however, be published in a newspaper as defined in the Newspaper Libel and Registration Act, 1881. Under this Act a newspaper must be published "at intervals not exceeding twenty-six days."

By section 3 of the Act of 1888 fair and accurate reports of judicial proceedings are absolutely privileged provided that the report is published contemporaneously with the proceedings, and no blasphemous or indecent matter is contained therein. By section 4 a limited privilege is given to fair and accurate reports (1) of the proceedings of a *bonâ fide* public meeting lawfully held for a lawful purpose and for the furtherance and discussion of any matter of public concern, even when the admission thereto is restricted; (2) of any meeting, open either to the public or to a reporter, of a vestry, town council, school board, board of guardians, board of local authority, formed or constituted under the provisions of any Act of Parliament, or of any committee appointed by any of these bodies; or of any meeting of any commissioners authorized to act by letters patent, Act of Parliament, warrant under royal sign manual, or other lawful warrant or authority, select committees of either House of Parliament, justices of the peace in quarter sessions assembled for administrative or deliberative purposes; (3) of the publication of any notice or report issued for the information of the public by any Government office or department, officer of state, commissioner of police or chief constable, and published at their request. But the privilege given in section 4 does not authorize the publication of any blasphemous or indecent matter; nor is the protection available as a defence if it be proved that the reports or notices were published maliciously, in the legal sense of the word, or the defendant has been requested to insert in the newspaper in which the report was issued a reasonable letter or statement by way of contradiction or explanation, and has refused or neglected to do so. Moreover, nothing in section 4 is to interfere with any privilege then existing, or to protect the publication of any matter not of public concern, or in cases where publication is not for the public benefit.

An alteration has also been made by the same Act in regard to criminal libel as affecting newspapers. As criminal proceedings for libel rest on the likelihood that a breach of the peace will result from the libel, no criminal prosecution should be commenced where the interests of the public are not affected. By the Law of Libel Amendment Act, 1888, sec. 8, no criminal prosecution for libel is to be commenced against any newspaper proprietor, publisher, or editor unless the order of a judge at chambers has been first obtained. This protection does not cover the actual writer of the alleged libel.

The law of slander has also been changed. In the former article it was shown that, save in a few cases, it is necessary in a slander action to prove special damage; in other words, that substantial or real damage has been caused to the plaintiff by the defendant's statement. The exceptions to this rule were the imputation of a criminal offence, of certain infectious disorders, or of incompetence in a trade, profession, or employment. Here damage is presumed as in libel. A fourth exception has been added, for by the Slander of Women Act, 1891, it is not necessary to prove special damage to support an action for slander where a woman has been accused of unchastity. (H. S. S.)

Libellatici was the name given to a class of persons who, during the persecution of Decius, A.D. 250, evaded the consequences of their Christian belief by procuring documents which certified that they had satisfied the authorities of their orthodoxy (*i.e.*, as heathens), and which thus exempted them from punishment. As thirty-eight years had elapsed since the last period of persecution, the Churches had become in many ways lax, and the number of those who failed to hold out under the persecution was very great. On the other hand, the procedure of the courts which had cognizance of the matter was by no means strict, and the judges and subordinate officials were often not ill-disposed towards Christians, so that evasion in one way or another was fairly easy. Many of those who could not hold out were able to secure certificates which gave them immunity without actually renouncing the faith, just as "Parliamentary certificates" of conformity used to be given in England without any pretext of fact. It is to the persons who received such certificates that the name belonged. To calculate their number would be impossible, but we know from the writings of Cyprian and other contemporaries that they were a numerous class, and that they were to be found in Italy, in Egypt, and in Africa, and amongst both clergy and laity. Archbishop Benson is probably right in thinking that "there was no systematic and regular procedure in the matter," and that the *libelli*, as the documents in question were called, may have been of very different kinds. They must, however, as a general rule, have consisted of a certificate *from the authorities* to the effect that the accused person had satisfied them. [The name *libellus* has also been applied to another kind of document—to the letters which were given by confessors, or by those who were about to suffer martyrdom, to persons who had fallen, to be used to secure forgiveness for them from the authorities of the Church. With such *libelli* we are not here concerned.] The subject has acquired a fresh interest from the fact that two of these actual *libelli* have been recovered, in 1893 and 1894 respectively, both from Egypt: one is now in the Brugsch Pasha collection in the Berlin Museum; the other is in the collection of papyri belonging to the Archduke Rainer. The former is on a papyrus leaf about 8 by 3 inches, the latter on mere fragments of papyrus which have been pieced together. The former was first deciphered and described by Dr Fritz Krebs, the latter by Dr K. Wessely: both are given and commented upon by Dr Benson. There is a remarkable similarity between them: in each the form is that N. "was ever constant in sacrificing to the gods"; and that he now, in the presence of the commissioners of the sacrifices (*οἱ ᾑρημένοι τῶν θυσίων*), has both sacrificed and drunk [*or* has poured libations], and has tasted of the victims, in witness whereof he begs them to sign this certificate. Then follows the signature, with attestations. The former of the two is dated, and the date must fall in the year 250. It is, of course, impossible to prove that either of the two actually refers to Christians: they may have been given to pagans who had been accused and had cleared themselves, or to former Christians who had apostatized. But no doubt *libelli* in this same form were delivered, in Egypt at least, to Christians who secured immunity without actual apostasy; and the form in Italy and Africa probably did not differ widely from this.

See Archbishop BENSON. *Cyprian*, London, 1897; *Theol. Literaturzeitung*, 20th January and 17th March 1894. (W. E. CO.)

Liberia, a negro republic in West Africa, extending along the coast for about 300 miles between 4° and 7° N. This strip of coast, which is watered by a number of parallel streams, consists for the most part of country of moderate elevation, ending seawards in a fairly high coast-line, the lower courses of the rivers being, however, fringed for a few miles by swamps, while forest seems to occupy a large part of the interior. The soil of the lowlands is generally sandy, except along the course of streams, where deep black fertile soil is found. The surface of the interior plateaux, which fall in a succession of steps towards the coast, consists largely of laterite. For a tropical country the climate is fairly moderate, the heat being lessened by the sea-breeze, which blows regularly during the day except in the Harmattan period. This lasts from December to the end of February, the Harmattan being a land wind marked by extreme dryness, with low temperature at night or in the early morning. The rainy season proper lasts from May to November, but no month passes without rain.

Coasts.—The coast of Liberia is much indented, though the lagoon formation so characteristic of other parts of the Guinea coast is little developed. Many of the capes rise abruptly from the sea. Cape Mount peninsula, on which Robertsport is placed, rises to about 1000 feet at the highest part, and Capes Mesurado and Palmas are also bold headlands. The largest lagoon (Fisherman Lake) is that enclosed by the Cape Mount peninsula. It is generally shallow. The remainder are much smaller, and are generally formed by expansions of the streams at their mouths. A tidal channel runs, however, behind Cape Mesurado parallel to the coasts as far as the mouth of the river Farmington—nearly 40 miles, connecting also with the river St Paul.

Interior.—Our knowledge of the interior of the country, and even of the courses of the main rivers, is still extremely scanty, and depends almost entirely on the journey of the negro Benjamin Anderson in 1868, and those of French explorers along the interior frontier. In the north-western half the head-streams of the rivers Lofa, Dé, or St Paul, and probably also those of the Manoh (which in part forms the frontier with Sierra Leone), rise at a distance of 200 miles from the coast, their upper basins widening fan-wise, while their lower courses approach each other within 35 miles. Their general direction is at right angles to the coast. The same is apparently the case with most of the rivers of the south-east, which have, however, much shorter courses, as the upper basin of the Kavalli (which forms the boundary of Liberia on the south-east) lies behind them, and, as shown by recent explorations of M. Hostains and others (1897–1900), closely approaches the headwaters of the St Paul. The lower courses of many of the smaller streams were explored by Büttikofer in 1879–82, but in few cases does our knowledge extend more than 25 miles from the coast, except in the case of the Sinoe, which was ascended in 1869 to the neighbourhood of the Gedeye mountains. A range named Niete is also reported by M. Hostains west of the Upper Kavalli, and mountains are said to exist near the source of the rivers St John and Lofa. The courses of all the rivers are more or less broken by rapids, and even on the St Paul the limit of navigation is less than 50 miles from the sea. All have bars at their mouths, those of the Manoh, Lofa, and St Paul being almost impassable, communication between the sea and the last named being effected by a channel leading from the Mesurado lagoon.

Limits.—The boundaries, previously indefinite, have now been regulated by agreement with Great Britain and France. That towards Sierra Leone was laid down in 1887 as first following the left bank of the Manoh, and afterwards a continuation of the line to the north-east. The north-eastern and south-eastern frontiers were broadly defined by agreement with France in 1892 (ratified 1894). On the coast the boundary is the Kavalli, Liberian claims to the country east of its mouth being abandoned, while France waived her supposed rights to points within the Liberian limits. The interior frontier, running as it does through country unknown at the time of the Convention, had not in 1902 been demarcated, and may require revision. It was to follow the Kavalli to 6° 30′ N. (the river being supposed here to be in 6° 52′ W.), and then to run west along that parallel to its intersection with 7° 40′ W.; to follow this meridian to 7° N. and then run in a straight line to the intersection of 8° 40′ W. with the parallel passing through Tembi Kunda; and finally to follow the latter to the Sierra Leone frontier. Certain stipulations, however, might prove inconsistent with the line thus laid down; France, *e.g.*, receiving the whole upper basin of the Niger, as well as that of the Fodedugu, a supposed upper branch of the Kavalli. The area of Liberia within the above limits is about 45,000 square miles.

Population.—Down to 1887 the American Colonization Society, which introduced the first settlement of freed slaves in 1820–22, is said to have spent over 2½ million dollars, and to have introduced from America some 12,000 coloured immigrants, over 1200 in addition having been brought by the Maryland Society. The number of the civilized negroes has been estimated at from 40,000 to 60,000, while the remaining black population is put down at a minimum of 2,000,000. The population of Monrovia, the capital, is about 5000; of Harper (with suburbs), 8000; of Buchanan (Grand Bassa) and Edina (on opposite sides of the river St John), 5000; and of Robertsport, 1200. At these ports, with Marshall (Junk river), Sesters River, Greenville, Settra Kru, and Half Cavalla, foreigners are allowed to trade.

Government.—The President and Vice-President of the Republic are elected by universal suffrage for a period of two years. The President controls the whole Government, and can dissolve the chambers at will; the Vice-President presides over the Senate, but takes the place of the President in case of the latter dying or going out of office before the expiration of his proper term. The cabinet consists of seven members, who are at the head of the seven departments of State. The Senate consists of nine members, two each for the counties of Bassa, Sinoe, and Maryland, and three for that of Mesurado, which contains the capital. The House of Representatives consists of thirteen members, one more for each county than are returned for the Senate. At the end of each session the two chambers meet jointly to pass the Bills which have been brought in before each of them. The judicial functions are discharged by four grades of officials, the local magistrates, the courts of common pleas, and the quarterly courts (one to each county town), and lastly the Supreme Court, presided over by the Chief Justice. The local administration is in the hands of superintendents, one each to the counties of Bassa, Sinoe, and Maryland, and one to each of the districts into which Mesurado is divided. Many parts, however, even along the coast, and all the interior more than 50 miles from the sea, are almost entirely beyond the influence of the Government. Schools exist in all the towns and villages, but, except at the West African College at Monrovia, the education given is very indifferent. In 1894 the revenue was estimated at £33,096 and the expenditure at £31,661.

Products and Trade.—Coffee is still the principal product, but the great fall in price and the insufficient preparation of the crops have lately ruined many cultivators. Experiments have since been made with the planting of cacao and caoutchouc. Wild rubber exists in large quantities in the forests. There are no industries on a large scale, though various civilized trades are carried on by the Liberians. Gold is said to exist, as also agates, rubies, and other precious stones. The foreign trade, though showing a decline, is still considerable, the largest share being in the hands of the Germans, while most of the remainder is divided between Great Britain and Holland. The principal lines of steamers run from Hamburg and Liverpool. The imports consist of articles of dress, food, &c., for the civilized negroes, and cotton goods for the native tribes. The principal exports are coffee, rubber (a monopoly of the English company called the Liberian Rubber Syndicate), piassava or raphia fibre (used for making brooms), palm oil and kernels, and a small amount of African mahogany. In addition to the Krumen, who engage themselves as crews of vessels, a large number of the natives of Liberia, especially the Vais, Golos, Bassas, and some Mandingos, emigrate to other parts of West Africa for labour on plantations, or for railway construction, or as police or militia. The majority go to Cameroon and Congo Free State.

Authorities.—Monner Sans. *Liberia. Apuntes historicos, geográphicos*, &c. Barcelona, 1884.—Wauwermans. *Libéria. Histoire de la fondation d'un état Nègre libre.* Brussels, 1885.—Schwarz. "Die Neger-Republik Liberia," *Das Ausland.* 1888.—Gudgeon. "Liberia." *Journ. Manchester Geogr. Soc.* 1888.—Büttikofer. *Reisebilder aus Liberia.* Leyden, 1890.—M'Pherson. "History of Liberia." *Johns Hopkins Univ. Studies*, 9 series, x. Baltimore, 1891.—Rouire. "Délimitation de la République de Libéria." *Annales de Géographie.* Paris, 1894.—Delafosse. "La République de Libéria." *Bulletin du Comité de l'Afrique Française*, Supplement No. 9, 1900.—Franklin. "La Question de Libéria." *Questions Dipl. et Colon.* vol. xii. Paris, 1901.

(E. He.)

Libourne, chief town of arrondissement, department of Gironde, France, 26 miles east-north-east of Bordeaux, on the railway from Paris to Bordeaux. Vineyards cover about 120,000 acres in the arrondissement. There are no textile manufactures of importance. The general coasting trade is brisk. In 1900, 283 coasting vessels entered and 308 cleared, total tonnage 20,939. Population (1881), 12,539; (1901), 19,175.

LIBRARIES.

THIS article is supplementary to that in the earlier volumes (ninth edition) of the *Encyclopædia Britannica* (1882), to which readers are referred for all historical particulars. The statistical tables appended to the article in vol. xiv. supplied details of 779 libraries (exclusive of those in the United States), containing about 50,225,000 volumes. All the libraries in the United Kingdom and its colonies were noticed, including those established under the Public Libraries Acts; but as regards the rest of the world, only those of 30,000 volumes and upwards, with a few exceptions, were described. The latter included 399 libraries, numbering 40,751,000 volumes. Taking the same limit of size, there were in 1902 outside the British islands, and excluding British colonies and the United States (see below), 595 libraries of 30,000 volumes and upwards, estimated to contain 61,378,000 volumes.

The following statistical abstract covers the same ground, with the same limitations and exceptions:—

Country.	1881.		1901.	
	Libs.	Vols.	Libs.	Vols.
Europe—				
United Kingdom	380 ...	9,474,000 ...	677 664[2]	11,942,000[1] 6,528,000[3]
German Empire	96	13,971,000	138	19,008,000
France	70	6,857,000	113	10,702,000
Austria-Hungary	56	4,357,000	70	6,425,000
Switzerland	18	1,082,000	23	1,773,000
Italy	64	5,874,000	79	8,261,000
Belgium	10	1,200,000	12	1,557,000
Holland	6	675,000	11	892,000
Denmark (and Iceland)	6	861,000	6	987,000
Norway and Sweden	6	885,000	17	1,754,000
Spain	16	1,052,000	26	1,661,000
Portugal	6	505,000	9	577,000
Greece	2	190,000	3	403,000
Russia	13	2,358,000	27	4,842,000
Bulgaria	No return		1	30,000
Rumania	do.		3	208,000
Servia	do.		1	54,000
Turkey	do.		1	30,000
Africa—				
Algeria—Algiers	do.		2	80,000
Egypt—Cairo	1	40,000	1	40,000
Asia—				
India	12	192,000	24	658,000
China	1	3,000	2	14,000
Java	1	20,000	1	30,000
Japan	1	68,000	2	200,000
Russia	No return		3	92,000
Philippines	do.		1	30,000
America—				
Argentina	3	85,000	4	225,000
Brazil	1	120,000	1	252,000
Chile	1	65,000	2	127,000
Mexico	5	195,000	5	241,000
Nicaragua	1	15,000	1	18,000
Peru	1	35,000	1	35,000
Uruguay	1	17,000	1	37,000
Venezuela	1	29,000	1	35,000
Other libraries	No return		3	100,000

[1] Non-municipal. [2] Including branches. [3] Municipal.

See *Minerva: Jahrbuch der Gelehrten Welt, heraug. v. K. Trübner*, 1902; *The Library Association Record*, 1889–1901; *The Library*, 1889–1901; *Library Journal* (New York), 1881–1901; *Centralblatt f. Bibliothekswesen*, 1884–1901.—E. Schultze. *Freie öffentl. Bibliotheken*, 1900.—*Annuaire des Bibliothèques*, 1901.

The United Kingdom.

The organized public libraries of Great Britain and Ireland in 1902 numbered 1341, containing 18,470,000 volumes; of these 677 were governmental, or belonged to universities, colleges, cathedrals, or societies and institutions, or were endowed or proprietary, and possessed 11,942,000 volumes. Since 1880 there has been an extraordinary growth in public libraries supported by the rates. The number of towns and places possessing these institutions in Great Britain and Ireland increased from 96 to 444. In 1881 not one of the capital towns of the three kingdoms had adopted the Public Libraries Acts, with the single exception of Westminster (London). Dublin possesses municipal libraries, Edinburgh has enforced the provisions of the Acts, and Greater London in 1902 had established 70 or 80 libraries or branches. In 1880–81, eighty-one libraries in the United Kingdom returned their contents at 1,448,192 volumes. The rate-supported libraries and their branches in 1902 included about 6,528,000 volumes. Many of these libraries owe much to the munificence of generous benefactors, among whom the names of Mr John Passmore Edwards[1] and Mr Andrew Carnegie (*q.v.*) should not be forgotten. To some are attached art galleries and museums. In others courses of instruction are given and lectures delivered. Nearly all possess collections of books, pamphlets, and prints of local interest. Many have special juvenile and ladies' rooms. Some kind of indicator to inform the reader whether the book he desires to borrow is available or not is largely used. In other libraries, notably at Clerkenwell (London) and Croydon (Surrey), a system of "open access" of readers to books has been found successful.

[Many interesting facts respecting British libraries, with tables of the progress and actual condition of municipal libraries, are to be found in the *British Library Year Book, 1900–1*, by T. Greenwood; also J. J. Ogle, *The Free Library* (1897). Refer also to the article in these volumes on Social Progress, *Libraries.*]

The following towns and places in the United Kingdom have adopted the general Acts, or have started libraries under local Acts; the dates of adoption are given within parentheses. In some places special legislation has been obtained to enable a higher rate than a penny in the pound (the authorized maximum) to be levied.

Aberdare (1901); Aberdeen (1884); Abergavenny (1900); Aberystwith (1874); Accrington (1899); Acton (1898); Airdrie (1853); Alloa (1885); Altrincham (1889); Andover (1896); Arbroath (1896); Arlecdon (1891); Ashton-on-Mersey (1896); Ashton-under-Lyme (1880); Aspatria (1902); Aston Manor (1877); Atherstone (1895); Ayr (1890); Banbridge (1890); Banff (1899); Bangor, Wales (1871); Barking (1888); Barnsley (1890); Barrow-in-Furness (1881); Barry and Cadoxton (1891); Bath (*Local Act*); Bebington (1894); Bedford (1889) [Acts not put in force]; Belfast (1882); Bexley, Kent (1896); Bideford (1877); Bilston (1870); Bingley (1890); Birkenhead (1856); Birmingham (1860); Blackburn (1853); Blackpool (1879); Blackrock (1900); Blaenau Festiniog (1894); Bodmin (1895); Bolton (1852); Bolton Percy, Yorks (1895); Bootle (1884); Bournemouth (1893); Bradford (1871); Bray, Ireland (1899); Brechin (1890); Brentford (1889); Bridgend (1901); Bridgwater (1860); Brierley Hill (1875); Brighouse (1897); Brighton (1850–91, *Local Act*); Bristol (1874); Bromley, Kent (1892); Broughton, Wrexham (1895); Brynmawr (1897); Buckley (1902); Burnley (1898); Burslem (1863); Burton-on-Trent (1895); Burwell, Cambs (1895); Bury (1897); Bury St Edmunds (1895); Buxton (1886); Camborne (1894); Cambridge (1853); Campbeltown (1896); Canterbury (1858); Cardiff (1862); Carlisle (1890); Carlton, Notts (1888); Carnarvon (1887); Castle Douglas (1902); Chatham (1893); Cheltenham (1883); Chester (1874); Chesterfield (1875); Chesterton (1897); Chiswick (1890); Chorley (1897); Clackmannan (1901); Claydon, East, and Botolph (1897); Claydon, Middle (1893); Claydon, Steeple (1901); Cleator Moor (1892); Cleethorpes (1900); Clitheroe (1878); Clonmel (1898); Clontarf, Dublin (1901); Coatbridge (1901); Colchester (1891); Coleraine (1881) [not carried into effect]; Colne (1894); Colwall (1898); Conway (1899); Cork (1855–92); Corwen, Wales (1896); Coventry (1867); Creich (1899); Croydon (1888); Dalkey (1894); Dalton-in-Furness (1899); Darlaston (1875); Darlington (1883); Darwen (1871); Denton and Haughton (1887); Derby (1870); Devonport (1880); Dewsbury (1887); Dingwall (1902); Doncaster (1868); Douglas, I. of M. (1886); Drumcondra (1900);

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[1] Mr Passmore Edwards (born in Cornwall, 1824) was for some years proprietor of the London *Echo*, and from 1880 to 1885 sat as a Liberal in Parliament for Salisbury. In later life he was a prominent donor of funds not only for libraries but also for convalescent homes and hospitals.

Drumoak, N.B. (1893); Dublin (1877); Dudley (1878); Dukinfield (1894); Dumbarton (1881); Dumfries (1899); Dundalk (1856); Dundee (1866); Dunfermline (1880); Ealing (1883); East Ham (1895); Eastbourne (1896); Edinburgh (1886); Edmonton (1891); Elgin (1891); Ellon (1899); Enfield (1892); Ennis (1860); Evesham (1897); Exeter (1869); Falkirk (1896); Falmouth (1893); Farsley (1899); Fleetwood (1887); Flint (1902); Folkestone (1878); Forfar (1870); Galashiels (1872); Gateshead (1880); Glasgow (*Special Act*, 1900); Glossop (1888); Gloucester (1894); Gorton (1897); Gosport and Alverstoke (1886); Grandborough (1896); Grangemouth (1887); Gravesend (1892); Grays Thurrock (1893); Greenock (1900); Grimsby (1899); Halifax (1881); Halkyn (1896); Halton (1895); Hamilton (1901); Hampton (1900); Handsworth (1876); Hanley (1884); Harlesden, *see* Willesden; Harrington (1899); Harrogate (1886); Hartlepool (1891); Hartlepool, West (1891); Haslingden (1900); Hawick (1878); Haworth (1898); Hayle (1896); Hemel Hempstead (1897); Hereford (1873); Hertford (1855); Heywood (1874); Hinckley (1888); Hindley (1887); Holyhead (1896); Holywell (1902); Hornsey (1896); Hove (1891); Hucknall Torkard (1884); Huddersfield (1897, *Local Act*); Hull (1892); Hyde (1893); Ibstock, Leicester (1895); Ilford (1892); Ilkeston (1901); Ince-in-Makerfield (1898); Inverness (1877); Ipswich (1853); Jedburgh (1892); Keighley (1900); Kendal (1891); Kettering (1895); Kidderminster (1855); Kilburn, *see* Willesden; Kilmarnock (1893); King's Lynn (1899); Kingston-on-Thames (1881, *Local Act*); Kingstown (1884); Kinning Park (1901); Kirkcaldy (*Local Act*); Kirkmichael (1895); Kirkwall (1890); Lancaster (1892); Larbert (1901); Larne (1897); Launceston (1897); Leadgate (1896); Leamington (1857); Leeds (1868); Leek (1887); Leicester (1870); Leigh (1892); Leominster (1899); Lewes (1897); Leyton (1891); Lichfield (1856); Limerick (1889); Lincoln (1892); Liskeard (1895); Liverpool (1852, *Local Act*); Llanelly (1898); Llantarnam (1897); Llanuwchllyn (1895); Lockerbie (1900).—LONDON: *Metropolitan Boroughs*—Battersea (1887); Bermondsey: Bermondsey (1887), Rotherhithe (1887), St Olave's District (1901); Camberwell (1889); Chelsea (1887); Finsbury: Clerkenwell (1887), Glasshouse Yard (1891), St Sepulchre's (1891); Fulham (1886); Greenwich (1902); Hammersmith (1887); Hampstead (1893); Holborn: Holborn (1891), St Giles's (1891); Kensington (1887); Lambeth (1886); Lewisham (1890); Lee (1901); Paddington: Kensal Town (1887); Poplar: Bow (1896), Bromley (1891), Poplar (1890); Shoreditch (1891); Southwark: Christchurch (1889), Newington (1890), St George-the-Martyr (1896), St Saviour's (1891); Stepney: Limehouse (1898), Mile End (1896), St George's-in-the-East (1896), Whitechapel (1889); Stoke Newington: South Hornsey (1898), Stoke Newington (1890); Wandsworth: Clapham (1887), Putney (1887), Streatham (1890), Wandsworth (1883); Westminster, City of: St George's, Hanover Square (1890), St James's (1901), St Martin's-in-the-Fields (1887), St Paul's, Covent Garden (1893), St Margaret's and St John's (1856), Strand District (1901); Tooting (1902); Woolwich: Eltham (1901), Plumstead (1898), Woolwich (1895).—Londonderry (1898); Longton (1891); Lossiemouth (1901); Loughborough (1885); Louth (1898); Lowestoft (1891); Lurgan (1891); Luton (1894); Macclesfield (1875); Machynlleth (1897); Maidstone (1855); Manchester (1852); Mansfield (1890); Maxwelltown (1899); Merthyr Tydvil (1899); Mexborough (1899); Middlesbrough (1871); Middleton (1887); Middlewich (1889); Millom (1887); Mold (1902); Montrose (1901); Morley (1892); Moss Side (1887); Motherwell (1902); Nantwich (1887); Neath (1897); Nelson (1889); Nenagh, Ireland (1895); Neston and Parkgate (1901); Newark-on-Trent (1882); Newburgh (1895); Newcastle-under-Lyme (1883); Newcastle-upon-Tyne (1874); New Mills (1893); Newmilns, N.B. (1900); Newport, Mon. (1870); Newry, Ireland (1895); Newton Abbot (1901); Newton, Montgomery (1898); Newtownards, Ireland (1895); North Walsham (1901); Northampton (1860); Northwich (1883); Norton (1898); Norwich (1850); Nottingham (1867); Nuneaton (1895); Oldbury (1888); Oldham (1865, *Local Act*); Ossett (1897); Oswestry (1890); Oxford (1852); Padiham (1897); Paisley (1867); Penarth (1894); Penge (1891); Penrith (1882); Penzance (1893); Perth (1896); Peterborough (1891); Peterhead (1890); Pleasley (1895); Plymouth (1871); Pontypridd (1887); Poole (1885); Portmadoc (1899); Portsmouth (1878); Preston (1878); Prestonpans (1902); Queenborough (1887); Rainham (1896); Ramsgate (1894); Rathmines (1887); Rawmarsh (1892); Reading (1877); Redruth (1894); Richmond, Surrey (1879); Rochdale (1870); Rochester (1894); Rotherham (1876); Rothwell (1894); Rugby (1890); Runcorn (1881); Rutherglen (1901); St Albans (1882); St Austell (1895); St Helens, Lancs (1869, *Local Act*); St Ives (1895); Sale (1890); Salford (*Museums Act*, 1849; *re-polled* 1892); Salisbury (1890); Selkirk (1889); Sheepshed (1896); Sheffield (1853); Shouldham (1895); Shrewsbury (1882); Sittingbourne (1887); Sligo (1880); Smethwick (1877); South Shields (1871); Southampton (1887); Southport (1875); Sowerby Bridge (1893); Stafford (1882); Stalybridge (1888); Steeple Claydon, *see* Claydon; Stirling (1897); Stockport (1860); Stockton-on-Tees (1874); Stoke-upon-Trent (1875); Stornoway (1898); Stratford-on-Avon (1902); Stretford (1893); Stromness (1900); Stroud (1896); Sunderland (1860 *Local Act*); Sutton-in-Ashfield (1898); Swansea (1870); Tain (1899); Tamworth (1882); Tarbat (1899); Tarves (1883); Teddington (1896); Thornaby-on-Tees (1890); Thurso (1872); Tipton (1883); Todmorden (1896); Tonbridge (1882); Tottenham (1891); Trimdon (1895); Trumpington (1898); Truro (1886); Tunbridge Wells (1895); Tunstall (1885); Twickenham (1882); Tynemouth (1869); Wallasey (1898); Walsall (1857); Walthamstow (1892); Warrington (1848, *Museums Act*); Warwick (1865); Water Eaton (1896); Waterford (1894); Waterloo-with-Seaforth (1892); Watford (1871); Wednesbury (1876); Welshpool (1887); West Bromwich (1870); West Ham (1890); Weston-super-Mare (1886); Whitchurch (1900); Whitehaven (1887); Wick (1887); Widnes (1885); Wigan (1876); Willenhall (1877); Willesden (1891) [includes Kilburn, Harlesden, and Willesden Green]; Wimbledon (1883); Winchester (1851); Winsford (1887); Wolverhampton (1869); Wood Green (1891); Woolton (1890); Worcester (1879); Workington (1890); Worksop (1895); Worthing (1892); Wrexham (1878); Yarmouth, Great (1885); York (1891).

[From list in *Library Association Year Book*, 1901, corrected to 1902.]

Law relating to public rate-supported libraries.

By the Public Libraries Act of 1892 all the Acts from that of 1855 to the Amendment Act of 1890 were consolidated in an amended form. This Act, which was promoted by the Library Association, simplified the steps necessary for the establishment of libraries; it also gave additional administrative powers to the library authority. It settled some difficult questions as to the polling of ratepayers for the adoption of the Acts and the levying and collection of the library rate. Facilities were also afforded whereby neighbouring localities might combine for library purposes. A short Act passed in 1893 provided the first step towards placing directly in the hands of the elected representatives of the ratepayers the right of adopting the Acts, which had hitherto been subject to the popular vote. At first this change applied only to the urban district authorities, but the Local Government Act of 1894 gave somewhat similar powers to rural parishes, and further extended the means for combination, particularly helpful in the case of small districts with limited financial resources. In 1898 an Act was passed to provide for good order and the punishment of offences in libraries. The following year (1899) saw the passing of the London Government Act, which, in creating the metropolitan borough councils, gave to them the power of putting the Library Acts into force. In 1901 an Act promoted by the Library Association was passed which removed some difficulties in regard to rating, gave power for the making of byelaws, and applied the Museums and Gymnasiums Act of 1891 to the metropolis. In Scotland and Ireland library legislation has been dealt with principally by separate Acts, and the variety of enactments tends to create doubt and confusion. The Library Association, with the help of Lord Avebury, Lord Windsor, and others, has devoted many efforts towards remedying these and other defects, including the anomalous condition of the law in regard to libel as it affects libraries, and liability to assessment for rates and taxes. The penny rate limitation lies heavily upon the majority of libraries, although by means of special and costly legislation some have been enabled to rid themselves of the restriction.

Enactments and Regulations.

ENGLAND AND WALES.—Acts 55 and 56 Vict. cap. 53 (1892); 56 Vict. cap. 11 (1893); 61 and 62 Vict. cap. 53 (1898); 62 and 63 Vict. cap. 14 (1899); 1 Edw. VII. cap. 19 (1901).

Adoption.—(1) In City of London by a poll of the voters (1892, § 21). (2) In metropolitan boroughs (1899, § 4) and urban districts (1893, § 2) by a resolution of council. (3) In rural parishes by a parish meeting, or, if demanded, a poll of the voters by ballot (1894, §§ 7 and 19). When adopted, notice must be sent to the Local Government Board (1901, § 8).

Library District.—City of London (1892, § 21), metropolitan boroughs (1899, § 4), urban districts (1892, § 1), parishes not in an urban district (1892, § 1).

Rate.—Not to exceed one penny in the £, with exceptions granted by local Acts of Parliament (1892, § 2). For list of these see *Library*, x. (1898), pp. 330–331. Museum expenses may be charged under the Museums and Gymnasiums Act, 1891, in addition to the penny rate (1901, § 7).

Authority.—In City of London: Common Council (1892, § 21). In metropolitan boroughs (1899, § 4) and urban districts (1892, § 4): the council. In parishes: parish council (1894, § 7), or where there is no parish council a committee (1894, § 19), or commissioners (1892, § 4).

Combination.—(1) Vestries (1892, § 9). (2) Parish and library districts (1892, § 10). (3) Urban districts (1893, § 4). (4) Library districts (1901, § 5). (5) Library authority and Charity Commissioners (1892, § 16).

Execution of Act.—Library authority may provide all or any: public libraries, public museums, schools for science, art galleries, and schools for art (1892, § 11).

Fees.—No charge for admission to library or museum or for use of lending library to the inhabitants of district, but use of lending library may be granted to persons not inhabitants of the district either gratuitously or for payment (1892, § 11).

Power to acquire and dispose of Land (1892, § 12).

General Management.—By library authority (1892, § 15). But an urban authority may appoint a committee, and delegate to it certain powers (1892, § 15). Persons appointed to be members of the committee need not be members of the urban authority (1892, § 15) nor of a London borough council (1899, § 8).

Expenses, how defrayed.—By a rate. See *Rate.*

Borrowing.—Authority may borrow on security of rate (1892, § 19).

Accounts and Audit.—Urban authority, as under Public Health Acts (1892, § 20). Commissioners, or parish authority, by district auditor (1892, § 20). Metropolitan borough, as London County Council (1899, § 14).

Bye-laws.—Authority may make. Penalties may be recovered under the Summary Jurisdiction Acts (1901, § 3).

Offences.—See also Library Offences Act (1898).

Damage to Buildings by Subsidence.—Not to be paid out of the penny library rate (1901, § 10).

SCOTLAND.—The Acts were amended and consolidated by the Public Libraries Consolidation (Scotland) Acts, 1887, 1894, and 1899.

IRELAND.—The original Act, 18 and 19 Vict. cap. 40, passed 1855, with amending Acts (1877, 1894). An Amending Act was in 1902 before Parliament.

[H. W. FOVARGUE and J. J. OGLE. *Public Library Legislation*, 1893. CHAMBERS and FOVARGUE, *Public Library Law*, 1899.]

British Museum.

The chief facts in the recent history of the great British national libraries may be briefly mentioned. The British Museum, which was estimated to include a million and a half of printed volumes and 50,000 MSS. in 1881, contained in 1902 upwards of two millions of printed volumes and 55,000 MSS., besides charters and rolls. The chief event in the later history of the institution was the completion in 1900 of the printing of the entire catalogue of the library, commenced in 1881. A supplement including the titles of all books added to the library while the general catalogue was in progress was also begun. Since 1888 the titles of new books are incorporated in the catalogue every fortnight. By the introduction of sliding presses in 1887 the space for the accommodation of books will eventually be more than doubled. The map catalogue has been completed; a revision of the rules for cataloguing has been issued. A special catalogue of English books printed before 1640 (1884), a synopsis of the French Revolutionary tracts (1899), and various excerpts from the printed catalogue have been published. There has been a marked improvement in the printed guides to the exhibited portion of the collection since 1890. In 1892 a separate department of Oriental books and MSS. was formed. The valuable *Subject Indexes of Modern Works*, prepared by Mr G. K. Fortescue, and Mr Robert Proctor's *Index to Early Printed Books* (not an official work), deserve special mention. A subject-index of all the books in the library published between 1881 and 1900 was passing through the press in 1902, and the question of compiling class catalogues of the entire library was under consideration. In the department of MSS. there have been most important acquisitions in all branches, especially in papyri of classical authors from Egypt, including "Aristotle on the Constitution of Athens," "Herondas," "Bacchylides," published by the Trustees, numerous other papyri from Professor Flinders Petrie, Mr Jesse Haworth, and others. Among the most important of other acquisitions are the duke of Newcastle's papers, presented by the earl of Chichester in 1886; the Hardwicke MSS., purchased from the earl of Hardwicke in 1899; the Asburnham MSS., chiefly historical, 1883; the Nelson papers of Viscount Bridport, 1895–97; the Gibbon papers, 1895; the Sforza Book of Hours, bequeathed by John Malcolm, Esq., of Poltalloch, 1893; MSS. of Keats, from his sister Señora Llanos, and the autograph MSS. of some of George Eliot's works, from Mrs C. L. Lewes. The department has published catalogues of papyri, of Spanish MSS., of romances, and of seals. The Oriental department has published catalogues of Arabic and Indian books.

Bodleian.

The Bodleian Library at Oxford contained in 1902 over 600,000 printed volumes and 31,000 MSS. The rate of increase is now considerably augmented, and the number of items received annually—including separate maps, parts of periodicals, &c.—exceeds 60,000, equivalent to about 17,000 volumes. A special feature of it is the entire body of dissertations or theses issued in the universities of Germany, Holland, Norway, Sweden, Denmark, Switzerland, and France. Since 1881 the further development has been very considerable. The number of week-days in the year during which the entire library is closed has been reduced from 29 to 6. The open reference-libraries in both reading-rooms have been materially increased. A very minute shelf-classification for current accessions was begun in 1883, and the corresponding shelf-lists are virtually subject-catalogues of the literature acquired since then. At the same time the preparation of a subject-catalogue of the entire library (compiled from a spare set of slips manifolded for the ordinary catalogue) has made great progress. A rough catalogue of *incunabula* (the work of Mr E. Gordon Duff and Mr R. Proctor) has also been formed. Six more volumes of catalogues of MSS. have been published, and considerable additions have been made to the collections of Sanskrit, Armenian, Hebrew, and Tibetan MSS. All current accessions of MSS. are now divided by language, with a subdivision by subject in the case of English, Latin, and Greek. The coin collection—the second largest in the empire—has been almost entirely reorganized; it numbered over 60,000 pieces in 1902. During the period under review the Savile and Music School libraries were added to the Bodleian, five colleges deposited their MSS. in it, and an important deposit collection was received from the Clarendon Press. The area occupied by the library includes the basements of the Sheldonian Theatre and of the Old Ashmolean building. The lending of volumes has been restricted by statute, so as to require the sanction of Convocation of the University: it may be said that printed books are never lent, and of manuscripts (never of prime value) only some half-dozen a year. The number of readers, both ordinary students and those engaged in research, has largely increased. In 1889 the gallery of the Radcliffe Camera was opened as an addition to the reading-room in that building. The three-hundredth anniversary of the opening of the Bodleian Library was in October 1902.

Cambridge University.

The contents of the University Library at Cambridge are estimated (perhaps excessively) by the University Calendar at half a million of volumes, but no enumeration has been made officially. The *incunabula* are about 2150, being especially strong in books printed in Holland and Belgium and in Cologne. The MSS. number 7872, exclusive of the Taylor-Schechter collection of Hebrew documents and fragments from Cairo, and of the Buxton collection of Norfolk court rolls, &c. The following catalogues of MSS. have been published: Persian (E. G. Browne), Syriac (W. Wright and S. A. Cook), Hebrew, vol. i. (S. M. Schiller-Szinessy), Hand-list of Mahommedan MSS. (E. G. Browne). Among recent additions are the Chinese library of the late Sir T. F. Wade, catalogued by Professor H. A. Giles; the library of H. Bradshaw, 1870 and 1886 (Irish, chiefly before 1800, probably 7000 numbers); R. Bensly's Oriental books and manuscripts, J. Venn's logic collection, J. C. Adams's collection of early printed mathematical works, Samuel Sandars's *incunabula*, early English, liturgical, books on vellum, &c. Volumes i. and ii. of the catalogue of English books before 1640, by C. Sayle (reaching No. 5909), had been published up to 1902.

Edinburgh. The Advocates' Library in Edinburgh now includes 455,000 printed volumes and 3200 MSS. In 1884 an addition was made to the building capable of holding 85,000 volumes, and in 1899 a further extension to accommodate 380,000 volumes. The Signet Library now includes about 100,000 volumes. The third volume of the printed catalogue, with a subject index, was published in 1891.

Dublin. The library of Trinity College, Dublin, in 1902 contained 255,000 volumes and 2027 MSS.; about 3000 volumes are added every year. The printed catalogue of books acquired before 1872 was completed in 1887, and a summary catalogue of the manuscripts has been published (1890).

Manchester. The most remarkable instance of a great library established by private munificence is that of the John Rylands Library at Manchester, which was founded, erected, and endowed by Mrs E. A. Rylands in memory of her husband, and is contained in a magnificent building opened in 1899. The collection was formed largely on the famous Althorp Library, made by Earl Spencer (40,000 volumes), one of the most remarkable collections of early printed books and rare Bibles ever brought together. The present number of volumes is about 80,000, of which 2500 are *incunabula.* Over 5000 volumes, including many of great rarity, were added in 1901. A short-title catalogue, 3 vols. 4to, and one of English books, have been published. A supplement, describing about 25,000 books, was begun.

Since 1880 the usefulness of public libraries has been increased by the work of the Library Association, founded in 1877, during the first International Library Conference held in London in October 1877. A charter of incorporation was granted to the association in 1898. It holds monthly and annual meetings, publishes a journal, conducts examinations, issues certificates, holds classes for instruction, and has greatly helped to improve the public library law. The Library Assistants' Association publishes a journal. A second International Library Conference was held at London in 1897. Library associations have been started in Germany and Switzerland. The Library Association of Australia held its third annual meeting in 1901.

BRITISH COLONIES.

I. AUSTRALASIA.—In the Australasian states and colonies there were 1361 libraries in 1902 receiving a Government grant, and containing 2,552,995 volumes.

1. *Victoria* has 424 libraries, with 1,029,743 volumes. The Melbourne Public Library is the largest in Australasia (178,900 vols.). Among other libraries in Melbourne are—The Library of Parliament, for the use of members; the Supreme Court Library, with 24,000 vols., free to members of the legal profession; the Patent Office Library, with 7000 vols.; the Libraries of the University, the Royal Society, the Linnæan Society, the Royal Geographical Society, and other institutions.

2. *New South Wales* contains 350 libraries receiving Government aid, with 510,000 vols.; Sydney Public Library (151,141 vols.), with lending department for the benefit of country libraries; Sydney University Library (50,000 vols.); School of Art Library (60,000 vols.); a circulating library for subscribers.

3. *South Australia.*—Adelaide Public Library (46,266 vols.), with circulating system of book boxes; Parliamentary Library, Adelaide, for the use of members. Besides these, 160 country libraries with 220,538 vols.

4. *Queensland* contains 141 institutions, with 166,589 vols., mostly open to the public. Pending the opening of the Brisbane Public Library, the most important is the Parliamentary Library, Brisbane (31,835 vols.).

5. *Tasmania* has 45 libraries, with 90,000 vols.; Tasmanian Public Library, Hobart, 19,000; Launceston Public Library, 22,000 vols.; Parlimentary Library, for use of members.

6. *West Australia* has 55 literary institutions, with 24,000 vols.; Victoria Public Library, Perth (43,940 vols.).

7. *New Zealand* has 304 libraries, with 409,604 vols. There are no state libraries, but they are partly supported by rates and partly by subscription. The largest are Auckland Public Library (34,000 vols.), containing Sir George Grey's collection of 13,000 rare books and MSS.; Wellington Public Library; the Dunedin and Christchurch Libraries; the Parliamentary Library of Wellington (40,000), and several university libraries.

The Parliament of the Commonwealth of Australia intends to establish a Federal Public Library in the new capital, containing as a special feature works on Australasian history.

II. CANADA.—Between 1887 and 1902 the number of volumes accessible to the public in the Dominion increased by about 1,300,000. All the chief cities of the Dominion now possess fine public libraries. Two provinces—Ontario and British Columbia—haved adopted a Public Libraries Act. Montreal has about thirty libraries, large and small, and Toronto about as many. Ottawa can draw upon the Parliamentary Library, which with those of the departments aggregate a quarter of a million volumes, and constitute the largest collection of books in the country.

The chief free public library in Canada is that of Toronto (110,000 vols.). The largest university library is that of Laval University, Quebec (110,000 vols.). Then follows M'Gill University, Montreal (81,000), with about 30,000 vols. of theological and patristic literature in its affiliated colleges. Travelling libraries have been organized in British Columbia. The Aberdeen Association, founded in 1890 through the instrumentality of the countess of Aberdeen, collects books for distribution in monthly parcels among settlers in outlying parts of the country. *Nova Scotia*—Halifax: Legislative Library (32,500 vols.), Dalhousie University (19,760), Citizens' Free Library (22,300), Garrison Library (15,000); Windsor: King's College (7500); Wolfville: Acadia College (8500). *New Brunswick*—St John: Free Library (12,000); Fredericton: Legislative Library (15,000), University of New Brunswick (8500); Sackville: Mount Allison College (8500). *Quebec* (*Province*)—Montreal: Fraser Institute (35,000), Château de Ramezay (6000), Montreal Free Library (20,000), Westmount Free Public Library (2500), Bibliothèque Paroissiale de Notre Dame (16,000), Mechanics' Institute (14,000), Grand Trunk Literary and Scientific Institute (7000), École Normale Jacques Cartier (12,500), M'Gill University (including medical works, 81,000), four college libraries affiliated with M'Gill University, viz., Presbyterian (16,000), Congregational (3500), Diocesan (4700), Wesleyan (3000), Montreal College (Roman Catholic) (45,000), St Mary's (Jesuit) College (32,000), Seminary of St Sulpice (70,000), Natural History Society (6000), Advocates' Library (17,000), New York Life Law Library (6500); Quebec (city): Laval University (110,000), Legislative Library (50,000), Department of Public Instruction (11,000), Bar Library (13,000), Literary and Historical Society (19,000); Sherbrooke: Art Institute and Public Library (4000); Knowlton: Pettes Memorial Library (1400); Lennoxville: Bishop's College (7500); Stanstead: Public Library (3000); St Hyacinth: Collège de St Hyacinthe (25,000); Ste Anne de la Pocatière: Collège de Ste Anne (13,000); Three Rivers: Seminaire des Trois Rivières (7000). *Ontario*—Toronto: Public Library (110,000), University Library (60,000), Legislative Library (70,000), Law Society of Ontario (30,000), Meteorological Office (Governmental) (5000); Kingston: Queen's University (36,000); Ottawa: University (35,000), four Governmental libraries, viz., Library of Parliament (200,000), Geological and Natural History Survey (16,000), Supreme Court (19,500), Archives (10,000). *Manitoba*—Winnepeg: Legislative Library (17,500), Literary and Historical Society (15,000), University of Manitoba (8000), Law Society (6000). *North-West Territories*—Regina: Legislative Library (3500). *British Columbia*—Victoria: Legislative Library (6000), Law Library (2000), Public Library (5000); New Westminster: Public Library (1500); Vancouver: Public Library (1000).

Summary of Canadian Libraries.

	Libraries.	Volumes.
Nova Scotia	9	90,000
Prince Edward Island	2	7,500
New Brunswick	6	50,500
Quebec	47	690,500
Ontario (including 5 Governmental libraries)	444	1,537,500
Manitoba	4	46,500
North-West Territories	1	3,500
British Columbia	5	17,000
	518	2,443,000

III. AFRICA.—*Cape Colony* has 126 libraries, with 421,732 vols., the chief being those of Cape Town (66,753 vols.), Graham's Town, Port Elizabeth (25,073 vols.); King William's Town (16,987 vols.); Kimberley (23,843 vols.); East London (7774 vols.); Cradock (7147 vols.); and Graaff-Reinet (8669 vols.). There is also a Parliamentary library in Cape Town (12,000 vols.).

Natal.—The Natal Society's library, Pietermaritzburg (11,500 vols.); a Parliamentary library, also at Pietermaritzburg; and a public library at Durban (12,000 vols.). There are also small libraries in the country districts.

IV. WEST INDIES.—The Institute of Jamaica (11,000 vols.); Trinidad Public Library (20,000 vols.); Nassau Public Library, Bahamas (13,000 vols.); Royal Agricultural and Commercial Society, British Guiana (20,000 vols.); Berbice Reading Society (5000 vols.); the Public Library of Grenada (4000 vols.); Public Library, St Lucia (3000 vols.).

V. EASTERN COLONIES.—*Ceylon* has 24 libraries, 4 of which are in Colombo. *The Straits Settlements* has 4 libraries (2 in Singapore and 2 in other parts of the colony). *Hong-Kong* has 2 libraries. *Mauritius.*—Public Library of Port Louis (12,000 vols.).

[See "The Libraries of Greater Britain," by J. R. BOOSÉ, in *The Library*, 1901; for Canada paper by J. BAIN (Public Library of Toronto) read at Montreal Library Conference 1900, with additional information from G. H. GOULD, M'Gill University Library, Montreal.]

GERMANY AND AUSTRIA-HUNGARY.

There are two libraries in Germany, Berlin and Munich, of nearly a million volumes, one of 600,000 volumes (Hamburg), two possessing about half a million (Göttingen and Leipzig). The following contain between a quarter and half a million volumes: Bamberg, Bonn, Breslau, Darmstadt, Dresden, Frankfort on the Main, Freiburg in Bresgau, Heidelberg, Munich (Univ. Lib.), Rostock, Stuttgart, Tübingen, Wolfenbüttel, and Würzburg. Libraries extending from 200,000 to 250,000 are at Augsburg, Gotha, Halle, Jena, Kiel, Königsberg, Mainz, Schwerin, and Weimar. Since 1892 the Royal Library at Berlin has issued a weekly accession list. A combined general catalogue of the great Prussian libraries, including since 1898 all the university libraries, is being compiled.

The largest collections in Austria-Hungary are the Royal Library (900,000 vols.) and the University Library (576,000) at Vienna, the Hungarian National Museum (400,000); and the University Library (222,000) at Budapest, and the Museum (200,000) and the University Library (269,000) at Prague.

FRANCE.

The Bibliothèques Municipales in the various departments are about 338, with an aggregate of 8,500,000 volumes. Within the period from 1879 to 1899 a million and a half of books and pamphlets were added. The various university libraries contain about 906,600 volumes. The number of Bibliothèques Populaires is a floating quantity, as many have but a brief existence. It is believed that the Bibliothèque Nationale possesses about three millions of volumes, a total which probably includes a great quantity of pamphlets reckoned as volumes. The separate entries in the catalogue of printed publications are close upon two millions. There are besides 250,000 maps, over 100,000 MSS., 250,000 engravings, and 150,000 coins and medals. The number of entries between 1879 and 1899 was 800,000. The most important work within recent years has been the preparation of the great general printed catalogue in octavo form, and the valuable publications of M. Delisle on French and Latin MSS. The other great Paris libraries are: Bibliothèque de l'Université de Paris (430,358 vols.); B. Sainte Geneviève (300,000 vols.); B. de l'Arsenal (250,000 vols.); B. Mazarine (200,000 vols.). (H. R. T.)

THE UNITED STATES.

The early history of public libraries in the United States, and the statistics down to 1876, will be found in the earlier article in vol. xiv. (p. 534) of the *Ency. Brit.* (ninth edition). The progress since that date has included an extraordinary activity (1) in the creation of additional rate-supported libraries of the customary type; (2) in the establishment of libraries by private gift, to be maintained wholly or in part by endowment; (3) in the extension of state aid to the establishment of libraries designed for local service, and of the counsel of state authorities in their administration; (4) in the construction of new library buildings of elaborate design; (5) in the organization of persons engaged in library work or interested in public libraries as a part of the educational system of the country into associated effort for the study of library economy, for the discussion of problems of library administration, and for the furtherance in general of the library movement; and (6) in the establishment of systematic instruction for library work.

Statistics.—Statistics of individual libraries of note are appended in a table. From time to time the United States Bureau of Education has compiled statistics of public, society, and school libraries in the United States, which show not only the wide extent of library facilities, but also a remarkable growth in recent years. Some of the main results of these inquiries may be noted.

Libraries of 1000 volumes and over.			Increase per cent.		Libraries of 300 volumes and over.	
Year.	Number.	Volumes.	Number.	Volumes.	Number.	Volumes.
1875	2039	11,487,778	...	...	3648	12,329,526
1885	2988	19,401,199	46·5	77·6	5338	20,722,393
1891	3503	25,977,643	17·2	33·9	...	...
1896	4026	33,051,872	14·9	27·2	7184	34,596,258
1900	5383	44,591,851[1]	33·7	34·9	9261	46,610,509

[1] Exclusive of pamphlets, reported as 7,503,588.

It will be noted that the libraries having 1000 volumes were about two and a half times as numerous in 1900 as twenty-five years previously, while in the same period their contents had increased nearly fourfold. The above statistics include society and school libraries, these being "public" and very generally free for reference use. Of the 5383 libraries of 1000 or more volumes reporting in 1900, 1979 were classed as "general," 1725 as "school," and 689 as "college." Four had 500,000 volumes or over; three, 300,000 to 500,000; forty-seven, 100,000 to 300,000; ninety, 50,000 to 100,000; and the remainder fell below 50,000. The distribution by groups of states was as follows: North Atlantic, 2473; South Atlantic, 421; South Central, 374; North Central, 1728; Western division, 387. In general, throughout the United States there is one library having 1000 volumes for every 14,118 persons, though in the North Atlantic states they are as many as one for every 8510, while in New England the number is still greater. New Hampshire leads with one library for every 2878. More significant perhaps are figures in relation to the books. In the country at large the libraries contain 59 books for every 100 people. In the North Atlantic states the books outnumber the people, being 111 of the former for 100 of the latter; in Massachusetts, indeed, the number is as high as 236 for every hundred persons. In these comparisons with the population the extreme Western states as a group make a better showing than the average of the nation, while other groups fall below it. This is due in a large measure to the influence of California, which compares favourably with the Eastern states both in the number of its libraries and their size.

Income.—988 libraries reported an income for the year 1900 of $2,213,755 from taxation; 1016, an income of $2,349,294 from state, county, and city appropriations; while 714 reported an income of $1,198,955. Other sources of income are reported, while a large number failed to specify the sources of income. The aggregate income reported by 3115 libraries was $7,812,406. 645 libraries reported endowment funds aggregating $25,267,643.

710 libraries reported the value of their buildings to be $47,083,805, while 2972 reported an expenditure for books during the year of $2,056,675.

Use.—During the year 1900 the records of 2405 libraries show 48,410,128 books issued for home use. The reference use is imperfectly recorded. Free access to shelves, at least to reference cases, and to periodicals, make a complete record impracticable, and there are only 783 libraries which make any report of books issued for use in the library (9,609,632). If all such use could be recorded and reported, it seems probable that the books used in the buildings would exceed those used at home. Circulation for home use reaches its highest point in the large cities, especially where the free libraries have a number of branches. Thus in Philadelphia and Chicago the circulation in 1900 reached one and three-fourth million books. The free circulating library of New York City circulated a million and a half of books, while the Boston Public Library and its branches had a circulation exceeding one and a quarter million. Several other city libraries have a circulation exceeding 500,000. These statistics, although imperfect, indicate a development unexampled in the history of education. This development has been fostered by legislation. In the fifty states and territories there were included in the report of 1900 before quoted only eleven in which libraries were not supported by taxation levied directly for such purpose. One of these—Delaware—has since passed a law authorizing taxation for the support of public libraries. The state of New Hampshire in 1897 enacted a law which, proceeding one step farther, made obligatory the establishment of free libraries by towns of a certain size. This carries to its extreme limit the theory, now generally accepted in the United States, that a free public library ranks with the common school as an agency for popular education whose maintenance is a duty of the community as a whole to its members. In certain towns the board of library commissioners is vested (by statute) with the authority to specify directly the amount to be levied for library purposes, being limited only to a certain maximum percentage of the assessed valuation. In general, however, the appropriations are made by the town councils.

State Library Commissions.—Twenty-one states, beginning with Massachusetts in 1890, have established commissions, which, acting on behalf of the state, encourage the formation of local libraries, particularly in towns and villages, and in many cases have authority to aid their establishment by the grant out of the state funds of a certain sum (usually $100) towards the purchase of books, upon the appropriation of a similar sum by the local authorities. These commissions are prepared to aid further with select lists of desirable books, and with suggestions or advice in the problems of construction and maintenance. Such commissions are in existence in Connecticut, Delaware, Georgia, Idaho, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Vermont, Washington, and Wisconsin. In Massachusetts the efforts of the commission have been so successful that of the 346 towns and cities in the state only seven at present lack public library privileges. The report of the commission for 1899, together with the report of the Connecticut commission of 1895, affords a very full statement of the progress of the typical town library in New England. The result of fostering legislation is seen in the greater portion of free rate-supported libraries established since 1875, as against those established during the preceding twenty-five years. From 1850 to 1875 the number was but 257, as against 1983 professional, society, school, and college libraries. The present tendency is either to the discontinuance of proprietary libraries of the older type—excluding the Y.M.C.A. and the fraternity libraries and those merely professional—or to their merger with the free town library. Those now remaining independently prosperous are to be found chiefly in the large cities—for example, the Boston Athenæum, the Mercantile of New York, and the Brooklyn.

Travelling Libraries.—In certain of the states the state authorities, acting usually through the state commissions, maintain at the expense of the state collections of books, which are despatched to various localities upon application from the local authorities, remaining during a fixed period in each locality for the benefit of the residents there, and then being withdrawn and forwarded for service elsewhere. This system of travelling libraries, inaugurated in New York state, and having its most elaborate development there, is now in existence in at least twenty-one states—Alabama, Colorado, Delaware, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, New York, Ohio, Michigan, Minnesota, Missouri, New Jersey, Pennsylvania, Texas, and Wisconsin. To the service of books is sometimes added that of photographs, lantern-slides, and other illustrations. Communities are reached by these travelling libraries (as in Wisconsin) remote from the book centres, and either ignorant of the stimulus of books or unable to afford it.

Endowments.—The creation and endowment of public libraries by private gift has kept pace with their establishment at the public expense. An annual report of donations to libraries is presented at the meeting of the American Library Association. The report for 1900–1 showed money gifts in the United States for general library purposes of $3,616,962, and for buildings, $15,217,702. Gifts of material aggregated 145,361 volumes. The total money value of gifts and bequests of money, buildings, and lands for library purposes since 1876 is estimated at nearly $60,000,000. Mr Carnegie's gifts alone have exceeded $20,000,000, and in 1901 he gave $5,200,000 to New York City for the erection of sixty-five branch libraries. Among other notable gifts of individuals have been the following:—Enoch Pratt, gift to Baltimore, $1,083,333; Walter L. Newberry, bequest to Chicago, $3,000,000; Samuel J. Tilden, bequest to New York, $2,125,000; John Crerar, bequest to Chicago, $2,714,191; Seth Low, gifts to Columbia, say $1,000,000. The gift of Enoch Pratt to Baltimore was a lump sum towards the establishment of the library, construction of the buildings, &c., with the condition that the city should appropriate for maintenance expenses a certain sum annually. This is a favourite form of gift, and was followed by Mr Carnegie in most of his benefactions. The Tilden, Newberry, and Crerar bequests went to the foundation of libraries which, while free, are administered by private corporate bodies.

Library Buildings.—The multiplication of these, both by private gift and at the public expense, has been extraordinary. In the smaller towns library buildings, costing from $5000 to $50,000, have now become the most popular form of memorial; pictures are given in the reports of the Massachusetts and Connecticut library commissions. Of the large buildings the result of gift, some of the most prominent are the Columbia University Library at New York (the gift of its president, at a cost of nearly $1,000,000); that of Pittsburg, a composite building, costing, with branches, $2,800,000, the gift of Mr Carnegie; the new library of Princeton University, costing $600,000, the gift of W. Taylor Pyne; that of Cornell, costing $250,000, the gift of Henry W. Sage (who added an endowment of $300,000); and that for the public library at Providence, Rhode Island (the gift in part of John Nicholas Brown). Of other buildings for libraries of intermediate size, those erected at Milwaukee and at Madison, Wisconsin, and at Newark, N.J., are specially interesting, from their provision for administrative needs complex in character. Of larger buildings, erected at the expense of municipalities for municipal libraries, that at Boston (completed 1895) cost $2,500,000; that at Chicago (completed 1897), $2,000,000. The culmination of buildings of this type will be that for the New York Public Library—larger, more elaborate, and doubtless more costly than either of the foregoing. The most ambitious of existing library buildings is that erected by the Federal Government for the library of Congress at Washington, and opened in 1897. It covers 3½ acres of ground, contains 10,000,000 cubic feet of space, and has possible accommodation for over four million volumes. Its cost was $6,500,000, or including the land, $7,000,000. It is the largest, most ornate and most costly building in the world yet erected for library purposes. The library itself is now likely to become worthy of the building as the National Library of the United States. It contains already the largest mass of material of any library on the western hemisphere (see Table). The total appropriations in its behalf for the year 1900-1 reached $563,000. This included $75,000 for printing and binding, and $156,000 for furniture and shelving and the care and maintenance of the building and grounds. $71,000 was for the purchase of books and other material. The advantage of combining under one roof institutions cognate in aim or related in activity has led to the construction of certain buildings composite in character, containing provision for museums, art galleries, and perhaps music halls and society rooms. Examples of such are at Allegheny, Buffalo, Madison, Milwaukee, Minneapolis, Pittsburg, and elsewhere. Not merely in number, but from an artistic standpoint, the library buildings erected since 1880 are, as a class, amongst the most notable achievements of American municipal architecture.

Administration.—In the United States the tendency is constant towards the removal of restrictions upon use. In almost no case is any credential required as a preliminary to reference use. The deposit or guarantee, formerly a condition precedent to the withdrawal of books for home use, is no longer universally exacted; at Boston, for instance, a simple reference to a second resident (who assumes, however, no responsibility) is all that is required. In spite of this waiver of security, the annual loss to the library, out of a circulation of 1,200,000 volumes issued for home use, is less than 100 volumes unaccounted for, the money value of which would not exceed $100. Direct access to the shelves is increasingly granted, not merely for purpose of reference, but for the selection of books for home use. Special provision for younger readers is a feature in all of the libraries undertaking a popular service, and children's reading-rooms, with direct access to a selected collection of books, are now provided in all the buildings erected for such libraries. A special educational service, highly developed of late years, involves co-operation with the common schools in the supply to teachers and pupils of books, special topical lists, and special facilities for collateral and supplementary reading. In this way the library is closely associated with the common educational system, becomes auxiliary to the schools, and develops a constituency of readers early trained to its use. In the larger cities the facilities of the central library are supplemented by branches and delivery stations; the former containing permanent collections of books issued independently, the latter serving as conduits through which books are issued from the central collection. The system of branches has been developed more particularly in Baltimore, Philadelphia, and Pittsburg; that of delivery stations and branch reading-rooms at Chicago and St Louis, and a composite system at Boston. For Chicago there are provided over forty delivery stations; at Boston, ten branches—five branch reading-rooms and thirteen delivery stations. Such cities support, therefore, not a mere library, but a *system* of libraries.

Library Associations.—The American Library Association, formed in 1876, has continued uninterruptedly, and now numbers over 500 members. It holds annual conferences at different places. It has done much to stimulate the interest in libraries, and to give form and expression to their needs. It has led to the formation of local clubs and associations, of which there now exist over twenty-five in the United States, with a total membership of more than 2000 persons. These, holding conferences at more frequent intervals than the A.L.A., have kept interest and enthusiasm active among smaller groups, and have been able to exert a potent influence in local library affairs. The publishing section of the A.L.A., among other undertakings, issues select lists for reading, and printed catalogue cards of current publications, and an index on cards of certain current scientific serials, compiled by five co-operating libraries. In general, effort among librarians is constant towards the economy both of specialization (as regards material) and co-operation (as regards service).

Library Schools.—Education for library work has been advanced by the establishment of schools giving instruction in library economy, and in some cases authorized to confer degrees (B.L.S.). The parent of these schools (now at Albany, N.Y.) was established in 1884. Others are now at Brooklyn, Philadelphia, the University of Illinois, and elsewhere. The admission requirements of two of them presuppose a college degree. The course covers a period varying from one to three years. The number of students graduating in a single year reaches perhaps twenty to each school.

Local Progress.—The multiplication and increasing elaboration of buildings for library uses is but suggestive of the general advance. The three largest cities in the United States no longer suffer the reproach of being without adequate library facilities. Chicago, besides its municipal (public) library system, has two liberally endowed free reference libraries, the Newberry and the Crerar, which divide in part the field of literature, the Crerar confining itself to science and the technical arts. Philadelphia has now a free library system, the central building of which will cost at least a million dollars, and which meanwhile surpasses all records in the number of books issued to its readers. New York has had for some years a system of free libraries, enlarging by gift and appropriation, to the maintenance of which the city contributes, and which parallel in activity the system at Philadelphia. In 1895 there was brought about the notable consolidation of the Astor, Lenox, and Tilden foundations upon which the New York Public Library is to be based. This brought together two great reference collections, aggregating over 500,000 books, besides pamphlets, and endowments in buildings and funds aggregating more than $8,000,000. The city assigned to it a superb site of ample dimensions, appropriated $2,500,000 for the main building, and will doubtless contribute towards maintenance, at any rate upon the assumption by the library trustees of the work of the present free circulating libraries. The union of all these funds and forces will provide for New York City the most elaborate library system of any city in the world, the culmination to date of library progress in American municipalities.

AUTHORITIES.—FLETCHER, WILLIAM I. *Public Libraries in America*, 2nd edit., Boston, 1899. A convenient sketch and manual. The statistics are now compiled systematically by the Bureau of Education, and published in its special reports on the *Public Libraries of the United States and Canada*, of which the first in 1876 has been followed by others in 1886, 1891, and 1896. On library administration the papers contributed to the Library Conference at the Chicago Exposition, 1892, summarize the best experience of American librarians at that date. See also DANA, JOHN C. *A Library Primer*, Chicago, 1899.—PLUMMER, MARY W. *Hints to Small Libraries*, 2nd edit., New York, 1898.—But the entire subject, historical, statistical, and administrative, is most amply covered in the files of the *Library Journal* (New York, September 1876, to date and current), a monthly. This is the official organ of the American Library Association, and includes its proceedings. See also the file of *Public Libraries*, a monthly, published at Chicago 1896, to date and current.

LIST OF THE PRINCIPAL LIBRARIES IN THE UNITED STATES,

INCLUDING THE TWO LARGEST LIBRARIES OF EACH STATE, AND ALL OTHERS HAVING 50,000 VOLUMES AND UPWARDS.

The statistics are official, furnished in part by the libraries to date, in part taken from their latest accessible printed reports (1897–1901); for the other libraries, marked *, they are taken from "Public, Society, and School Libraries," Washington, 1901 (advance sheets from the *Annual Report of the United States Commissioner of Education, 1899–1900*). Under printed volumes are included pamphlets; when the number of the latter is large in proportion to the total it is noted under "Remarks." In that column libraries are also distinguished as T., supported by taxation; E., maintained by endowment or special funds; C., free circulating; R., reference only; C. and R., circulating and reference; F.R., free for reference; S., society or proprietary; Sub., subscription: special character is noted when not self-evident, *e.g.*, Science. The list contains 224 libraries in all (including 67 libraries with 100,000 volumes and upwards). The reference "1897 report" or "1901 report" in the "Remarks" column is to the statistics of the Bureau of Education.

Library.	Founded.	Printed Vols.	Approximate Annual Accessions.	Approximate Annual Income.	Remarks.
Alabama—				$	
*State and Supreme Court Library, Montgomery	1828	32,152	†941	†1,500	T., F.R. †1897 rept.
*Spring Hill College, Spring Hill	1836	†33,905	250	...	E., F.R. †Incl. 8255 pams.
Arizona—					
*Territorial Library, Phœnix	1870	16,000	...	...	T., C. & R.
*University of Arizona, Tucson	1891	7,000	1,000	1,500	T., C. & R.
Arkansas—					
*Arkansas State Library, Little Rock	1840	75,000	†8,750	†1,100	T., C. & R. †1897 rept.
Arkansas Supreme Court Library, Little Rock	1836	†40,000	250	1,050	T., F.R. †Incl. 10,000 pams.
California—					
Bancroft Library, San Francisco	...	50,000	...	...	E., F.R. History.
California State Library, Sacramento	1852	113,600	4,395	44,693	T., F.R.
Leland Stanford University Library, Palo Alto	1891	†68,694	2,000	9,250	E., C. & R. †Incl. 24,000 pams.
*Los Angeles Public Library	1872	54,535	5,842	28,581	T., C. & R.
*San Francisco Mechanics' Institute	1855	100,170	3,748	26,776	Sub., C. & R.
*San Francisco Mercantile Library	1852	75,000	...	...	Sub., C. & R.
*San Francisco Public Library	1879	131,274	10,315	55,791	T., C. & R.
Sutro Library, San Francisco	1883	220,000	...	...	F.R. Science.
University of California, Berkeley	1868	†150,577	4,000	‡12,940	T., C. & R. †Incl. 7000 pams. ‡1901 rept.

Library.	Founded.	Printed Vols.	Approximate Annual Accessions.	Approximate Annual Income.	Remarks.
Colorado—				$	
*Colorado College, Coburn Library, Colorado Springs	1880	†50,000	1,400	1,650	Sub., C. & R. †Incl. 25,000 pams.
*Denver Public Library	1886	81,000	3,000	27,514	T., C. & R.
Connecticut—					
Connecticut Historical Society, Hartford	1825	†50,000	749	2,786	S., F.R. †Incl. 25,000 pams.
*Hartford Public Library	1892	67,000	5,692	15,317	T., C. & R.
*Hartford Theological Seminary—Case Memorial Library	1834	†115,247	3,921	2,418	E., C. †Incl. 39,355 pams.
*New Haven Free Public Library	1886	54,824	†3,381	17,840	T., C. & R. †1897 rept.
*Silas Bronson Library, Waterbury	1869	66,042	1,352	11,693	E., C. & R.
*Trinity College Library, Hartford	1823	†67,071	1,054	2,000	E., C. & R. †Incl. 26,335 pams.
*Watkinson Library of Reference, Hartford	1858	52,117	1,463	5,800	E., F.R.
*Wesleyan University Library, Middletown	1833	58,000	2,900	3,186	E., Sub., C. & R.
Yale University Library, New Haven	1700	384,500	10,000	34,500	E., C. & R.
Delaware—					
Delaware State Library, Dover	1830	†45,000	‡200	300	T., F.R. †Incl. 15,000 pams. ‡1901 rept.
*Wilmington Institute Free Library	1788	39,912	3,197	14,941	T., C. & R.
District of Columbia—					
*Georgetown College	1789	†119,923	921	‡3,843	E., C. & R. †Incl. 44,473 pams. ‡1897 rept.
Library of Congress	1800	†957,056 MSS. 26,500, maps 52,181, music 277,465	32,000	‡510,000	T., F.R. †Incl. pams. and dups. ‡for 1900–1.
*Supreme Council, 33° A.A.S.R. of Freemasonry, S.J., U.S.A.	1880	75,000	...	...	S., C. & R.
United States Bureau of Education	1868	†325,967	2,173	2,251	T., C. & R. †Incl. 150,000 pams.
United States Department of Agriculture	1869	†96,720	4,000	11,960	T., C. & R. †Incl. 30,000 pams.
*United States Department of State	1789	65,500	†1,487	2,000	T., C. & R. †1897 rept.
United States Geological Survey	1882	†125,532 maps 30,000	‡5,500	§2,000	T., C. & R. †Incl. 80,000 pams. ‡Incl. 3,000 pams. §For books.
*United States House of Representatives	...	†200,000	...	...	T., F.R. †Public documents.
*United States National Museum	1881	†55,000	1,005	...	T., F.R. †Incl. 30,000 pams.
*United States Patent Office	1836	74,140	1,721	1,500	T., F.R.
*United States Senate	1868	†125,000	3,554	...	T., F.R. Printed documents.
*United States Surgeon-General's Office	1870	†364,604	3,186	10,000	T., C. & R. †Incl. 229,546 pams.
Florida—					
*John B. Stetson University, De Land	1886	10,000	660	692	E., C. & R.
*Florida State Library, Tallahassee	...	11,500	...	...	T., F.R.
Georgia—					
Georgia State Library, Atlanta	1847	60,000	†500	3,000	T., F.R. †1901 rept.
*Georgia Historical Society, Savannah	1839	27,982	376	2,673	S., Sub., C. & R.
Idaho—					
*Idaho State Law Library, Boise	1863	15,000	†340	†1,150	T., F.R. †1897 rept.
*University of Idaho and Agricultural College, Moscow	1889	7,700	1,000	1,000	T., F.R.
Illinois—					
*Chicago Historical Society	1856	†75,000	...	...	S., Sub., R. †Incl. 50,000 pams.
*Chicago Public Library	1872	306,601	12,911	272,790	T., C. & R.
*Illinois State Library, Springfield	1839	50,000	3,200	1,200	T., F.R.
*John Crerar Library, Chicago	1894	59,817	13,877	139,944	E., F.R. Science.
Newberry Library, Chicago	1887	†220,928	7,729	..	E., F.R. †Incl. 63,628 pams.
*Northwestern University, Evanston	1855	†70,182	2,899	...	E., C. & R. †Incl. 27,000 pams.
*Peoria Public Library	1880	74,361	4,400	15,808	T., C. & R.
*University of Chicago	1892	†479,778	‡10,000	...	E., Sub., C. & R. †Incl. 150,000 pams. ‡1897 rept.
Indian Territory—					
*Cherokee National Library, Tahlequah	...	2,900	28	...	T., F.R.
*Cherokee National Male Seminary, Tahlequah	1866	4,026	90	...	T., F.R.
Indiana—					
*Indianapolis Public Library	1873	95,007	7,462	48,000	T., C. & R.
*University of Notre Dame (Lemonnier's Library)	1856	60,000	2,500	350	E., F.
*Wabash College, Crawfordsville	1832	†51,000	900	‡2,274	E., C. & R. †Incl. 15,000 pams. ‡1897 rept.
Iowa—					
Iowa State Library, Des Moines	1838	65,093	2,500	7,000	T., F.R.
*University of Iowa, Iowa City	1856	55,000	5,650	†4,950	T., C. & R. †1897 rept.
Kansas—					
*Kansas State Historical Society, Topeka	1875	†111,101	2,605	5,194	T., F.R. †Incl. 66,257 pams.
*Kansas State Library, Topeka	1870	77,000	7,500	10,400	T., F.R.
Kentucky—					
Kentucky State Library, Frankfort	1820	102,000	1.000	900	T., F.R.
*Polytechnic Society of Kentucky, Louisville	†1878	52,000	889	4,087	S., Sub., C. & R. †1897 rept.

Library.	Founded.	Printed Vols.	Approximate Annual Accessions.	Approximate Annual Income.	Remarks.
Louisiana—				$	
*Fisk Free and Public Library, New Orleans	1897	43,000	3,250	11,993	T., C. & R.
*Howard Memorial Library, New Orleans	1887	38,000	2,046	7,500	E., F. & R.
Maine—					
*Bangor Public Library	1883	56,697	1,425	5,769	C., F.R.
*Bowdoin College, Brunswick	1794	67,164	2,059	2,965	E., C. & R.
Colby University, Waterville	1820	†54,837	1,000	‡430	E., C. & R., Sub. †Incl. 20,000 pams. ‡1901 rept.
*Maine State Library, Augusta	1861	63,000	2,800	4,300	T., C. & R.
Maryland—					
*Baltimore New Mercantile Library	1888	67,540	2,083	6,352	E., C. & R., Sub.
*Enoch Pratt Free Library, Baltimore	1882	217,118	10,000	55,000	E., C. & R.
*Johns Hopkins University	1876	†193,000	4,000	...	E., C. & R. †Incl. 100,000 pams.
Peabody Institute, Baltimore	1857	149,542	2,687	21,428	E., F.R.
*Woodstock College	1869	†77,000	500	...	E., C. & R. †Incl. 10,000 pams.
Massachusetts—					
American Antiquarian Society, Worcester	1812	150,000	†1,487	...	S., R. History. †1901 rept.
*Amherst College	1821	†92,000	2,500	‡3,000	E., C. & R. †Incl. 10,000 pams. ‡1897 rept.
Andover Theological Seminary	1808	†77,000	‡277	§530	E., C. & R. †Incl. 25,000 pams. ‡1901 rept. §For books only.
*Boston Athenæum	1807	196,000	4,586	41,741	S., C. & R.
*Boston Public Library	1854	772,432	32,368	302,457	T., C. & R.
*Brookline Public Library	1857	54,570	4,441	20,068	T., C. & R.
Cambridge Public Library	1858	56,315	31,847	20,000	T., C. & R.
*Congregational Library, Boston	1853	†91,105	1,003	6,824	S., F.R. †Incl. 48,747 pams.
Essex Institute, Salem	1848	†362,000	‡2,976	‡39,600	E., C. & R. Science. †Incl. 285,000 pams. ‡1901 rept.
Fall River Public Library	1861	57,419	2,185	13,336	T., C. & R.
*Forbes Library, Northampton	1894	81,296	8,191	21,780	E., C. & R.
Harvard University, Cambridge	1638	†956,337	23,745	62,000	E., C. & R. †Incl. 427,822 pams.
*Haverhill Public Library	1873	60,000	3,080	15,605	E. & T., C. & R.
*Lawrence Free Public Library	1872	57,893	1,692	13,303	T., C. & R.
Lowell City Library	1844	59,650	1,523	15,761	T., C. & R.
Lynn Free Public Library	1862	64,574	2,486	8,656	T., C. & R.
Massachusetts Historical Society, Boston	1791	†144,000	3,000	...	S., C. & R. †Incl. 102,000 pams.
*Massachusetts Institute of Technology, Boston	†1870	‡68,000	4,000	...	E., C. & R. †1897 rept. ‡Incl. 15,000 pams.
*Massachusetts State Library, Boston	1826	†193,567	4,084	8,300	T., F.R. †Incl. 87,216 pams.
New Bedford Free Public Library	1852	80,681	1,347	17,773	T., C. & R.
*New England Historic Genealogical Society, Boston	1845	†51,000	430	4,813	S., C. & R. †Incl. 24,000 pams.
Newton Free Library	1871	57,000	1,807	15,120	T. & E., C. & R.
*Springfield City Library Association	1857	130,091	8,118	45,208	T., C. & R.
*Tufts College, Tufts College	1854	†68,701	2,331	...	E., C. & R. †Incl. 27,666 pams.
*Watertown Free Public Library	1869	†51,000	482	4,925	T., C. & R. †Incl. 25,000 pams.
*Wellesley College	1875	51,659	1,520	5,593	E., C. & R.
Williams College, Williamstown	1793	†61,000	2,500	6,500	E., C. & R. †Incl. 16,000 pams.
Worcester Free Public Library	1859	†128,196	5,156	44,058	T., C. & R. †1901 rept.
Michigan—					
*Detroit Public Library	1865	157,510	6,905	56,046	T., C. & R.
Grand Rapids Public School Library	1861	60,171	2,099	9,346	T., C. & R.
*Michigan State Library, Lansing	†1828	100,000	3,299	7,500	T., C. & R. †1897 rept.
*University of Michigan, Ann Arbor	1841	145,460	12,256	16,200	E., C. & R.
Minnesota—					
*Minnesota Historical Society, St Paul	1849	†64,280	1,357	7,500	T., C. & R. †Incl. 32,200 pams.
*Minneapolis Public Library	1885	114,000	7,155	61,295	T., C. & R.
*St Paul Public Library	1882	50,000	3,457	17,934	T., C. & R.
*University of Minnesota, Minneapolis	1868	65,000	†3,350	10,876	T., F.R. †1897 rept.
Mississippi—					
*Mississippi State Library, Jackson	1838	79,090	†2,000	1,500	T., F.R. †1897 rept.
*University of Mississippi, University	1848	17,000	200	1,000	E., C. & R.
Missouri—					
*Drury College, Springfield	1873	†55,000	557	129	E., Sub., C. & R. †Incl. 30,000 pams.
*St Louis Mercantile Library	1846	128,587	5,021	52,839	E., Sub., C. & R.
*St Louis Public Library	1865	165,000	5,441	78,225	T., C. & R.
Montana—					
*Butte Free Public Library	1890	27,150	2,800	1,700	T., C. & R.
*Helena Public Library	1868	44,710	1,788	9,640	T., C. & R.
Nebraska—					
*Omaha Public Library	1877	53,800	4,402	20,227	T., C. & R.
*University of Nebraska, Lincoln	1859	55,000	4,685	13,604	T., C. & R.

Library.	Founded.	Printed Vols.	Approximate Annual Accessions.	Approximate Annual Income.	Remarks.
Nevada—				$	
*Miners' Union Library, Virginia City	1877	10,684	†299	...	S., C. & R. †1897 rept.
*Nevada State Library, Carson City	1865	45,000	1,500	2,947	T., C. & R.
New Hampshire—					
*Dartmouth College, Hanover	1769	112,000	2,938	12,290	E., C. & R.
New Hampshire Historical Society, Concord	1823	†94,111	‡4,000	1,500	S., F.R. †Incl. 78,566 pams., ‡incl. 3000 pams.
New Hampshire State Library, Concord	1820	†107,606	11,000	12,844	T., F.R. †Incl. 50,000 pams.
New Jersey—					
*Drew Theological Seminary, Madison	1866	†106,388	9,767	850	E., C. & R. †Incl. 47,585 pams.
*Gardner A. Sage Library, New Brunswick	1856	52,570	483	1,650	E., C. & R. Theology.
*Jersey City Free Public Library	1889	72,963	3,506	32,443	T., C. & R.
*Newark Free Public Library	1888	74,687	6,600	49,950	T., C. & R.
*New Jersey State Library, Trenton	1796	58,500	2,000	7,600	T., F.R.
*Princeton Theological Seminary	1812	†91,500	1,816	‡6,176	E., C. & R. †Incl. 27,000 pams. ‡1897 rept.
*Princeton University	1746	†151,149	12,000	25,000	E., C. & R. †Incl. 25,000 pams.
New Mexico—					
*New Mexico College of Agriculture and Mechanic Arts, Mesilla Park	1890	4,000	†960	750	T., Sub., C. & R. †1897 rept.
*New Mexico Territorial Library, Santa Fé	1850	4,500	300	†2,500	T., F. & R. †1897 rept.
*University of New Mexico, Albuquerque	1892	5,200	96	500	T., F.R.
New York—					
*Aguilar Free Library, New York City	1886	76,779	13,009	†13,852	E. & T., C. & R. †1897 rept.
*Arthur W. Tams Music Library, New York City	1885	†1,500,000	...	25,000	Sub., C. & R. †Incl. 1,000,000 pams.
Association of the Bar of the City of New York	1870	51,454	†1,819	77,171	S.R. †1897 rept.
*Brooklyn Library	1857	168,676	3,523	21,893	S., Sub., C. & R.
*Buffalo Public Library	1837	167,000	21,221	85,801	T., C. & R.
*College of St Francis Xavier, New York City	1847	82,000	2,400	†800	E., C. & R. †1897 rept.
*Columbia University, New York City	1754	310,000	22,000	†67,882	E., C. & R. †1897 rept.
*Cornell University, Ithaca	1868	†261,622	15,344	34,098	E., C. & R. †Incl. 36,000 pams.
*Davenport Library, Bath	1889	90,138	†200	...	S., C. & R. †1897 rept.
*Grosvenor Library, Buffalo, N.Y.	1859	56,766	5,059	25,786	T., F.R.
Hamilton College, Clinton	1812	†65,247	945	2,150	E., C. & R. †Incl. 24,894 pams.
*Long Island Historical Society	1863	64,683	2,161	8,281	S., Sub., R.
Maimonides Free Library, New York City	1852	64,802	10,961	10,375	T., C. & R.
*New York Academy of Medicine	1847	†100,000	‡2,039	‡4,500	S., C. & R. †Incl. 20,000 pams., ‡1897 rept.
*New York City Free Circulating Library	1880	163,465	14,574	98,497	E. & T., C. & R.
*New York City Free Library of the General Society of Mechanics and Tradesmen	1820	109,955	†4,000	6,622	E. & T., C. & R. †1897 rept.
*New York Historical Society	1804	108,403	4,878	11,540	S., Sub., R.
*New York Law Institute	1828	52.373	2,123	16,636	S., C. & R.
New York City Mercantile Library Association	1820	293,943	3,564	26,316	S., C. & R.
New York Public Library, Astor, Lenox, and Tilden foundations	1895	†608,775 MSS. 50,000	51,182	144,578	E. & T., C. & R. †Incl. 129,416 pams.
*New York Society Library, New York City	1754	100,000	†1,890	127,061	S., C. & R. †1897 rept.
*New York State Law Library, Albany	1818	64,296	1,684	...	T., F.R.
New York State Library, Albany	1818	†539,741 MSS. 250,000	49,382	72,351	T., F.R. †Incl. 128,975 pams.
*New York University Library, New York City	1831	55,000	4,466	6,413	E., F.R.
New York City Y.M.C.A. Library	1852	76,864	...	14,400	S., R.
*Pratt Institute Free Library, Brooklyn	1888	70,249	4,064	...	E., C. & R.
Syracuse University	1871	†61,611	2,700	3,557	E., C. & R. †Incl. 16,611 pams.
*Union Theological Seminary, New York City	1836	†105,000	766	4,772	E., C. & R. †Incl. 30,000 pams.
*U.S. Military Academy, West Point	1816	51,924	1,513	73,900	T., C. & R.
North Carolina—					
North Carolina State Library, Raleigh	1821	†40,000	2,267	‡500	T., F.R. †Incl. 15,000 pams. ‡1901 rept.
*University of North Carolina, Chapelhill	1800	†43,000	‡1,250	...	E., C. & R. †Incl. 12,000 pams. ‡1897 rept.
North Dakota—					
*North Dakota Agricultural College, Agricultural College	1890	8,200	†888	...	T., F.R. †1897 rept.
*North Dakota State Library, Bismarck	1889	13,400	600	1,000	T., F.R.
*University of North Dakota, University	1884	7,000	†700	†1,000	T., F.R. †1897 rept.
Ohio—					
*Case Library, Cleveland	1848	53,000	†2,250	15,507	E. Sub., C. & R. †1897 rept.
*Cincinnati Public Library	1867	230,892	8,176	65,428	T., C. & R.
*Cincinnati Y.M. Mercantile Library	1835	63,000	1,020	7,500	Sub., C. & R., S.
*Cleveland Public Library	1869	175,868	19,422	72,943	T., C. & R.
*Dayton Public Library	1855	51,362	2,458	14,259	T., C. & R.
*Marietta College, Marietta	1835	65,000	18,100	†3,000	E., C. & R. †1897 rept.
Oberlin College	1833	†95,350	5,000	15,120	E., C. & R. †Incl. 49,350 pams.
*Ohio State Library, Columbus	1817	68,215	6.875	14,640	T., C. & R.

Library.	Founded.	Printed Vols.	Approximate Annual Accessions.	Approximate Annual Income.	Remarks.
Oklahoma—				$	
*Oklahoma Library, Guthrie	1893	8,000	300	2,300	T., F.R.
*University of Oklahoma, Norman	1892	8,000	1,000	1,200	T., F.R.
Oregon—					
*Oregon State Library, Salem	1850	25,000	500	1,500	T., C. & R.
Portland Library Association	1864	27,456	1,500	5,079	S., C. & R.
Pennsylvania—					
*Academy of Natural Science of Philadelphia	1812	†68,866	647	‡13,665	S., F.R. †Incl. 18,646 pams. ‡1897 rept.
*Carnegie Library, Pittsburg	1895	112,487	29,113	93,739	E. & T., C. & R.
*College of Physicians of Philadelphia	1788	†96,384	2,655	5,169	S., C. & R. †Incl. 37,179 pams.
*Franklin Institute Library, Philadelphia	1824	†87,156	1,579	18,600	E., Sub., C. & R. Science. †Incl. 35,996 pams.
*German Society of Pennsylvania, Philadelphia	1817	51,200	500	746	E., C. & R.
*Lehigh University, South Bethlehem	1877	†112,158	1,350	‡5,590	E., F. & R. †Incl. 30,832 pams. ‡1897 rept.
*Philadelphia Free Library	1891	207,585	22,898	164,000	E. & T., C. & R.
*Philadelphia Library Company	1731	231,184	3,619	43,695	S., C. & R.
Philadelphia Mercantile Library	1821	194,011	2,506	15,000	S., C. & R.
Pennsylvania State Library, Harrisburg	1790	118,000	...	7,500	T., F.R.
*Pittsburg Library Association	1848	†50,000	750	2,500	S., Sub., C. & R. †Incl. 10,000 pams.
*Presbyterian Historical Society, Philadelphia	1852	†70,000	‡300	759	S., F.R. †Incl. 50,000 pams., ‡1897 rept.
University of Pennsylvania	1749	†266,709	9,118	‡1,518	E., C. & R. †Incl. 100,000 pams., ‡1901 rept.
*Wilson's Library, Philadelphia	1875	95,000	5,140	†11,750	Sub., C. †1897 rept.
Rhode Island—					
*Brown University, Providence	1767	†140,000	5,438	15,066	E., C. & R. †Incl. 30,000 pams.
Providence Athenæum	1836	66,711	1,200	9,392	S., C. & R.
*Providence Public Library	1878	†108,723	2,840	135,125	E. & T., C. & R. †Incl. 20,000 pams.
*Rhode Island Historical Society, Providence	1822	†65,000	396	4,456	S. & T., C. & R. †Incl. 45,000 pams.
South Carolina—					
*South Carolina College Library, Columbia	1805	32,783	277	...	T., C. & R.
*South Carolina State Library, Columbia	1816	†75,000	3,000	...	T., C. & R. †Incl. 25,000 pams.
South Dakota—					
*State Agricultural College, Brookings	1885	†14,870	549	675	E., F. & R. †Incl. 95,000 pams.
*State Normal School, Spearfish	1887	14,850	1,000	†1,700	E. & T., C. & R. †1897 rept.
Tennessee—					
*Tennessee State Library, Nashville	†1854	40,000	2,000	1,100	T., F. & R. †1897 rept.
*Vanderbilt University, Nashville	1875	40,000	4,000	2,900	E., Sub , C. & R.
*University of the South, Sewanee	...	42,536	612	1,564	E. Sub., R.
Texas—					
*Texas State Library, Austin	1839	21,800	705	1,990	T., F.R.
*University of Texas, Austin	1884	†44,000	1,800	3,000	E., C. & R. †Incl. 10,000 pams.
Utah—					
*Salt Lake City Free Public Library	1897	14,498	1,661	6,660	T., C. & R.
*University of Utah, Salt Lake City	†1869	‡30,000	1,300	14	T., F.R. †1897 rept. ‡Incl. 10,000 pams.
Vermont—					
*Fletcher Free Library, Burlington	1874	40,000	760	3,165	T., C. & R.
University of Vermont, Burlington	1824	88,217	3,000	4,500	E., C. & R.
Virginia—					
*University of Virginia, Charlottesville	1819	50,694	9,144	450	E. & T., C. & R.
*Virginia State Library, Richmond	1823	98,500	389	†3,000	T., F.R. †1897 rept.
Washington—					
*Seattle Public Library	1891	†31,877	1,952	14,058	T., C. & R. †Incl. 12,000 pams.
*Washington State Library, Olympia	1854	27,000	†2,767	†3,550	T., C. & R. †1897 rept.
West Virginia—					
West Virginia University, Morgantown	1867	16,500	2,200	3,656	E., C. & R., Sub.
*Wheeling Public Library	1882	17,200	1,024	6,720	T., C. & R.
Wisconsin—					
*Milwaukee Public Library	1878	130,184	8,401	48,631	T., C. & R.
*University of Wisconsin, Madison	1850	†83,750	5,150	12,000	T., C. & R. †Incl. 20,000 pams.
*Wisconsin Historical Society, Madison	1854	†215,000	3,560	12,326	T., F.R. †Incl. 105,000 pams.
Wyoming—					
*University of Wyoming, Laramie	1891	†14,800	2,359	4,470	E., C.R. †Incl. 5500 pams.
*Wyoming State Law Library, Cheyenne	1872	15,000	...	...	T., F.R.

(H. P.)

Licata, a seaport town of the province of Girgenti, Sicily, Italy, on the south coast, at the mouth of the river Salso, 24 miles south-east of Girgenti (54 miles by rail). The town, which stands below the level of the sea, is "a very miserable place to look at now, with its nooks and corners, its blind alleys and dark lanes, its dirty, ill-smelling, narrow, crooked streets" (Vice-consul Giglio in 1896). It has a Gothic church, a technical school, and the ruins of two ancient castles; one of these, San Angelo, was bought and repaired by the Italian Government in 1888, and equipped as a signalling tower. The people carry on live-stock breeding, the cultivation of fruits, flowers, and vegetables, cheese-making, sulphur mining and refining, the manufacture of pottery (porous jars) and macaroni, flour-milling, brick- and tile-making, and fish-curing, chiefly anchovies and sardines. Licata is one of the principal Sicilian ports for the exports of sulphur. In 1888 sulphur was exported to the value of £549,000; and £380,150 in 1898. The total exports were valued at £576,600 in 1888; £453,700 in 1899. The total imports fluctuate from £34,000 (1887) to £246,650 (1896); £125,600 in 1899. The port was cleared by an average of 933 vessels of 157,200 tons in the years 1893–99 inclusive. In 1896 the Government voted £66,730 for the improvement of the harbour (10–16 feet deep); and at the same time a concession was granted for the construction of an entirely new harbour, 2 miles from the old one, with every appliance of a first-class port. Population (1881), 17,478; (1899), 23,700.

Lichfield, a city, municipal borough, and county of itself in the Lichfield parliamentary division (since 1885) of Staffordshire, England, 118 miles north-west of London by rail. The restoration of the cathedral has been completed; the old church of St Chad at Stowe and that of St Michael have been restored. The house in which Dr Johnson was born has been acquired by the corporation through the generosity of Alderman Gilbert, and opened to the public in a similar manner to Shakespeare's birthplace at Stratford-on-Avon. Area, 3421 acres. Population (1881), 8349; (1891), 7864; (1901), 7902.

Liddell, Henry George (1811–1898), English scholar and divine, eldest son of the Rev. Henry George Liddell, younger brother of the first Baron Ravensworth, was born at Binchester, 6th February 1811, but his father becoming soon afterwards rector of Boldon, between Newcastle-on-Tyne and Sunderland, most of his childhood and boyhood was passed there. When eight years old he was sent to a private school near Ripon, from which he proceeded at the age of twelve to Charterhouse, and seven years later, May 1830, to Christ Church, Oxford. Gaining a double first in 1833, Liddell became a college tutor, and pursuing the study of divinity, was ordained in 1838. In the same year Dean Gaisford appointed him Greek reader in Christ Church, and in May 1846 he was appointed to the headmastership of Westminster School. Meanwhile his life work, the great *Lexicon* (based on the German work of Passow), which he and Robert Scott began as early as 1834, had made good progress, and after about ten years of hard work the first edition, which may more properly be termed the first draft, appeared in 1843. It immediately became the standard Greek-English dictionary and still maintains this rank, although, notwithstanding the great additions made of late to our Greek vocabulary from inscriptions, papyri, and other sources, scarcely any enlargement has been made since about 1880. It is nevertheless understood that Dean Liddell continued to labour upon it almost to the last day of his long life. As headmaster of Westminster Liddell enjoyed a period of great success, followed by trouble due to the outbreak of fever and cholera in the school. When this was over he found time to write a *History of Ancient Rome*, and to take a very active part in the first Oxford University Commission. In 1855 he received the appointment of dean of Christ Church, with which his name will always be connected. His tall figure, fine presence, and aristocratic mien were for many years associated with all that was characteristic of Oxford life. Coming just at the transition period when the "old Christ Church," which Pusey strove so hard to preserve, was inevitably becoming broader and more liberal, it was chiefly due to Liddell that necessary changes were effected with the minimum of friction. With the buildings of Christ Church also his name will long be associated, especially with the much-needed restoration of the cathedral and the improvement of the services. In 1859 Dean Liddell welcomed the then prince of Wales when he matriculated at Christ Church, being the first holder of that title who had matriculated since Henry V. In conjunction with Sir Henry Acland, Dean Liddell did much to encourage the study of art at Oxford, and his taste and judgment gained him the admiration and friendship of Ruskin. In 1891, owing to advancing years, he resigned the deanery. The last years of his life were spent at Ascot, where he died 18th January 1898. Dean Liddell married in July 1846 Miss Lorina Reeve, by whom he had a numerous family.

Liddon, Henry Parry (1829–1890), English divine, was born at North Stoneham, Hampshire, on 20th August 1829. He was educated at King's College School, London, and at Christ Church, Oxford. He graduated, taking a second class, in 1850. In 1854 he was made vice-principal of the Theological College at Cuddesdon. His influence over the students was immense, and his sermons held some ten or twelve hearers as much enthralled as they afterwards did the vast congregations in St Paul's Cathedral. In 1859 he resigned the vice-principalship, in consequence of some divergence of opinion between him and Bishop Wilberforce. He returned to Oxford, and became a growing force there among the undergraduates, exercising his influence in strong opposition to the Liberal reaction against Tractarianism, which had set in after Newman's secession in 1845. In 1864 Bishop Hamilton of Salisbury, whose examining chaplain he had been, appointed him prebendary of Salisbury Cathedral. In 1866 he delivered his famous Bampton Lectures, in which, with a wide range of general knowledge, with remarkable clearness, brilliancy, and logical coherence, as well as with a considerable store of theological learning, he enforced and illustrated the doctrine of the Divinity of Christ. From that time his fame as a preacher, which had been steadily growing, may be considered to have been established. In 1870 he was made canon of St Paul's. He had before this published *Some Words for God*, in which, with great power and eloquence, he combated the scepticism of the day. His preaching at St Paul's soon attracted vast crowds. The afternoon sermon, which fell to the lot of the canon in residence, had usually been delivered in the choir of the Cathedral. But soon after Liddon's appointment it became necessary to preach the sermon under the dome, where as many as 4000 persons, it was estimated, used to gather to hear the preacher. Few orators belonging to the Church of England have acquired so great a reputation as Canon Liddon. Others may have surpassed him in originality, learning, or reasoning power. But for grasp of his subject, clearness of language, lucidity of arrangement, felicity of illustration, vividness of imagination, elegance of diction, and above all, for sympathy with the intellectual position of those whom he addressed, he has hardly a rival among the celebrated preachers of the Anglican communion. In the elaborate arrangement of his matter he is thought to have imitated the great French preachers of the age of Louis XIV. In 1870 he was also made Ireland Professor of Exegesis at Oxford. These two appointments combined gave him extensive influence over the Church of England. Liddon at Oxford, and Liddon and Church at St Paul's, may be said to have restored the waning influence of the Tractarian school, and the former succeeded in popularizing the opinions which, in the hands of Pusey and Keble, had appealed to thinkers and scholars. Some clouds in connexion with the Pusey House at Oxford, where Liddon considered that a departure was being made from the line of thought laid down by Pusey himself, disturbed the repose of his later days. Illness seized him in 1889, and on 9th September 1890 he passed away at Weston-super-Mare, in the full vigour of his intellect and at the zenith of his reputation. He had undertaken an elaborate life of Dr Pusey, for whom his admiration was unbounded; and this work was completed after his death by other hands. Canon Liddon's character was as much a force as his eloquence. His strong advocacy of Church views, which were somewhat "advanced," raised up a host of opponents and critics. But there was none who could fail to entertain respect for his honesty, sincerity, and devotion, as well as for a combination of personal gifts only too rarely found in any branch of the Church. (J. J. L*.)

Lie, Jonas Lauritz Edemil (1833-——), Norwegian novelist, was born on 6th November 1833 close to Hougsund (Eker), near Drammen. In 1838, his father being appointed sheriff of Tromsö, the family removed to that Arctic town. Here the future novelist enjoyed an untrammelled childhood among the shipping of the little Nordland capital, and gained acquaintance with the wild seafaring life which he was afterwards to describe. In 1846 he was sent to the naval school at Frederiksværn to become a cadet, but his extreme near-sight unfitted him for service, and he was transferred to the Latin school at Bergen. In 1851 he went up to the University of Christiania, where Ibsen and Björnson were among his fellow-students. Jonas Lie, however, showed at this time no inclination to literature. He pursued his studies as a lawyer, took his degrees in law in 1858, and settled down to practice as a solicitor in the little town of Kongsvinger. In 1860 he married his cousin, Thomasine Lie. In 1866 Lie published his first book, a volume of poems. Two years later, at the mature age of thirty-five, he abandoned the law, and came back to Christiania to try his luck as a man of letters. As a journalist he had no success, but in 1870 he published a melancholy little romance, *The Man with the Second Sight*, which enjoyed some favour with the public. Lie proceeded to Rome, and published *Tales* in 1871, and *The Three-master "The Future,"* a novel, in 1872. His first great book, however, was *The Pilot and his Wife* (1874), which placed Jonas Lie at the head of Norwegian novelists; it was written in the little town of Rocca di Papa in the Albano mountains. Lie spent the next few years partly in Dresden, partly in Stuttgart, with frequent summer excursions to Berchtesgaden in the Bavarian highlands. During his exile he produced the drama in verse called *Faustina Strozzi* (1876). Returning to Norway, Lie began a series of romances of modern life in Christiania, of which *Thomas Ross* (1878) and *Adam Schrader* (1879) were the earliest. He returned to Germany, and settled first in Dresden again, then in Hamburg, until 1882, when he took up his abode finally in Paris. The novels of his German period are *Rutland* (1881) and *Go Ahead!* (1882), tales of life in the Norwegian merchant navy. His later works, produced with great regularity, have enjoyed an immense reputation in Norway. Two of the most successful of these have been *The Commodore's Daughters* (1886) and *Niobe* (1894), both of which have been presented to English readers in the International Library, edited by Mr Gosse. One of the best of Lie's works is the romance called *When the Sun goes down* (1895). It has been said that "Jonas Lie stands, as a novelist, with those minute and unobtrusive painters of contemporary manners who defy arrangement in this or that school. He is with Mrs Gaskell or M. Ferdinand Fabre; he is not entirely without relation with that old-fashioned favourite of the public, Fredrika Bremer. His truthfulness, his simple pathos, his deep moral sincerity, have gradually conquered for him a place in the hearts of his countrymen and countrywomen which there is no one to dispute with him." He is by far the most popular of the living novelists of Norway. Among his later works must be mentioned the powerful novel of *Dyre Rein* (1896), the fairy drama of *Lindelin* (1897), *Faste Forland* (1899), a romance, and *When the Iron Curtain falls* (1902). Jonas Lie has resided for many years in Paris, spending every summer in his villa at Berchtesgaden in Tirol.

Lie, Marius Sophus (1842-1899), Norwegian mathematician, was born at Nordfjordeif, near Bergen, on 12th December 1842, and was educated at the University of Christiania, where he took his doctor's degree in 1868 and became extraordinary professor of mathematics four years later. In 1886 he was chosen to succeed Klein in the chair of geometry at Leipzig, but as his fame grew his countrymen began to feel that it was not right that one so distinguished should be obliged to work in a foreign land, and a special post was therefore arranged for him in Christiania. This, however, he did not live to enjoy very long, for his health was broken down by too assiduous study, and he died at Christiania on 12th February 1899, six months after his return. Lie's work exercised a great influence on the progress of mathematical science during the later decades of the 19th century. His primary aim has been declared to be the advancement and elaboration of the theory of differential equations, and it was with this end in view that he developed his theory of transformation groups, set forth in his *Theorie der Transformationsgruppen* (3 vols., Leipzig, 1888-93), a work of wide range and great originality, by which probably his name is best known. A special application of his theory of continuous groups was to the general problem of non-Euclidean geometry. The latter part of the book above mentioned was devoted to a study of the foundations of geometry, considered from the standpoint of Riemann and Helmholtz; and he intended to publish a systematic exposition of his geometrical investigations, in conjunction with Dr G. Scheffers, but only one volume made its appearance (*Geometrie der Beruhrüngstransformationen*, Leipzig, 1896). The reader will find many references to Lie's work scattered through the mathematical articles in these volumes, *e.g.*, DIFFERENTIAL EQUATIONS; GEOMETRY, LINE; GEOMETRY, NON-EUCLIDEAN; GROUPS, THEORY OF. Lie was a foreign member of the Royal Society, as well as an honorary member of the Cambridge Philosophical Society and the London Mathematical Society, and his geometrical inquiries gained him the much-coveted honour of the Lobatchewsky prize.

Lieben, a village and commune in the government district of Karolinenthal, Bohemia, north-east of Prague, and a station on the north-western and the Austro-Hungarian state railways. It immediately adjoins the Karolinenthal suburb, and is a busy industrial centre with numerous textile and other factories, manufacturing among other things chemicals, colours, oil, pipes, gloves, leather, machinery, bricks, tiles, and beer. Population (1890) of the village, 9000, and of its commune, 12,536; (1900), 21,300, almost exclusively Czech and Catholic.

Liebknecht, Wilhelm (1826–1900), German Socialist, was born in Giessen, on 29th March 1826, of a respectable middle-class family. Left an orphan at an early age, he was educated at the gymnasium in his native town, and attended the universities of Giessen, Berlin, and Marburg. Before he left school he had become affected by the political discontent then so universal in Germany; he had already studied the writings of St Simon, from which he gained his first interest in Communism, and had been converted to the extreme Republican theories of which Giessen had long been a centre. He soon came into conflict with the established authorities—no difficult matter in those days—and was expelled from Berlin apparently in consequence of the strong sympathy he displayed for the Poles, who were being tried for high treason. Like so many of his countrymen, he proposed in 1846 to migrate to America, but went instead to Switzerland, where he earned his living as a teacher in the Froebel Institute. As soon as the Revolution of 1848 broke out he hastened to Paris, but the attempt to organize a Republican corps for the invasion of Germany was prevented by the Government. In September, however, in concert with Struve, he crossed the Rhine from Switzerland at the head of a band of volunteers, and proclaimed a Republic in Baden. The attempt collapsed; he was captured, and after suffering eight months' imprisonment, was brought to trial. Fortunately for him, a new rising had just broken out; the mob burst into the court, and he was acquitted. During the short duration of the Revolutionary Government he was an active member of the most extreme party, but on the arrival of the Prussian troops succeeded in escaping to France. Thence he went to Geneva, where he came into intercourse with Mazzini; but, unlike most of the German exiles, he was already an adherent of the Socialist creed, which at that time was more strongly held in France. Expelled from Switzerland, he went to London, where he lived for thirteen years in close association with Karl Marx. Like most of the other exiles, he endured great hardships, but secured a livelihood by teaching and writing; he was a correspondent of the *Augsburger Allgemeine Zeitung*. During his imprisonment in Freiburg he had won the affections of the gaoler's daughter, and in 1856 she came to London, where they were married. The amnesty of 1861 opened for him the way back to Germany, and in 1862 he accepted the post of editor of the *Norddeutsche Allgemeine Zeitung*, the founder of which was an old revolutionist. Only a few months elapsed before the paper passed under Bismarck's influence. There is no more curious episode in German history than the success with which Bismarck acquired the services of many of the men of 1848. Liebknecht remained faithful to his principles, and resigned his editorship. He became a member of the Arbeiterverein, and after Lassalle's death was the chief mouthpiece in Germany of Karl Marx, and was instrumental in spreading the influence of the newly-founded *International*. Expelled from Prussia in 1865, he settled at Leipzig, and it is primarily to his activity in Saxony among the newly-formed unions of workers that the modern Social Democrat party owes its origin. He was in 1867 elected member of the North German Reichstag, but in opposition to Lassalle's followers refused all compromise with the "capitalists," and avowedly used his position merely for purposes of agitation and to take every opportunity for making the Parliament ridiculous. He was strongly influenced by the "great German" traditions of the Democrats of 1848, and, violently anti-Prussian, he distinguished himself by his attacks on the policy of 1866 and the "Revolution from above," and by his opposition to every form of militarism. The traditions of 1848 are also seen in his dread of Russia, which he maintained to his death. His opposition to the war of 1870 (he and Bebel alone refused to vote for the war loan) exposed him to insults and violence, and in 1872, with Bebel, he was condemned to two years' imprisonment in a fortress for treasonable intentions. The union of the German Socialists in 1874 at the Congress of Gotha was really a triumph of his influence, and from that time he was regarded as founder and leader of the party. He was till his death a member at the German Reichstag, and for many years also of the Saxon Parliament. In all debates he was one of the chief spokesmen of the party, and he took a very important part in directing their policy. In 1881 he was expelled from Leipzig, but took up his residence in a neighbouring village. After the lapse of the Socialist law (1890) he became chief editor of the *Vorwärts*, and settled in Berlin. In November 1895 he was condemned to four months' imprisonment for *lèse majesté*. If he did not always find it easy in his later years to follow the new developments, he preserved to his death the idealism of his youth, the hatred both of Liberalism and of State Socialism; and though he was to some extent overshadowed by Bebel's greater oratorical power, he was the chief support of the orthodox Marxian tradition. Liebknecht was the author of numerous pamphlets and books, of which the most important were—*Soll Europa Kosakisch werden? Robert Blum und seine Zeit, Geschichte der Französischen Revolution, Die Emser Depesche*, and *Robert Owen*. He died in Berlin on 6th August 1900.

See also Kurt Eisner. *Wilhelm Liebknecht, sein Leben und Wirken.* Berlin, 1900.

Liechtenstein, the smallest independent state in Europe, save San Marino and Monaco, extending along the right bank of the Rhine, opposite Swiss territory between Sargans and Sennwald, while to the east it also comprises the upper portion of the Samina glen which debouches into the Ill valley at Frastanz, below Feldkirch. It is 12 miles in length, and has an area of 68·8 square miles. Its loftiest point rises on the crest of the Rhätikon range at the south-east angle of the state, and is called the Naafkopf or Rothe Wand (8426 or 8445 feet); on its summit the Swiss, Vorarlberg, and Liechtenstein frontiers join. Population (1886), 9593; (1896), 9600. Compulsory military service was abolished in 1868, and the state now contains more men than women. The capital is Vaduz (1523 feet), which has 1100 inhabitants. Till the 17th century the Romonsch language was not extinguished in the state, and many Romonsch place-names still linger, *e.g.*, Vaduz, Samina, Gavadura, &c. The constitution of 1862 was amended in 1878 and 1895. All males of twenty-four years are primary electors, but the twelve elected members of the Diet (holding their seats for four years) are elected indirectly through a second set of electors. The prince has a lieutenant at Vaduz, whence there is an appeal to the prince's court at Vienna, with (since 1884) a final appeal to the supreme court at Innsbruck. The principality is joined with Vorarlberg from the customs point of view, and with Austria as regards postal and coinage arrangements. The principality is ecclesiastically in the diocese of Coire. It has now no public debt, while in 1899 the receipts amounted to 281,548 florins and the expenses to 281,375 florins. According to the agreement of 1852, by which Liechtenstein made a customs union with Austria, Austria must yearly pay it at least 20,000 florins.

See J. FALKE's *Geschichte d. fürstlichen Hauses Liechtenstein*, 3 vols. Vienna, 1868–83.—P. KAISER. *Geschichte d. Fürstenthums Liechtenstein.* Coire, 1847.—F. UMLAUFT. *Das Fürstenthum Liechtenstein.* Vienna, 1891.—E. WALDER. *Aus den Bergen.* Zürich, 1896.—A. WALTENBERGER. *Algäu, Vorarlberg, und Westtirol* (Rtes. 25 and 26). 8th edition, Innsbruck, 1896.

(W. A. B. C.)

Liège (Flemish, *Luik*), a province of Belgium, bordering on Dutch Limburg, Rhenish Prussia, and the Belgian provinces of Luxembourg, Namur, Brabant, and Limbourg. The province is of very varied character, ranging in altitude from 300 to over 2000 feet, and distributed in part into four quite distinct regions—the highly agricultural Hesbaye, the pastoral Herve, the calcareous Condroz, and the schistose, uneven and picturesque Ardenne. The principal rivers are the Meuse and its affluent the Ourthe. A canal runs laterally by the Meuse from Liège to Maastricht. The mineral productions are important: coal worked at seventy different places and occupying 30,000 workers; zinc and lead ores (250 workers); iron ores (200 workers); building and paving-stone quarries at 240 places, and employing more than 5000 workers. The agricultural products are oats, wheat, potatoes, rye, beetroot. Woods cover 18 per cent. of the area. Agriculture and mining are the two special industries of the province. The metal industry is carried on in every branch: smelting, making of iron, steel, sheet-iron, rails, steam-engines, armoury, &c., employing altogether 40,000 workers, principally in the arrondissement of Liège; the other industries include wool-spinning and the making of woollen stuffs and cloths carried on in the arrondissement of Verviers, and employing 15,000 workers. The making of crystal is also an industry of important dimensions, employing 4400 workers in the arrondissement of Liège. The province is divided into four administrative arrondissements, whose capitals are Liège (173,706 inhabitants); Huy (14,644 inhabitants); Verviers (52,203); Waremme (4000). Among other noteworthy places are Seraing (39,623 inhabitants), near Liège, famous for its vast metallurgic establishment founded in 1817 by John Cockerell, and the pretty town of Spa (8192 inhabitants), well known for its mineral waters. The province of Liège has an area of 1117 square miles, with a population of 851,485, or 762·3 to the square mile. The administrative arrondissement of Liège has the greatest density of population, namely, nearly 1700 inhabitants per square mile. In 1875 the population of the province numbered 645,000, and the increase since that date has been 30 per cent.

Liège, a city in the province of Liège, the seat of a bishopric, at the confluence of the Ourthe with the Meuse, 50° 38′ 48″ N. and 5° 34′ 30″ E. Since 1860 great works have been carried out, which, regulating the course of the river, prevent as far as possible the inundations formerly frequent, and have brought about a complete transformation of the city. Along its whole course through the city the Meuse is bordered by quays. Its banks are connected by six bridges. A canal of very slight fall (*canal de dérivation*), bordered with quays, receives the waters of the Ourthe and conducts them into the Meuse below the city, forming in so doing a long island on the right bank. A magnificent quarter has been laid out on the left bank, on the site of an old dock. Higher instruction is largely represented by a state university (with 1500 students), to which are annexed special institutes of botany, zoology, anatomy, physiology, pharmacy, and chemistry, an electro-technical institute, a school of mines, a school of arts and manufactures, and a rich library. At Liège there are also a Conservatoire de Musique and an observatory. Industry is brisk and flourishing. The characteristic branches are coal-mining (employing 5000 workers), the working of which has had to be stopped in the galleries penetrating under the city and the river, and the manufacture of small arms, more than a million pieces being tried annually on the testing-bench, employing more than 3000 workers in the city, a great number of them working at home. Other industries are the smelting of metals, the making of mechanical works, tools, electrical machines, and railway material. Liège is, moreover, the centre of a considerable number of important industrial localities. Its lines of communication are the Meuse and the canal from Liège to Maastricht, and the railways running to Namur, to Brussels, to Hasselt and Limbourg, to Maastricht and Holland, to Aix-la-Chapelle and Germany, and to Luxembourg. Population (1875), 117,600; (1900), 173,706, an increase in twenty-five years of 47·7 per cent.

Liegnitz, a town of Prussia, province of Silesia, 40 miles west of Breslau by rail. The Lutheran church of St Peter and St Paul was restored in 1892–94. The town has monuments to Frederick the Great (1869), Emperor William I. (1898), and the war of 1870–71; also an agricultural school and a deaf and dumb institute. The growing of vegetables, especially small cucumbers (*gurken*) and onions, is a speciality; other industries are the making of machinery, pianos, sewing-machines, cloth, wool, and artistic turnery. Population (1885), 43,347; (1900), 54,839.

Lien.—The word *lien* is literally the French for a band, cord, or chain, and keeping in mind that meaning we see in what respect it differs from a pledge on the one hand and a mortgage on the other. It is the bond which attaches a creditor's right to a debtor's property, but which gives no right *ad rem, i.e.*, to property in the thing; if the property is in the possession of the creditor he may retain it, but in the absence of statute he cannot sell to recover what is due to him without the ordinary legal process against the debtor; and if it is not in possession, the law would indeed assist him to seize the property, and will hold it for him, and enable him to sell it in due course and pay himself out of the proceeds, but does not give him the property itself. It is difficult to say at what period the term lien made its appearance in English law; it probably came from more than one source. In fact, it was used as a convenient phrase for any right against the owner of property in regard to the property not specially defined by other better recognized species of title.

The possessory lien of a tradesman for work done on the thing, of a carrier for his hire, and of an innkeeper for his bill, would seem to be an inherent right which must have been in existence from the dawn, or before the dawn, of civilization. Probably the man who made or repaired weapons in the Stone Age was careful not to deliver them until he received what was stipulated for, but it is also probable that the term itself resulted from the infusion of the civil law of Rome into the common law of England which the Norman Conquest brought about, and that it represents the "tacit pledge" of the civil law. As might be expected, so far as the possessory lien is concerned, the common law and civil law, and probably the laws of all countries, whether civilized or not, coincide; but there are many differences with respect to other species of lien. For instance, by the common law—in this respect a legacy of the feudal system—a landlord has a lien over his tenant's furniture and effects for rent due, which can be enforced without the assistance of the law simply by the landlord taking possession, personally or by his agent, and selling enough to satisfy his claim; whereas the maritime lien is more distinctly the product of the civil law, and is only found and used in Admiralty proceedings, the High Court of Admiralty having been founded upon the civil law, and still (except so far as restrained by the common law courts prior to the amalgamation and co-ordination of the various courts by the Judicature Acts, and as affected by statute law) acting upon it. The peculiar effects of this maritime lien are discussed below. There is also a class of liens, usually called equitable liens (*e.g.*, that of an unpaid vendor of real property over the property sold), which are akin to the nature of the civil law rather than of the common law. The word lien does not frequently occur in statute law, but it is found in the extension of the common law "carriers' or shipowners' lien" in the Merchant Shipping Act, 1894; in the definition, extension, and limitation of the vendor's lien; in the Factors Act, 1877, and the Sale of Goods Act, 1893; in granting a maritime lien to a shipmaster for his wages and disbursements, and in regulating that of the seamen in the Merchant Shipping Act, 1894; and in the Equity jurisdiction of the County Courts, 1888.

Common-Law Liens.—These may be either particular, *i.e.*, a right over one or more specified articles for a particular debt, or general, *i.e.*, for all debts owing to the creditor by the debtor.

The requisites for a particular lien are, firstly, that the creditor should be in possession of the article; secondly, that the debt should be incurred with reference to the article; and thirdly, that the amount of the debt should be certain. It may be created by express contract, by implied contract (such as the usage of a particular trade or business), or as a consequence of the legal relation existing between the parties. As an example of the first, a shipowner at common law has a lien on the cargo for the freight; but though the shipper agrees to pay dead freight in addition, *i.e.*, to pay freight on any space in the ship which he fails to occupy with his cargo, the shipowner has no lien on the cargo for such dead freight except by express agreement. The most usual form of the second is that which is termed a possessory lien—the right a ship-repairer has to retain a ship in his yard till he is paid for the repairs executed upon her,[1] and the right a cobbler has to retain a pair of shoes till he is paid for the repairs done to them. But this lien is only in respect of the work done on, and consequent benefit received by, the subject of the lien. Hence an agistor of cattle has no lien at common law upon them for the value of the pasturage consumed, though he may have one by agreement; nor a conveyancer upon deeds which he has not drawn, but which are in his possession for reference. The most common example of the third is that of a carrier, who is bound by law to carry for all persons, and has therefore a lien for the price of the carriage on the goods carried. So much favoured is this lien that it has been held that even if the goods are stolen, and entrusted to the carrier by the thief, the carrier can hold them for the price of the carriage against the rightful owner. Of the same nature is the common-law lien of an innkeeper on the baggage of his customer for the amount of his account, he being under a legal obligation to entertain travellers generally. Another instance of the same class is where a person has obtained possession of certain things over which he claims to hold a lien in the exercise of a legal right. For example, when a lord of a manor has seized cattle as estrays, he has a lien upon them for the expense of their keep as against the real owner; but, as before pointed out, the holder's claim must be specific, otherwise a general tender of compensation releases the lien.

A general lien is a right of a creditor to retain property, not merely for charges relating to it specifically, but for debts due on a general account. This not being a common-law right, is viewed by the English courts with the greatest jealousy, and to be enforced must be strictly proved. This can be done by proof either of an express or implied contract or of a general usage of trade. The first of these is established by the ordinary methods or by previous dealings between the parties on such terms; the second is recognized in certain businesses, and it would probably be exceedingly difficult, if not impossible, to extend it at the present time to any other trades. When, however, a lien by general usage has once been judicially established, it becomes part of the Law Merchant, and the courts are bound to recognize and enforce it. The best known and most important instance is the right of a solicitor to retain papers in his hands belonging to his client until his account is settled. The solicitor's lien, though probably more commonly enforced than any other, is of no great antiquity in English law, the earliest reported case of it being in the reign of James II.; but it is now of a twofold nature. In the first place there is the retaining lien. This is similar in kind to other possessory liens, but of a general nature attaching to all papers of the client, and even to his money, up to the amount of the solicitor's bill, in the hands of the solicitor in the ordinary course of business. There are certain exceptions which seem to have crept in for the same reason as the solicitor's lien itself, *i.e.*, general convenience of litigation; such exceptions are the will of the client after his decease, and proceedings in bankruptcy. In this latter case the actual possessory lien is given up, the solicitor's interests and priorities being protected by the courts, and it may be said that the giving up the papers is really only a means of enforcing the lien they give in the bankruptcy proceedings. In the second place there is what is called a charging lien—more correctly classed under the head of equitable lien, since it does not require possession, but is a lien the solicitor holds over property recovered or preserved for his client. He had the lien on an order by the court upon a fund in court by the common law, but as to property generally it was only given by 23 and 24 Vict. c. 127, § 28; and it has been held to attach to property recovered in a probate action (*ex parte* Tweed, C. A. 1899, 2 Q.B. 167). A banker's lien is the right of a banker to retain securities belonging to his customer for money due on a general balance. Other general liens, which have been judicially established, are those of wharfingers, brokers, and factors (which are in their nature akin to those of solicitors and bankers), and of calico printers, packers of goods, fullers (at all events at Exeter), dyers, and millers; but in all these special trades it is probable that the true reason is that the account due was for one continuous transaction. The calico would come to be printed, the goods to be packed, the cloth to be bleached, the silk to be dyed, and the corn to be ground, in separate parcels, it is true, and at different times, but all as one undertaking; and they are therefore, though spoken of as instances of general lien, only adaptations by the courts of the doctrine of particular lien to special peculiarities of business. In none of these cases would the lien exist, in the absence of special agreement, for other matters of account, such as money lent or goods sold.

Equitable Liens.—"Where equity has jurisdiction to enforce rights and obligations growing out of an executory contract," *e.g.*, in a suit for specific performance, "this equitable theory of remedies cannot be carried out unless the notion is admitted that the contract creates some right or interest in or over specific property, which the decree of the court can lay hold of, and by means of which the equitable relief can be made efficient. The doctrine of equitable liens supplies this necessary element; and it was introduced for the sole purpose of furnishing a ground for these specific remedies which equity confers, operating upon particular identified property instead of the general pecuniary recoveries granted by courts of common law. It follows therefore that in a large class of executory contracts express and implied, which the common law regards as creating no property, right, nor interest analogous to property, but only a mere personal right to obligation, equity recognizes in addition to the personal obligation a particular right over the thing with which the contract deals, which it calls a *lien*, and which though not property is analogous to property, and by means of which the plaintiff is enabled to follow the identical thing and to enforce the defendant's obligation by a remedy which operates directly on the thing. The theory of equitable liens has its ultimate foundation, therefore, in contracts express or implied which either deal with or in some manner relate to specific property, such as a tract of land, particular chattels or securities, a certain fund, and the like. It is necessary to divest oneself of the purely legal notion concerning the effects of such contracts, and to recognize the fact that equity regards them as creating a charge upon, or hypothecation of, the specific thing, by means of which the personal obligation arising from the agreement may be more effectively enforced than by a mere pecuniary recovery at law" (Pomeroy, 2 Eq. Jur. 232). This description from an American text-book seems to give at once the fullest and most concise definition and description of an equitable lien. It will be seen that it differs essentially from a common-law lien, inasmuch as in the latter possession or occupation is as a rule necessary for its existence, whereas in the equitable lien the person claiming the lien is seldom in possession or occupation of the property, its object being to obtain the possession wholly or partially. A special instance of such a lien is that claimed by a publisher over the copyright of a book which he has agreed to publish on terms which are not complied with—for example, the author attempting to get the book published elsewhere. It cannot perhaps be said that this has been absolutely decided to exist, but a strong opinion of the English Court of Exchequer towards the close of the 18th century was expressed in its favour (*Brook* v. *Wentworth*, 3 Anstruther 881). Other instances are the charging lien of a solicitor, already referred to, and the lien of a person on improvements effected by him on the property of another who "lies by" and allows the work to be done before claiming the property. So also of a trustee for expenses lawfully incurred about the trust property. The power of a limited liability company to create a lien upon its own shares was in 1901 established (*Allen* v. *Gold Reefs, &c.*, C.A. [1900] 1 Ch. 656).

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[1] This right, however, is not absolute, but depends on the custom of the port (*Raitt* v. *Mitchell*, 4 Camp. 146).

Maritime Liens.—Maritime lien differs from all the others yet considered, in its more elastic nature. Where a maritime lien has once attached to property—and it may and generally does attach without possession—it will continue to attach, unless lost by laches, so long as the thing to which it attaches exists, notwithstanding changes in the possession of and property in the thing, and notwithstanding that the new possessor or owner may be entirely ignorant of its existence; and even if enforced it leaves the owner's personal liability for any balance unrealized intact (the *Gemma*, 1899, P. 285). So far as England is concerned, it must be borne in mind that the Courts of Admiralty were conducted in accordance with the principles of civil law, and in that law both the pledge with possession and the hypothecation without possession were well recognized. The extreme convenience of such a right as the latter with regard to such essentially movable chattels as ships is apparent. Strictly speaking, a maritime lien is confined to cases arising in those matters over which the Courts of Admiralty had original jurisdiction, viz., collisions at sea, seamen's wages, salvage, and bottomry, in all of which cases the appropriate remedy is a proceeding *in rem* in the Admiralty Court. In the first of these—collisions at sea—if there were no maritime lien there would frequently be no remedy at all. When two ships have collided at sea it may well be that the innocent ship knows neither the name nor the nationality of the wrongdoer, and the vessel may escape with slight damage and not have to make a port of refuge in the neighbourhood. Months afterwards it is ascertained that she was a foreign ship, and in the interval she has changed owners. Then, were it not a fact that a maritime lien invisible to the wrongdoer nevertheless attaches itself to his ship at the moment of collision, and continues to attach, the unfortunate owner of the innocent ship would have no remedy, except the doubtful one of pursuing the former owner of the wrong-doing vessel in his own country in a personal action where such proceedings are allowed—which is by no means the case in all foreign countries. The same reasons apply, though not possibly with quite the same force, to the other classes of cases mentioned.

Between 1840 and 1873 the jurisdiction of the Admiralty Court was largely extended. At the latter date it ceased to exist as a separate court, and was merged in the Probate, Divorce, and Admiralty division of the High Court of Justice. Since the merger questions have arisen as to how far the enlargement of jurisdiction has extended the principle of maritime lien. An interesting article on this subject by J. Mansfield, barrister-at-law, will be found in the *Law Quarterly Review*, vol. iv., October 1888. It must be sufficient to state here that where legislation has extended the already existing jurisdiction to which a maritime lien pertained, the maritime lien is extended to the subject matter, but that where a new jurisdiction is given, or where a jurisdiction formerly existing without a maritime lien is extended, no maritime lien is given, though even then the extended jurisdiction can be enforced by proceedings *in rem.* Of the first class of extended jurisdictions are collisions, salvage, and seamen's wages. Prior to 1840 the Court of Admiralty only had jurisdiction over these when occurring or earned on the high seas. The jurisdiction, and with it the maritime lien, is extended to places within the body of a county in collision or salvage; and as to seamen's wages, whereas they were dependent on the earning of freight, they are now free from any such limitation; and also, whereas the remedy *in rem* was limited to seamen's wages not earned under a special contract, it is now extended to all seamen's wages, and also to a master's wages and disbursements, and the maritime lien covers all these. The new jurisdiction given over claims for damage to cargo carried into any port in England or Wales, and on appeal from the county courts over all claims for damage to cargo under £300, though it may be prosecuted by proceedings *in rem, i.e.*, by arrest of the ship, yet confers no maritime lien; and so also in the case of claims by material men (builders and fitters-out of ships) and for necessaries. Even though in the latter case the Admiralty Court had jurisdiction previously to 1840 where the necessaries were supplied on the high seas, yet as it could not be shown that such jurisdiction had ever been held to confer a maritime lien, no such lien is given. Even now there is much doubt as to whether towage confers a maritime lien or not, the services rendered being pursuant to contract, and frequently to a contract made verbally or in writing on the high seas, and being rendered also to a great extent on the high seas. In these cases and to that extent the High Court of Admiralty would have had original jurisdiction. But prior to 1840 towage, as now rendered by steam tugs expressly employed for the service, was practically unknown, and therefore there was no established catena of precedent to show the exercise of a maritime lien. It may be argued on the one hand that towage is only a modified form of salvage, and therefore entitled to a maritime lien, and on the other that it is only a form of necessary power supplied like a new sail or mast to a ship to enable her to complete her voyage expeditiously, and therefore of the nature of necessaries, and as such not entitled to a maritime lien. The matter is not of academical interest only, for though in the case of an inward-bound ship the tug owner can make use of his statutory right of proceeding *in rem*, and so obtain much of the benefit of a maritime lien, yet in the case of an outward-bound ship, if she once gets away without payment, and the agent or other authorized person refuses or is unable to pay, the tug owner's claim may very likely, on the return of the ship to a British port, be met by an allegation of a change of ownership, which defeats his right of proceeding at all if he has no maritime lien; whereas if he has a maritime lien he can still proceed against the ship and recover his claim, if he has not been guilty of laches.

A convenient division of the special liens other than possessory on ships may be made by classifying them as maritime, statutory-maritime or quasi-maritime, and statutory. The first attach only in the case of damage done by collision between ships on the high seas, salvage on the high seas, bottomry, and seamen's wages so far as freight has been earned; the second attach in cases of damage by collision within the body of a county, salvage within the body of a county, life salvage everywhere, seamen's wages even if no freight has been earned, master's wages and disbursements. These two classes continue to attach notwithstanding a change of ownership without notice of the lien, if there have been no laches in enforcing it (the *Bold Buccleuch*, 7 Moo. P.C. 267; the *Kong Magnus*, 1891, P. 233). The third class, which only give a right to proceed *in rem*, *i.e.*, against the ship itself, attach, so long as there is no *bonâ fide* change of ownership, without citing the owners, in all cases of claims for damage to ship and of claims for damage to cargo where no owner is domiciled in England or Wales. Irrespective of this limitation, they attach in all cases not only of damage to cargo, but also of breaches of contract to carry where the damage does not exceed £300, when the suit must be commenced in a county court having Admiralty jurisdiction; and in cases of claims for necessaries supplied elsewhere than in the ship's home port, for wages earned even under a special contract by masters and mariners, and of claims for towage. As already observed, it is still doubtful whether the lien for towage is not, in some cases at all events, within the former classes. In all three classes the lien also exists over cargo where the suit from its nature extends to it, as in salvage and in some cases of bottomry or respondentia, and in cases where proceedings are taken against cargo by the shipowner for a breach of contract (cargo *ex Argos* and the *Hewsons*, L.R., 5 P.C. 134; the *Alina*, 5 Ex. Div. 227).

Elsewhere than in England, and those countries such as the United States which have adopted her jurisprudence in maritime matters generally, the doctrine of maritime lien, or that which is substituted for it, is very differently treated. Speaking generally, those states which have adopted the Napoleonic codes or modifications of them—France, Italy, Spain, Holland, Portugal, Belgium, Greece, Turkey, and to some extent Russia—have instead of a maritime lien the civil-law principle of privileged debts. Amongst these in all cases are found claims for salvage, wages, bottomry under certain restrictions, and necessaries. Each of these has a privileged claim against the ship, and in some cases against freight and cargo as well, but it is a matter of very great importance that, except in Belgium, a claim for collision damage (which as we have seen confers a maritime lien, and one of a very high order, in Great Britain) confers no privilege against the wrong-doing ship, whilst in all these countries an owner can get rid of his personal liability by abandoning the ship and freight to his creditor, and so, if the ship is sunk, escape all liability whilst retaining any insurance there may be. This, indeed, was at one time the law of Great Britain; the measure of damage was limited by the value of the *res;* and in the United States at the present time a shipowner can get rid of his liability for damage by abandoning the ship and freight. A different rule prevails in Germany and the Scandinavian states. There claims relating to the ship, unless the owner has specially rendered himself liable, confer no personal claim at all against him. The claim is limited *ab initio* to ship and freight, except in the case of seamen's wages, which do confer a personal claim so far as they have been earned on a voyage or passage completed prior to the loss of the ship. In all maritime states, however, except Spain, a provisional arrest of the ship is allowed, and thus between the privilege accorded to the debt and the power to arrest till bail is given or the ship abandoned to creditors, a condition of things analogous to the maritime lien is established; especially as these claims when the proper legal steps have been taken to render them valid—usually by endorsement on the ship's papers on board, or by registration at her port of registry—attach to the ship and follow her into the hands of a purchaser. They are in fact notice to him of the incumbrance.

Duration of Lien.—So long as the party claiming the lien at common law retains the property, the lien continues, notwithstanding the debt in respect of which it is claimed becoming barred by the Statute of Limitations (*Higgins* v. *Scott*, 2 B. and Ald. 413). But if he takes proceedings at law to recover the debt, and on a sale of the goods to satisfy the judgment purchases them himself, he so alters the nature of the possession that he loses his lien (*Jacobs* v. *Lawton*, 5 Bing. 130). An equitable lien probably in all cases continues, provided the purchaser of the subject matter has notice of the lien at the time of his purchase. A maritime lien is in no respect subject to the Statute of Limitations, and continues in force notwithstanding a change in the ownership of the property without notice, and is only terminated when it has once attached, by laches on the part of the person claiming it (the *Kong Magnus*, 1891, P. 223). There is an exception in the case of seamen's wages, where by 4 Anne c. 16 (*Stat. Rev.* 4 and 5 Anne c. 3) all suits for seamen's wages in the Admiralty must be brought within six years.

Ranking of Maritime Liens.—It is clear from what has been said that at times there may be several claimants holding maritime and other liens on the same vessel. For example, a foreign vessel comes into collision by her own fault and is damaged and her cargo also; she is assisted into port by salvors and ultimately under a towage agreement, and put into the hands of a shipwright who does necessary repairs. The innocent party to the collision has a maritime lien for his damage, and the seamen for their wages; the cargo owner has a suit *in rem* or a statutory lien for damage, and the shipwright a possessory lien for the value of his repairs, while the tugs certainly have a right *in rem* and possibly a maritime lien also in the nature of salvage. It is highly probable that the value of the property will be insufficient to pay all, and it becomes a matter of great consequence to settle whether any, and if so which, have priority over the others, or whether all rank alike and have to divide the proceeds of the property *pro ratâ* amongst them. The following general rules apply: liens for benefits conferred rank against the fund in the inverse, and those for the reparation of damage sustained in the direct order of their attaching to the *res ;* as between the two classes those last mentioned rank before those first mentioned of earlier date; as between liens of the same class and the same date, the first claimant has priority over others who have not taken action. The Courts of Admiralty, however, allow equitable considerations, and enter into the question of marshalling assets. For example, if one claimant has a lien on two funds, or an effective right of action in addition to his lien, and another claimant has only a lien upon one fund, the first claimant will be obliged to exhaust his second remedy before coming into competition with the second. As regards possessory liens, the shipwright takes the ship as she stands, *i.e.*, with her incumbrances, and it appears that the lien for seamen's wages takes precedence of a solicitor's lien for costs, under a charging order made in pursuance of 23 and 24 Vict. c. 127, § 28. Subject to equitable considerations, the true principle appears to be that services rendered under an actual or implied contract, which confer a maritime lien, make the holder of the lien in some sort a proprietor of the vessel, and therefore liable for damage done by her—hence the priority of the damage lien—but, directly it has attached, benefits conferred on the property by enabling it to reach port in safety benefit the holder of the damage lien in common with all other prior holders of maritime liens. It is less easy to see why of two damage liens the earlier should take precedence of the later, except on the principle that the *res* which came into collision the second time is depreciated in value by the amount of the existing lien upon her for the first collision, and where there was more than one damage lien, and also liens for benefits conferred prior to the first collision between the two collisions and subsequent to the second, the court would have to make a special order to meet the peculiar circumstances, which happily do not often occur. The claim of a mortgagee naturally is deferred to all maritime liens, whether they are for benefits conferred on the property in which he is interested or for damage done by it, and also for the same reason to the possessory lien of the shipwright, but both the possessory lien of the shipwright and the claim of the mortgagee take precedence over a claim for necessaries, which, as we have seen, only confers a statutory lien or a right to proceed *in rem* in certain cases. In other maritime states possessing codes of commercial law, the privileged debts are all set out in order of priority in these codes, though, as has been already pointed out, the lien for damage by collision—the most important in English law—has no counterpart in most of the foreign codes.

Stoppage in Transitu.—This is a lien held by an unpaid vendor in certain cases over goods sold after they have passed out of his actual possession. It has been much discussed whether it is an equitable or common-law right or lien. The fact appears to be that it has always been a part of the Law Merchant, which, properly speaking, is itself a part of the common law of England unless inconsistent with it. This particular right was, in the first instance, held by a court of equity to be equitable and not contrary to English law, and by that decision this particular part of the Law Merchant was approved and became part of the common law of England (see per Lord Abinger in *Gibson* v. *Carruthers*, 8 M. and W., p. 336 *et seq.*). It may be described as a lien by the Law Merchant, decided by equity to be part of the common law, but in its nature partaking rather of the character of an equitable lien than one at common law. "It is a right which arises solely upon the insolvency of the buyer, and is based on the plain reason of justice and equity that one man's goods shall not be applied to the payment of another man's debts. If therefore, after the vendor has delivered the goods out of his own possession and put them in the hands of a carrier for delivery to the buyer, he discovers that the buyer is insolvent, he may re-take the goods if he can before they reach the buyer's possession, and thus avoid having his property applied to paying debts due by the buyer to other people" (*Benjamin on Sales*, 2nd edition, 289). This right, though only recognized by English law in 1690, is highly favoured by the courts on account of its intrinsic justice, and extends to quasi-vendors, or persons in the same position, such as consignors who have bought on behalf of a principal and forwarded the goods, and other similar cases. It is, however, defeated by a lawful transfer of the document of title to the goods by the vendor to a third person, who takes it *bonâ fide* and for valuable consideration (Factors Act, 1889; Sale of Goods Act, 1893).

Assignment or Transfer of Lien.—A lien being a personal right acquired in respect of personal services, it cannot, as a rule, be assigned or transferred; but here again there are exceptions. The personal representative of the holder of a possessory lien on his decease would probably in all cases be held entitled to it; and it has been held that the lien over a client's papers remains with the firm of solicitors notwithstanding changes in the constitution of the firm (*Gregory* v. *Cresswell*, 14 L.J. Ch. 300). So also where a solicitor, having a lien on documents for his costs, assigned the debt to his bankers with the benefit of the lien, it was held that the bankers might enforce such lien in equity. But though a tradesman has a lien on the property of his customer for his charges for work done upon it, where the property is delivered to him by a servant acting within the scope of his employment, such lien cannot be transferred to the servant, even if he has paid the money himself; and the lien does not exist at all if the servant was acting without authority in delivering the goods, except where (as in the case of a common carrier) he is bound to receive the goods, in which case he retains his lien for the carriage against the rightful owner. On the other hand, where there is a lien on property of any sort not in possession, a person acquiring the property with knowledge of the lien takes it subject to such lien. This applies to equitable liens, and cannot from the nature of the case apply to those common-law liens in which possession is necessary. It is, however, true that by statute certain common-law liens can be transferred, *e.g.*, under the Merchant Shipping Act a master of a ship having a lien upon cargo for his freight can transfer the possession of the cargo to a wharfinger, and with it the lien (Merchant Shipping Act, 1894, § 494). In this case, however, though the matter is simplified by the statute, if the wharfinger was constituted the agent or servant of the shipmaster, his possession would be the possession of the shipmaster, and there would be no real transfer of the lien; therefore the common-law doctrine is not altered, only greater facilities for the furtherance of trade are given by the statute, enabling the wharfinger to act in his own name without reference to his principal, who may be at the other side of the world. So also a lien may be retained, notwithstanding that the property passes out of possession, where it has to be deposited in some special place (such as the Custom-

House) to comply with the law. Seamen cannot sell or assign or in any way part with their maritime lien for wages (Merchant Shipping Act, 1894, § 156), but nevertheless, with the sanction of the Court, a person who pays seamen their wages is entitled to stand in their place and exercise their rights (the *Cornelia Henrietta*, L.R. 1 A. and E. 51).

Waiver.—Any parting with the possession of goods is in general a waiver of the lien upon them; for example, when a factor having a lien on the goods of his principal gives them to a carrier to be carried at the expense of his principal, even if undisclosed, he waives his lien, and has no right to stop the goods *in transitu* to recover it; so also where a coach-builder who has a lien on a carriage for repairs allows the owner from time to time to take it out for use without expressly reserving his lien, he has waived it, nor has he a lien for the standage of the carriage except by express agreement, as mere standage does not give a possessory lien. It has even been held that where a portion of goods sold as a whole for a lump sum has been taken away and paid for proportionately, the conversion has taken place and the lien for the residue of the unpaid purchase-money has gone (*Gurr* v. *Cuthbert*, 12 L.J. Ex. 309). Again, an acceptance of security for a debt payable at a future date is inconsistent with the existence of a lien, as it substitutes the credit of the owner for the material guarantee of the thing itself, and so acts as a waiver of the lien. For the same reason even an agreement to take security is a waiver of the lien, though the security is not, in fact, given (*Alliance Bank* v. *Broon*, 11 L.T. 332).

Sale of Goods under Lien.—At common law the lien, as already pointed out, only gives a right to retain the goods, and ultimately to sell by legal process, against the owner; but in certain cases a right has been given by statute to sell without the intervention of legal process, such as the right of an innkeeper to sell the goods of his customer for his unpaid account (Innkeepers Act, 1878, § 1), the right of a wharfinger to sell goods entrusted to him by a shipowner with a lien upon them for freight, and also for their own charges (Merchant Shipping Act, 1894, §§ 497, 498), and of a railway company to sell goods for their charges (Railway Clauses Act, 1845, § 97). Property affected by an equitable lien or a maritime lien cannot be sold by the holder of the lien without the interposition of the Court to enforce an order, or judgment of the Court. In Admiralty cases, where a sale is necessary, no bail having been given and the property being under arrest, the sale is usually made by the marshal in London, but may be elsewhere on application of the parties concerned showing that a better price is likely to be obtained.

American Law.—In the United States, speaking very generally, the law relating to liens is that of England, but there are some considerable differences occasioned by three principal causes. (1) Some of the Southern states, notably Louisiana, have never adopted the common law of England as their own. When that state became one of the United States of North America it had (and still preserves) its own system of law. In this respect the law is practically identical with the Code Napoleon, which, again speaking generally, substitutes privileges for liens, *i.e.*, gives certain claims a prior right to others against particular property. These privileges being *strictissimæ interpretationis*, cannot be extended by any principle analogous to the English doctrine of equitable liens. (2) Probably in consequence of the United States and the several states composing it having had a more democratic government than Great Britain, until at all events recent years, certain liens have been created by statute in several states in the interest of the working classes which have no parallel in Great Britain: *e.g.*, in some states workmen employed in building a house or a ship have a lien upon the building or structure itself for their unpaid wages. This statutory lien partakes rather of the nature of an equitable than of a common-law lien, as the property is not in the possession of the workman, and it may be doubted whether the right thus conferred is more beneficial to the workman than the priority his wages have in bankruptcy proceedings in England. Some of the states have also practically extended the maritime lien to matters over which it was never contended for in England. (3) By the constitution of the United States the Admiralty and inter-state jurisdiction is vested in the Federal as distinguished from the state courts, and these Federal courts have not been liable to have their jurisdiction curtailed by prohibition from courts of common law, as the Court of Admiralty had in England up to the time of the Judicature Acts; consequently the maritime lien in the United States extends farther than it does in England, even after recent enlargements; that is to say, it covers claims for necessaries and by material men (see *Maritime Lien*), as well as collision, salvage, wages, bottomry, and damage to cargo.

Difficulties connected with lien occasionally arise in the Federal courts in Admiralty cases, from a conflict on the subject between the municipal law of the state where the court happens to sit and the admiralty law; but as there is no power to prohibit the Federal court, its view of the admiralty law based on the civil law prevails. More serious difficulties arise where a Federal court has to try inter-state questions, where the two states have different laws on the subject of lien; one for example, like Louisiana, following the civil law, and the other the common law and equitable practice of Great Britain. The question as to which law is to govern in such a case can hardly be said to be decided. "The question whether equitable liens can exist to be enforced in Louisiana by the Federal courts, notwithstanding its restrictive law of privileges, is still an open one" (Derris, *Contracts of Pledge*, 517; and see *Burdon Sugar Refining Co.* v. *Payne*, 167 U.S. 127).

British Colonies.—In those colonies which before the Canadian federation were known as Upper Canada and the Maritime Provinces of British North America, and in the several Australasian states where the English common law is enforced except as modified by colonial statute, the principles of lien, whether by common law or equitable or maritime, discussed above with reference to England, will prevail; but questions not dissimilar to those treated of in reference to the United States may arise where colonies have come to the Crown of Great Britain by cession, and where different systems of municipal law are enforced. For example, in Lower Canada the law of France prior to the Revolution occupies the place of the common law in England, but is generally regulated by a code very similar to the Code Napoleon; in Mauritius and its dependencies the Code Napoleon itself is in force except so far as modified by subsequent ordinances. In the South African colonies, and to some extent in Ceylon and Guiana, Roman-Dutch law is in force; in the island of Trinidad old Spanish law, prior to the introduction of the present civil code of Spain, is the basis of jurisprudence. Therefore it is by no means safe to assume that the English law of lien is in force in all British colonies. Each several system of law requires to be studied on the point; but, speaking generally, apart from the possessory lien of workmen and the maritime lien of the vice-admiralty courts, it may be assumed that the rules of the civil law, giving a privilege or priority in certain specified cases rather than a lien as understood in English law, prevail in those colonies where the English law is not in force. (F. W. Ra.)

Lierre, or Lier, a town of Belgium, in the province and 10 miles south-east of Antwerp by rail. Among its numerous industries are the manufacture of boots and shoes, brushes, and cutlery. Population (1880), 17,133; (1890), 20,133; (1900), 22,654.

Liestal, the capital (since 1833) of the half canton Basel-Stadt. It is 9¼ miles by rail from Basel, and 15½ miles from Olten. It is a well-built but uninteresting little town, the largest in the canton after Basel. In the Rathhaus is the drinking-cup of Charles the Bold of Burgundy, taken at the battle of Nancy in 1477. Population (1888), 4850; (1900), 5488.

Liévin. See Lens.

Life-Boat.—A very marked advance in the direction of improvement in design and suitability for practical service has been made in the life-boat since 1882, such development dating in some degree from the reorganization of the Royal National Life-boat Institution of Great Britain in 1883, but principally from the beginning of 1887, when, as the result of a serious accident in December 1886 to two self-righting life-boats in Lancashire, twenty-seven out of twenty-nine of the men who manned them were lost in their efforts to render assistance to a vessel in distress. At this time a permanent technical sub-committee was appointed by the Institution, whose object was, with the assistance of an eminent consulting naval architect—a new post created—and the Institution's official experts, to give its careful attention to the designing of improvements in the life-boat and its equipment, and to the scientific consideration of any inventions or proposals submitted by the public, with a view to adopting them if of practical utility. Whereas, therefore, in 1881 the self-righting life-boat of that time was looked upon as the Institution's special life-boat, and there were only a very few of the 271 life-boats in the Institution's fleet which were not of that type, at the close of 1901 the 288 life-boats of the Institution stationed on the coast of the United Kingdom included only 228 boats of the self-righting type, the remaining 60 all being non-self-righting boats of various types, known by the following designations:—Steam life-boats 4, Cromer 3, Lamb and White 1, Liverpool 14, Norfolk and Suffolk 19, tubular 1, Watson 18. Of the 271 life-boats on the coast at the end of 1881, only 12 remained at the close of 1901, 259 having been replaced by boats of the latest types, provided with the newest improvements in equipment and gear. The self-righting life-boat of 1901 was a very different boat from that of 1881. The Institution's present policy is to allow the men who man the life-boats, after having seen and tried by deputation the various types, to select that in which they have the most confidence. In 1901 a steam-tug was placed at Padstow for use solely in conjunction with the life-boats on the north coast of Cornwall.

The present life-boat of the self-righting type (Fig. 1) differs materially, as already stated, from its predecessor, the stability being increased and the righting power greatly improved. The test of efficiency in this last quality was formerly considered sufficient if the boat would quickly right herself in smooth water without her crew and gear, but every self-righting life-boat now built by the Institution will right with her full crew and gear on board, with her sails set, and the anchor down. Most of the larger self-righting boats are furnished with "centre-boards" or "drop-keels" of varying size and weight, which can be used at pleasure, and materially add to their weather qualities. The drop-keel was for the first time placed in a life-boat in 1885.

Steam was first introduced into a life-boat in 1890, when the Royal National Life-boat Institution, after very full inquiry and consideration, stationed on the coast a steel life-boat, 50 feet long and 12 feet beam, and a depth of 3 feet 6 inches, propelled by a turbine wheel driven by engines developing 170 horse-power. It had been previously held by all competent judges that a mechanically-propelled life-boat, suitable for service in heavy weather, was a problem surrounded by so many and great difficulties that even the most sanguine experts dared not hope for an early solution of it. This type of boat (Fig. 2) has proved very useful, and been the means of saving many lives. It is, however, on all hands fully recognized that boats of this description can necessarily be used at only a very limited number of stations, and where there is a harbour which never dries out. The Institution has since built five other steam life-boats, the latest of which was completed in April 1901, the last three being fitted with a protected screw-propeller. It had been hoped that

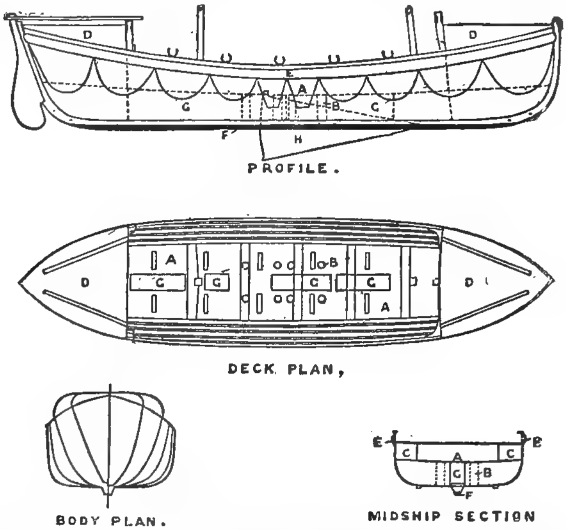

Fig. 1.—Plans, profile, and section of self-righting life-boat. A, deck; B, relieving valves for automatic discharge of water off deck; C, side air-cases above deck; D, end air compartments, usually called "end-boxes," an important factor in self-righting; E, wale, or fender; F, iron keel ballast, important in general stability and self-righting; G, water-ballast tanks; H, drop-keel.

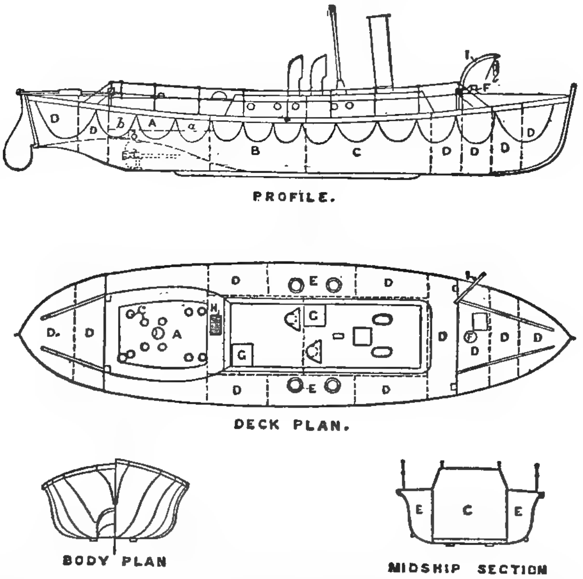

Fig. 2.—Plans, profile, and section of steam life-boat. A, cockpit; a, deck; b, propeller hatch; c, relief valves; B, engine-room; C, boiler-room; D, water-tight compartments; E, coal-bunkers; F, capstan; G, hatches to engine- and boiler-rooms; H, cable reel; I, anchor davit.

electrical propulsion and oil fuel might have been used in the steam life-boats, but the experiment with the latter, which had a fair trial in the earlier boats built, was not very successful, and it was not repeated in the later boats. The idea of employing electricity was, after the most careful consideration, regretfully abandoned. The highest speed attained by the first hydraulic steam life-boat was rather more than 9 knots, and that secured in the latest 9½ knots.

The other types of pulling and sailing life-boats are all non-self-righting, and are specially suitable for the requirements of the different parts of the coast on which they are placed. Their various qualities will be understood by a glance at the illustrations (Figs. 3, 4, 5, 6, and 7).

The Institution continues to build life-boats of different sizes according to the requirements of the various points of the coast at which they are placed, but of late years the tendency has been generally to increase the dimensions of the boats as the smaller ones become worn out or obsolete.

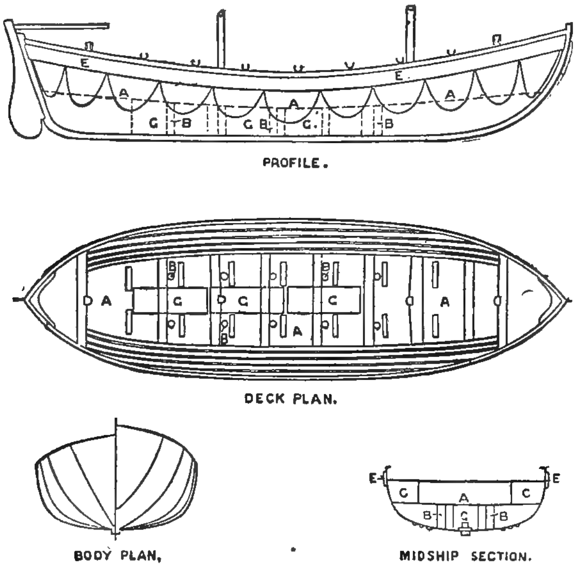

Fig. 3.—Plans, profile, and section of Cromer type of life-boat. A, deck; B, relieving valves for automatic discharge of water off deck; C, side air-cases above deck; E, wale, or fender; G, water-ballast tanks.

This change of policy is mainly due to the great transformation which has taken place in the shipping of all the trading nations, the small coasters and fishing-boats having in great measure disappeared, their places being taken by steamers and steam trawlers. The cost of the building and equipping of pulling and sailing life-boats has materially increased, more especially since 1898, the increase being mainly due to improvements and the seriously augmented charges for materials and labour. In 1881 the average cost of a fully-equipped life-boat and carriage was £650, whereas at the end of 1901 it amounted to £1000, the average annual cost of maintaining a station having risen to more than £100.

The *transporting-carriage* continues to be a most important part of the equipment of life-boats, generally of the self-righting type, and is absolutely indispensable where it is necessary to convey the boats for the purpose of launching to any point not in the immediate vicinity of the boat-house. It is not, however, usual to supply carriages to boats of larger dimensions than 37 feet in length by 9 feet beam, those in excess as regards length and beam being either launched by means of special slipways or kept afloat. The transporting-carriage of to-day is, however, an improvement on that used in 1881, and has been rendered particularly useful at places where the beach is soft, sandy, or shingly, by the introduction in 1888 of Tipping's sand-plates. These very efficient adjuncts to easy and prompt launching are composed of an endless plateway or jointed wheel tyre fitted to the main wheels of the carriage, thereby enabling the boat to be transferred with rapidity and with greatly decreased labour over beach and soft sand. Further efficiency in launching has also been attained at many stations by the introduction in 1890 of pushing-poles, attached to the transporting-carriages, and of horse launching-poles, first used in 1892. Fig. 8 gives a view of the modern transporting-carriage fitted with Tipping's sand- or wheel-plates.

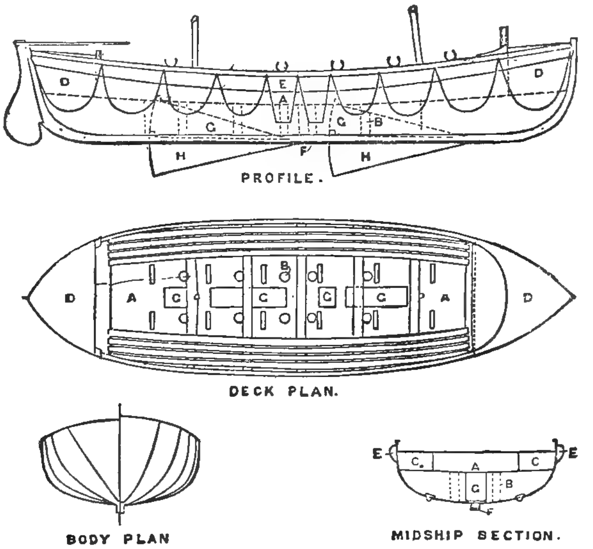

Fig. 4.—Plans, profile, and section of Liverpool type of life-boat. A, B, C, E, G, as in Fig. 8; D, end air-compartments; F, iron keel; H, drop-keels.

The *life-belt* has since 1898 been considerably improved, being now less cumbersome than formerly, and more comfortable. The feature of the principal improvement is the reduction in length of the corks under the arms of the wearer and the rounding-off of the upper portions, the result being that considerably more freedom is provided for the arms. The maximum extra buoyancy has thereby been reduced from 25 ℔ to 22 ℔, which is more than sufficient to support a man heavily clothed with his head and shoulders above the water, or to enable him to support another person besides

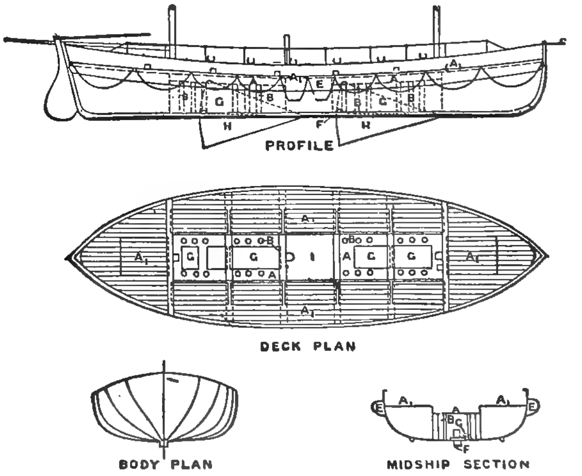

Fig. 5.—Plans, profile, and section of Norfolk and Suffolk type of life-boat. A, B, E, F, G, H, as in Fig. 4; A₁ side deck; I, cable-well.

himself. Numerous life-belts of very varied descriptions, and made of all sorts of materials, have been patented, but it is generally agreed that for life-boat work the cork life-belt of the Royal National Life-boat Institution has not yet been equalled.

Life-saving rafts, seats for ships' decks, dresses, buoys, belts, &c., have been produced of late years in all shapes and sizes, but nothing apparently has as yet been brought out which has been generally acknowledged to be indispensable. Those interested in life-saving appliances were hopeful that the great International Exhibition held at Paris in 1900 would have produced some life-saving invention which might prove a benefit to the civilized world, but so lacking in real merit were the life-saving exhibits that the jury of experts were unable, after three months' careful examination and consideration, to award to any of the 435 competitors the Andrew Pollok prize of £4000 for the best method or device for saving life from shipwreck.

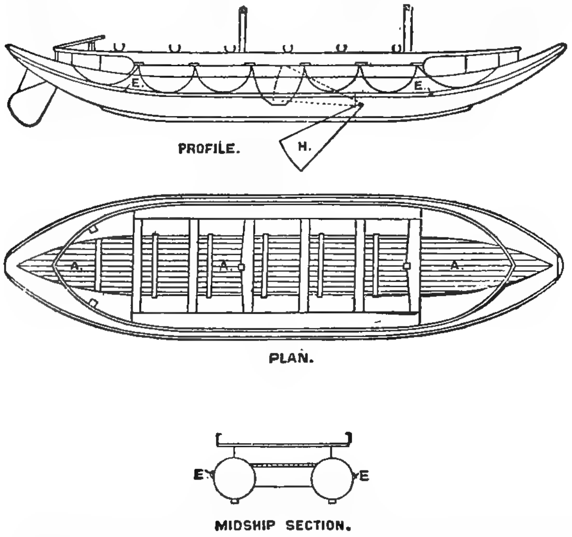

FIG. 6.—Plan, profile, and section of Tubular type of life-boat. A, deck; E, wale, or fender; H, drop-keel.

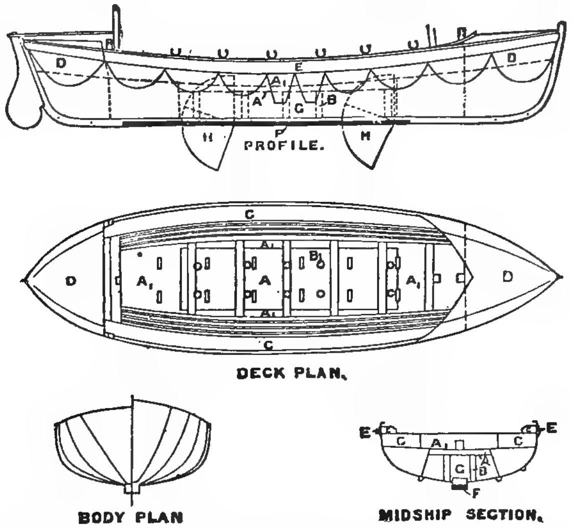

FIG. 7.—Plans, profile, and section of Watson type of life-boat. Lettering as in Fig. 4, but C, side air-cases above deck and thwarts.

History.—Since 1881 the necessity and importance of the existence of a thoroughly efficient life-boat service have been more generally felt and acknowledged by the people not only of Great Britain, but also of those other countries on the European Continent which have a sea-board, and of the British colonies—the countries which possessed such life-saving services having since greatly improved and enlarged their scope where necessary, while those which were not so provided have established life-boat services. All the foreign life-boat institutions and services have been founded more or less on the lines of the Royal National Life-boat Institution, which is regarded by them in the light of a foster-mother. The British Institution has greatly developed since its reorganization in 1883, both in its life-saving efficiency and financially, and has been spoken of in the highest terms as regards its management by successive Governments—a Select Committee of the House of Commons in 1897 reporting to the House that the thanks of the whole community were due to the Institution for its energy and good management. At the close of 1901 the Institution's fleet consisted of 288 life-boats, and the total number of lives for the saving of which the committee of management had granted rewards since the establishment of the Institution in 1824 was 43,197. At this time there were only fifteen life-boats of any sort on the coast of the United Kingdom which did not belong to the Institution. In 1882 the total amount of money received by the Institution from all sources was £57,797, 11s. 9d., whereas in 1901 the total amount received had more than doubled, having increased to £107,293, 6s. 11d.; this latter sum was on three occasions considerably exceeded, namely, in 1894, 1896, and 1898.

In 1882 the Institution undertook, with the view of diminishing the loss of life annually occurring among the coast fishermen, to provide the masters and owners of fishing-vessels with trustworthy aneroid barometers, at about a third of the retail price, and in 1883 the privilege was extended to the masters and owners of coasters under 100 tons burden. This action was highly appreciated, and at the end of 1901 as many as 4417 of these valuable instruments had been supplied. In 1889 the committee of management promoted a Bill in the House of Commons to provide for the removal of wrecks in non-navigable waters which might prove dangerous to life-boat crews and others. This Bill, under the title Removal of Wrecks Act, 1877, Amendment Act, 1889, became law on the 31st May 1889, and under its useful provisions numerous highly dangerous wrecks have been removed. This Act was the first signed in 1889 by Queen Victoria, who, from 1837 until her death in January 1901, was the patron of the Institution, being then succeeded by King Edward VII., who as prince of Wales had been the president of the Institution for several years.

In 1893, at the instance of the committee of management, the chairman of the Institution moved a resolution in the House of Commons that, in order to decrease the serious loss of life from shipwreck on the coast, the British Government should provide either telephonic or telegraphic communication between all the coast-guard stations and signal stations on the coast of the United Kingdom; and that on those parts of the coast where there are no coast-guard stations the post offices nearest to the life-boat stations should be electrically connected, the object being to give the earliest possible information to the life-boat authorities at all times, by day and night, when the life-boats are required for service; and further, that a Royal Commission should be appointed to consider the desirability of electrically connecting the rock lighthouses, light-ships, &c., with the shore. The resolution was agreed to without a division, and since then its intention has been practically carried out, the results obtained having proved most valuable and useful in the saving of life.

On the 1st of January 1898 a pension and gratuity scheme was introduced by the committee of management, under which life-boat coxswains, bowmen, and signalmen of long and meritorious service, retiring on account of old age, accident, ill-health, or abolition of office, receive special allowances as a reward for their good services. The adoption of this course gave the greatest satisfaction to the life-boat men all round the coast; and while these payments act as an incentive and inducement to the men to do their utmost to discharge their duties satisfactorily, they at the same time assist the committee of management in their effort to obtain the best men for the work. For many years the Institution has given compensation to any who may have received injury while employed in the service, besides granting liberal help to the widows and dependent relatives of any in the service who lose their own lives when endeavouring to rescue others.

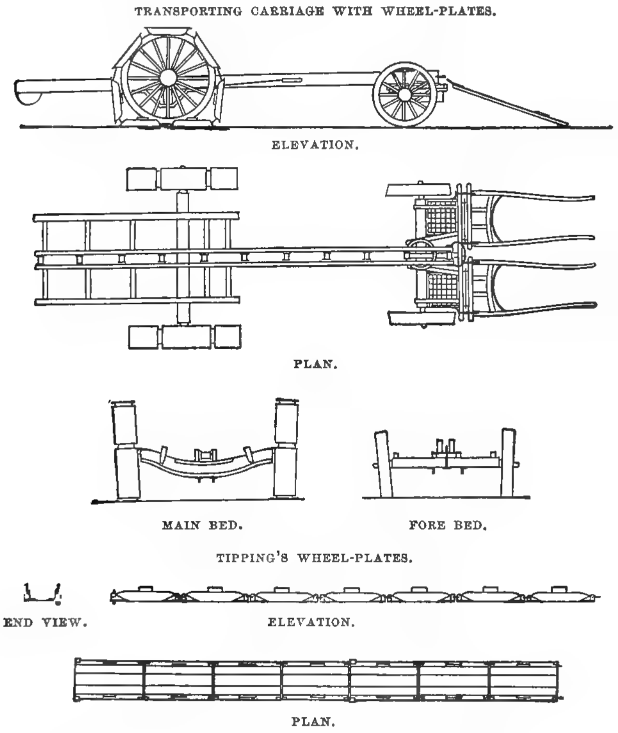

FIG. 8.—Life-boat transporting-carriage with Tipping's wheel-plates.

The *rocket apparatus*, which is under the management of the coast-guard, continues to render excellent service in life-saving. No alteration or improvement of any moment has of late years been made in the apparatus. During the year ended the 30th June 1901, 152 lives were thus saved, this number being 154 less than the average for the previous ten years. The total number of lives saved by the life-saving apparatus between 1870 and 1901 was 7762. On the 30th June 1901 there were 217 life-saving companies, numbering in all 3770 volunteers, and there were six brigades with a total membership of 429.

The *United States* life-saving service, established in 1871, continues to be one of the chief life-saving services of the world. At the close of the fiscal year 30th June 1899 its establishment embraced 265 stations. Of this number 193 were situated on the Atlantic and Gulf coasts, 56 on the coasts of the Great Lakes, 15 on the Pacific coast, and one at the falls of the Ohio, Louisville, Kentucky. Comparatively few of the stations are open all the year round as in Great Britain, local requirements apparently rendering it necessary for the great majority of the stations to be "active" only for periods ranging from two to ten months. The number of disasters to documented vessels within the field of station operations during the year was 428, and there were on board these vessels 3903 persons, of whom only 56 were lost. The estimated value of the vessels was $6,072,635, and that of their cargoes $2,032,005, making the total value of the property imperilled $8,104,640. Of this amount $6,261,900 was saved and $1,842,740 lost. In addition to these there were 294 casualties to undocumented craft—sailing boats, rowing boats, &c.—carrying 671 persons, seven of whom perished. The value of the property involved in these instances was estimated at $138,535, of which $129,285 was saved and $9250 lost; 751 persons received assistance at the stations, the number of days' relief afforded aggregating 1460; 63 lives were lost within the scope of the service during the year—a larger number, with a single exception, than in any year during the previous two decades. There were during the year 97 persons rescued from positions of danger otherwise than from vessels, who would in all probability have perished but for the aid of the surfmen. There were 591 stranded vessels floated off, repaired when damaged, piloted out of dangerous positions, and in similar ways assisted by the station crews. Minor assistance was also afforded to 382 vessels and small craft. 193 vessels running into danger of stranding were warned off by the signals of the patrol-men, most of them having been thus saved from either serious danger or total loss. The surf-boat was used 773 times, making 1089 trips. The self-righting and self-bailing life-boat was used 132 times, making 163 trips. The gasoline launches (at City Point station) were used 80 times, making 90 trips. Smaller boats were used 432 times, making 526 trips. The river life-skiffs (at the Louisville station) were used 41 times, making 97 trips. The breeches buoy was used 11 times, making 55 trips. The wreck gun was employed 17 times, firing 29 shots, and the heavy stick was used 28 times. There were 949 persons landed by the surf-boat, 111 by the life-boat, 184 by the gasoline launches, 162 by the river skiffs, 151 by other station boats, and 55 by the breeches buoy. In addition to these, 11 persons were rescued by men wading out into the surf, 6 by a ladder from shore to a stranded vessel, 6 by a line from a sinking vessel to a pier, 2 by means of heaving lines, and 1 person was hauled through the surf on the whip-line when the hawser was not set up. The total cost of maintaining the United States life-saving service during the year ended 30th June 1899 was $1,549,411.

Life-boat Service in other Countries.—Good life-saving work continues to be done by the other life-boat services in Europe and elsewhere, most of these institutions having been formed on the lines of the Royal National Life-boat Institution of Great Britain. The services are operating in the following countries:—

Belgium.—Established in 1838. Supported entirely by Government.

Denmark.—Established in 1848. Government service.

Sweden.—Established in 1856. Government service.

France.—Established in 1865. Voluntary association, but assisted by the Government.

Germany.—Established in 1885. Supported entirely by voluntary contributions.

Turkey (Black Sea).—Established in 1868. Supported by dues.

Russia.—Established in 1872. Voluntary association, but receiving an annual grant from the Government.

Italy.—Established in 1879. Voluntary association.

Spain.—Established in 1880. Voluntary association, but receiving annually a grant of £1440 from Government.

Canada.—Established in 1880. Government service.

Holland.—Established in 1884. Voluntary association, but assisted by a Government subsidy.

Norway.—Established in 1891. Voluntary association, but receiving a small annual grant from Government.

Portugal.—Established in 1898. Voluntary society.
India (*East Coast*).—Voluntary association.
Australia (*South*).—Voluntary association.
New Zealand.—Voluntary association.

Japan.—The National Life-boat Institution of Japan was founded in 1889. It is a voluntary society, but is assisted by Government. Its affairs are successfully managed and worked by a president and a vice-president, supported by a very influential council. The head office is at Tôkyô, and numerous branches with local committees have been established. In June 1900 there were 17 rescue stations in full working order. The Imperial Government contributes an annual subsidy of 20,000 *yen* (£2000) and also renders every possible assistance. The following are the statistics of the lives and vessels saved during the years 1894 to 1898 inclusive:—

	Vessels saved.	Lives saved.
1894 . .	33	196
1895 . .	17	62
1896 . .	22	95
1897 . .	60	272
1898 . .	208	980

The council of the Institution are very sanguine that in the course of a few years they may, with the assistance of the Government, be able to establish as many as 113 rescue stations; and these will, they think, be sufficient for the purposes of the objects of the Institution on the coast of Japan. The members of the Institution consist of three classes—honorary, ordinary, and sub-ordinary, the amount contributed by the member determining the class in which he is placed. Any member guilty of conduct detrimental to the credit of the Institution, or of delaying to pay his annual subscription, is deprived of his membership at the discretion of the council. The chairman and council are not, as in Great Britain, appointed by the subscribers, but by the president, who must always be a member of the imperial family. The institution bestows three medals:—(*a*) the medal of merit, to be awarded to persons rendering distinguished service to the Institution; (*b*) the medal of membership, to be held by honorary and ordinary members or subscribers; and (*c*) the medal of praise, which is bestowed on those distinguishing themselves for special service in the work of rescue. (C. DI.)

Ligao, a town near the centre of the province of Albay, Luzon, Philippine Islands. The rich volcanic soil in its vicinity produces rice, hemp, Indian corn, fine sugar-cane, and indigo, agriculture being the sole occupation of its inhabitants. The language is Bicol. Population, 17,000.

LIGHT.

THE view that light is physically a disturbance propagated through a subtle medium called the æther is now universally accepted. There are, no doubt, difficulties in realizing mentally the essential characteristics of this æther, but these are of a much less serious nature than those which beset any other supposition as to the mode of propagation of light. The simplicity and directness with which the accepted theory explains the ordinary laws of reflection, refraction, polarization, and interference phenomena have been fully illustrated in the articles LIGHT (*Ency. Brit.* vol. xiv.) and WAVE THEORY (*Id.* vol. xxiv.). In the great majority of cases of ordinary experience the mere conception of light as a wave motion through the æther supplies a sufficient explanation, and that without any regard to the essential character of the æther or to the nature of its connexion with matter. It is sufficient to assume that the disturbances in the æther are in some sense *transverse* to the direction in which the light is being propagated, and that matter tends to increase the effective density of the æther in the region where it is present. When, however, we pass to the consideration of the various phenomena that may be grouped under the head of "Dispersion," we are forced to inquire more particularly into the manner in which the particles of matter imbedded in the æther react upon the vibratory motion that is being propagated through it. This inquiry leads almost immediately to the more fundamental questions, What is the constitution of the æther, and what is the mode of connexion between æther and matter? In striving after an answer to these questions scientific men have indulged in a great deal of curious speculation, and it is important in discussing the advances made in our knowledge of the laws and nature of light to bear in mind the speculative character of much of our modern theory. Apart altogether from theoretic considerations, however, new facts are being added daily to our stores of knowledge, together with a fresh and deeper acquaintance with old ones, and it may be safely said that no recent result of experiment has been out of harmony with the broad theoretic view that light is physically an undulatory disturbance in a medium. Curious and complicated phenomena have, it is true, been brought to light, but these have not materially increased the difficulties of the theorist, whose hold of the fundamental principles has of late been greatly strengthened. It is the purpose of the present supplementary article to show how experiment and theory have aided each other in deepening our knowledge of this important branch of physical science. (See ÆTHER.)

Standards of light.

Photometry.—The great development of artificial lighting during the later years of the 19th century has given photometry an increased importance. For example, electric lights are classified according to their "candle-power." The candle, in terms of whose brightness the brightness of other sources of light is to be expressed, must, of course, fulfil the conditions demanded of all standards. It must give under definite and easily realizable conditions a definite and constant luminous effect, and it must be easily reproducible. The earlier attempts to get a candle of constant brightness were not very satisfactory. The British standard is a sperm candle which weighs $\frac{1}{6}$ ℔ and loses in burning 120 grains per hour. It is found that these conditions are not sufficient to determine the luminous power of the candle, since the length and shape of the wick, the height of the flame, and the composition, temperature, and humidity of the atmosphere all have an effect upon its brightness. The same is true of other similar sources of light—for example, the German standard candle, which is made of paraffin, has a diameter of 2 cm., and has its wick cut until the flame is 5 cm. high, but which with all precautions suffers continual alterations in brightness. For ordinary practical purposes, however, these candles are steady enough. Other kinds of flame have also been used as a standard source of light. The oldest of these is the French Carcel lamp, which is provided with a cylindrical Argand burner, and gives the standard brightness when 42 grammes of colza oil are consumed per hour. The supply and draught are regulated by clockwork. Vernon Harcourt's Pentane standard, in which a mixture of gaseous pentane and air is burned so as to maintain a flame 2·5 inches high at ordinary barometric pressure, gives good results, and is readily adjustable to suit varied conditions. For accurate scientific purposes the best standard is the Hefner-Alteneck or amyl-acetate lamp. It is of simple construction, and gives the standard brightness when it burns in still air with a flame 4 cm. in height. The brightness is affected by change of humidity, but careful measurements show that it may be trusted to within 2 per cent.

Violle has proposed to use as standard the light emitted by a square centimetre of surface of platinum at its melting-point, but there are obvious practical difficulties in the way of realizing this suggested standard. Petavel, who carefully examined the necessary conditions for producing it (*Proc. Roy. Soc.*, 1899), finds that the platinum must be chemically pure, that the crucible must be made of pure lime, that the fusion must be by means of the oxy-hydrogen blow-pipe, that the gases must be thoroughly mixed in the proportion of 4 volumes of hydrogen to 3 of oxygen, and that the hydrogen must contain no hydrocarbons. Under these conditions the variation in the light emitted by the molten platinum would probably not exceed 1 per cent. Lummer and Kurlbaum have proposed as a standard a strip of platinum foil 25 mm. wide and ·015 mm. thick brought to incandescence by an electric current of about 80 amperes. The temperature is gradually increased until $\frac{1}{10}$th of the total radiation is transmitted through a water trough 2 cm. in width. This ratio is determined by means of a bolometer, and so long as it is adjusted to $\frac{1}{10}$th the light is practically constant. For comparative photometric work the incandescent electric light is very convenient, having the one great advantage over candles and flames that it is not affected by atmospheric changes. So far, however, it has not been found possible to make to specification a glow-light of definite candle-power when a given current is passed through it. A standard glow-lamp is yet to be devised.

Photometers.

The illuminating powers of two sources of light are most simply compared by so adjusting their distances from a given point as to have at this point equal illumination from the two sources. In addition to the methods associated with the names of Ritchie, Rumford, Bunsen, and Wheatstone (*Ency. Brit.* vol. xiv. pp. 583–84), there are several other methods, either new in principle or important modifications of those mentioned, which have come greatly into use, or which have special advantages for particular kinds of work.

Swan's prism photometer invented in 1859 is a beautiful application of the same principle that is embodied in Bunsen's grease-spot photometer (see *Trans. Roy. Soc. Ed.* vol. xxi.). The instrument is essentially the same as that described by Lummer and Brodhun in 1889, and generally named after them. It consists of two equal rectangular glass prisms placed with their diagonal faces together so as to form a cube (Fig. 1), and cemented together by a small patch of Canada balsam, which spreads out into a circle when the prisms are pressed together. In Fig. 1, which represents a central section of the bi-prism, the Canada balsam is represented by the letter N. The light from two illuminated surfaces, PQ, RS, is allowed to fall perpendicularly on the faces AB, AD. In each case that part of the light falling internally on the portion of the diagonal face which is not backed with the Canada balsam is totally reflected. On the other hand, the light which falls on the portion backed by the Canada balsam is almost wholly transmitted. Thus an eye placed in the position *qtp* receives light from both sources, the surface RS supplying nearly all the light that seems to come from the patch N, and the surface PQ supplying all the light which seems to come from the region immediately surrounding N. The patch N will in general be visible; but it will quite disappear when the luminosity of the ray *Tt*, which traverses the Canada balsam, is exactly equal to the luminosity of the rays *Pp*, *Qq*, which have come after total reflection from the surface PQ. This condition of invisibility of N is arrived at by adjusting the positions of the sources of light which illuminate the surfaces PQ, RS. The brightnesses of the two sources will then be as the squares of their distances from their respective screens.

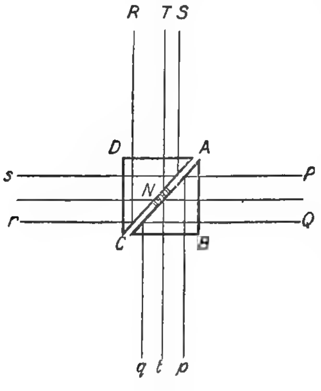

Fig. 1.

The essential part of Lummer and Brodhun's photometer is a combination of prisms very similar to Swan's. In its most improved form the bi-prism or "optical cube" has one of its component prisms cut in a peculiar manner. The diagonal face is partly cut away, so that the central part only of this face can be brought into contact with the diagonal face of the other prism. The Canada balsam may be dispensed with if the surfaces are pressed closely together so that no layer of air is left between them. In order to make the instrument convenient for use with an optical bench, Lummer and Brodhun make the illuminated surfaces which are to be compared the opposite sides of an opaque screen set in the continuation of the diagonal (CA) of the bi-prism, the rays being brought by reflection from symmetrically situated mirrors so as to enter the sides AB and AD perpendicularly. An important modification, due also to Lummer and Brodhun, is the following: By means of a sand-blast a portion, which may be called *r*, is removed from one half of the diagonal face of the one prism, and from the other half of the same prism there is removed in like manner all but a part *l* corresponding to the part *r*. The portions which have not been removed are pressed close to the diagonal face of the other prism, and become the parts through which light is freely transmitted. On the other hand, the light which enters the second prism and falls on the portions of surface backed by the layers of air filling the cut-out parts is totally reflected. The general result is the production of two similar luminous patches *l* and *r*, each of which is surrounded by a field of the same intensity as the other patch. When the photometric match is made the whole region will be uniformly bright. But, by insertion of strips of glass so as to weaken equally the intensity in the surrounding fields, the match will be obtained when these fields are made of equal intensity and when at the same time the two patches differ equally in intensity from them. Under these conditions the eye is able to judge more certainly as to the equality of intensity of the two patches, and an untrained observer is able to effect a comparison with an accuracy which is impossible with most forms of photometer.

Joly's diffusion photometer consists of two equal rectangular parallelepipeds of a translucent substance like paraffin separated by a thin opaque disc. It is set between the sources of light to be compared in such a way that each paraffin block is illuminated by one only of the sources, and is adjusted until the two blocks appear to be of the same brightness. The method is made more sensitive by mounting the photometer on an elastic vibrator so as to render it capable of a slight to-and-fro oscillation about a mean position.

Reducing intensity.

When the sources of light differ in brightness, it is often convenient to cut down the intensity of the stronger by the interposition of an absorbing medium of neutral tint. A wedge of glass capable of a to-and-fro adjustment across the path of the rays is a favourite device, or a set of translucent plates of glass, the absorbing powers of which have been carefully determined. If light of intensity I is reduced by passage through such a plate to I', the fraction transmitted by the plate is the ratio I'/I. Since every successive layer of given thickness through which the light passes reduces the intensity of the light incident upon it in a given ratio, it follows that the intensity of the light is diminished in a geometrical progression as the distance travelled through increases in an arithmetical progression; in other words, the rate at which the intensity falls off per unit distance is proportional to the intensity, a law which is mathematically expressed by means of the exponential function. Thus after traversing thickness x the intensity I is reduced to $I' = Ie^{-ax}$ where e is the number 2·71828 . . . and a is known as the extinction-coefficient. Another method of cutting down the intensity of a ray in a given ratio is to make the beam intermittent by interposition of a rotating disc of which a sector has been removed. This was the method used by Swan in 1849 in his investigations on the "Gradual Production of Luminous Impressions on the Eye" (*Trans. R. S. E.* vol. xvi.), and it has been employed with various modifications by many other experimenters. The properties of plane polarized light may also with great advantage be used to effect the same purpose. Let the brighter beam be polarized by passage through an appropriate crystal, and then let a second polarizer be interposed. For certain positions of this polarizer nearly all the light will pass, and for certain other positions the light will be wholly cut off. Between these limits any intermediate intensity of light may be obtained by simply rotating the polarizer into a particular position. If I is the maximum intensity of light which can pass, the intensity of the light transmitted when the polarizer is turned through an angle ϕ is $I \cos^2 \phi$.

Colour photometry.

So long as the lights to be compared are of the same or nearly the same tint, the photometric match obtained by different observers is practically the same, but if they are of distinctly different colours, not only do different observers obtain different results, but those obtained by the same observer at different times are not always in agreement. It is probable, however, that when due precautions are taken to have all conditions identically the same the well-trained eye will obtain consistent results. To show the necessity for such precautions two points of physiological importance may be briefly touched upon. Suppose that two discs, coloured, say, red and blue, when viewed in a bright light, appear to the eye to be of the same intensity, the blue disc will appear to be brighter than the red when viewed in a less bright light. This phenomenon, which was first clearly described by Purkinje in 1825, is exemplified in the familiar fact that blue flowers are visible longer than red flowers in deepening twilight. In like manner the blue and violet end of a spectrum is more stimulating to the eye than the red end when the general luminosity is low, but at high luminosities the red gains relatively in brightness until it becomes more stimulating than the blue. Then, again, the condition of the eye must be taken into account. The judgment as to the relative intensities of two coloured discs will depend upon whether, previous to making the comparison, the eye has been resting in darkness or has been exposed to the influence of ordinary illumination. The eye adapts itself differently in darkness and in light, and it is found that the dark-adapted eye is more powerfully affected by the blue half of the spectrum, but to the light-adapted eye the yellow and red end is more stimulating. In short, the part of the spectrum which appears brightest to the eye shifts towards or from the violet end (1) as the general luminosity diminishes or increases, and (2) as the eye tends towards the dark-adapted state or towards the light-adapted state. It is evident, in fact, that in comparing the intensities of differently-coloured lights the eye supplies no criterion as to the relative amounts of energy in the rays. Physically the energy in a given ray of light depends on the square of the amplitudes of the vibrations. Physiologically the sensitiveness of the eye depends partly upon the wave-length of the light, so that there is no simple relation between apparent intensity and energy. It is the physiological factor which renders the photometric comparison of differently-coloured lights difficult and uncertain. A few of the methods for overcoming these difficulties will now be described.

Contrast colours.

An obvious method of making a photometric comparison between two lights of markedly different colour is to fill up the gap between them by means of a series of lights differing by small gradations of tint. The relative intensities of each contiguous pair may then be determined by any of the usual photometric methods, and a final comparison effected by calculation between the extremes. To facilitate the comparison of lights differing slightly in tint, A. M. Mayer designed a photometer in which the phenomenon of contrast colours was taken advantage of. The simplest experiment in contrast colours is made by an application of Rumford's photometric method to the comparison of the shadows cast by two flames, one of which gives a white light and the other, say, a red light. Each flame will illuminate the part of the screen on which the shadow due to the other falls, and we might expect the one shadow to appear white and the other red. But when the experiment is made the one appears a beautiful green while the other appears red. The usual explanation of this striking effect is that the doubly illuminated surface of the screen gives a false criterion for white, compared with which the really white but less bright shadow thrown by the red flame appears green. This explanation seems to be hardly sufficient, in view of the fact established by Mayer that the same contrast of colours is observed even when no "doubly illuminated" part of the screen can be seen by the eye of an observer quite unprepared for what is to be seen and quite ignorant of the arrangement of the apparatus. Mayer also describes some very beautiful contrast effects obtained by using as the one source of light the flash of an electric discharge (*Phil. Mag.*, Aug. 1893). Put generally, the phenomenon of contrast colours consists in this, that a strong colour tends to impart its complementary tint to a neutral tint placed in juxtaposition, and to have a corresponding effect upon a non-neutral tint of feeble hue. It is evident, then, that by juxtaposition of a strong colour we may appreciably alter the hue of a particular tint. This is the principle of the method devised by Mayer for bringing into a condition of *apparent* equality of tint two coloured surfaces which, when viewed without the presence of the strong colour which induces the contrast tint, appear of distinctly different hue. Under these conditions the surfaces can be compared photometrically with greatly increased certainty.

When the intensities of two differently-coloured lights differ considerably there is no difficulty in judging which is the stronger. By making the one light pass through a fairly large range of brightness we may easily assign limits outside which the intensities are undoubtedly different. After some experience these limits get closer; and many experimenters find it possible, by taking proper precautions, not only to effect a match, but to effect practically the same match time after time. According to Abney, whose memoirs on colour photometry (*Phil. Trans.*, 1886, 1892) form a most important contribution to the subject, the observer in making his judgment as to the equality of luminosity of two patches of colour placed side by side must not begin to think about it, but must let the eye act as unconsciously as possible. His method was to compare the coloured patch with white light given by a particular standard and cut down to the proper intensity by use of a rotating sector, which could be adjusted by means of a suitable mechanism while it was rotating. In this way the relative brightness of different parts of the spectrum was obtained, and thus a curve known as the luminosity curve (Fig. 2) was constructed. Wave-lengths were measured horizontally, and the height of the luminosity curve above any point represented the luminosity of the light of the corresponding wave-length. The comparison of luminosity curves obtained by normal eyes and by colour-blind eyes is of great interest and importance, and brings out very clearly certain fundamental differences between normal and abnormal vision. Abney has also given special attention to the manner in which the feeling of colour is lost when the light is cut down sufficiently in intensity. When, for example, the intensity of a beam of white light which has been drawn out into a spectrum is gradually diminished, the part of the spectrum which first loses its colour is the dark red, and the part which retains its colour longest is the orange. Next to the orange and yellow the green is most persistent. It is in accordance with these facts that the gray tints at early dawn gradually assume colour as the dawn brightens; yellow, orange, and blue flowers show in their true colours, while red flowers still remain black, and not till a certain brightness is reached do all the colours come out unmistakably in their appropriate tints. To express the matter in another way, a normal eye in feeble lights acts as an eye afflicted with red colour-blindness. A useful account of many of these colour phenomena is given in Sir W. de W. Abney's book on Colour Vision.

Flicker photometry.

If two sources of light of different intensity or of different colour are presented to the eye in more or less rapid alternation, and if the rate of alternation can be adjusted at will, then for slow or moderate rates of alternation the eye will perceive a flickering, which disappears when the alternation becomes rapid enough. Thus a singing flame announces its intermittent character to the ear, but appears perfectly steady to the eye. If the sources of light are to begin with of different colour and intensity, and if we gradually diminish the intensity of the more intense, we shall find that the rate of alternation at which flickering just disappears gets less as the intensities approach equality. When the intensities are equal the rate of alternation for which the flickering ceases reaches its minimum. With any change in the intensity of either the flickering reappears, and can be got rid of only by increasing the rate of alternation. The phenomenon was noticed by Plateau and its true meaning pointed out by Helmholtz. Rood was, however, the first to show how the phenomenon of flickering could be utilized for purposes of photometry (see *Amer. Jour. Sci.*, 1893). Haycraft successfully employed what is at bottom the same principle in comparing the luminosities of different parts of the spectrum (*Journ. Physiol.* vol. xxi., 1897). The spectrum of an intermittent beam of light was viewed by the eye. Now intermission may be regarded as an alternation of light and darkness, and the brighter the light the more rapid must be the intermission for which flickering just disappears. Thus there will be a particular rate of intermission for which the less luminous red will appear quite steady, while the more luminous green, for example, will flicker. As the rate of intermission is increased the non-flickering part of the spectrum will increase, and ultimately a rate will be reached at which flickering will be visible in a very narrow strip of the spectrum. This narrow strip will indicate by its position the most luminous part of the spectrum.

By varying the rate of intermission and noting the points in the spectrum which for each rate of intermission separated the flickering from the non-flickering regions, Haycraft obtained very simply curves of luminosity for the whole spectrum. Some of these are reproduced in Fig. 2. The abscissæ are wave-lengths, and the ordinates the rates of intermission. The three curves belong to experiments with different widths of slit, the lowest corresponding to the narrowest slit and the highest to the widest slit. Any point on a curve gives the rate of intermission at which light of the indicated wave-length just ceased to flicker. The letters along the axis of wave-lengths indicate the positions of the colours, blue, green, yellow, red. The curves show the nature of Purkinje's phenomenon, the relative luminosity of the red increasing with increased brightness of the beam, and the point of maximum luminosity shifting towards the red end of the spectrum. The order of brightness is—

In the lower curve, green, yellow, blue, red.
In the middle ,, yellow, green, red, blue.
In the upper ,, yellow, red, green, blue.

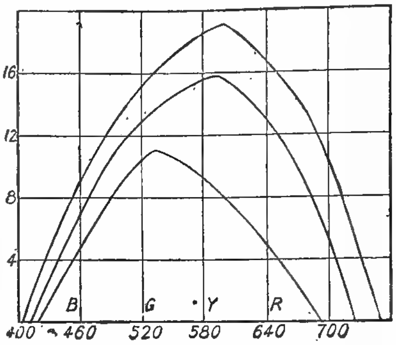

Fig. 2.

According to Rood's experiments, when a disc whose halves differ in tint but not in luminosity is rotated rather slowly, the eye of the observer sees no flickering such as is at once apparent when the halves differ slightly in luminosity. Rood has himself suggested various forms of photometer based on this principle. In his latest form (see *Amer. Jour. Sci.*, Sept. 1899) the differently-coloured beams of light which are to be compared photometrically are made to illuminate the two surfaces of a prism of paper or of plaster of Paris set facing the eye. Between the prism and the eye is placed a cylindrical concave lens, which can be set in oscillation by means of a motor in such a way that first the one illuminated surface of the prism and then the other is presented to the eye in sufficiently rapid alternation. The one source of light is kept fixed, while the other is moved about until the sensation of flicker disappears. From work with this form of instrument Rood concludes that "the accuracy attainable with the flicker photometer, as at present constructed, and using light of different colours almost spectral in hue, is about the same as with ordinary photometers using plain white light, or light of exactly the same colour." A simple form of flicker photometer has been constructed by Whitman (see *Physical Review*, vol. iii., 1895–96), and his conclusions as to its accuracy and convenience fully corroborate Rood's.

It appears that, when in the comparison of lights of different colour the flicker vanishes, the sensation of colour is greatly diminished, but increases markedly as soon as the balance is destroyed and the flicker reproduced. This suggests the possibility that the sensations of brightness and of colour are produced by different structures in the eye. It has long been recognized that the sensation of colour is much feebler when the retina is stimulated in regions removed from the yellow spot, which is also the part of the retina specially implicated in the production of clear vision. Another familiar fact is that the eye fails to appreciate colour when the luminosity is faint, as if a stronger stimulus were needed to affect the nerves which have to do with colour sensation than to affect those which have to do with luminosity. When a dark body is gradually heated up to a red heat, careful experiment shows that of the faint, colourless, unsteady radiation which is visible some time before the dull red glow begins to be seen, the eye seems unable to get a steady hold. When, with rising temperature, the body begins to emit the first dull red rays, the early fitful character of the luminosity quite disappears and the radiation becomes steady. Now there are two well-known structures in the eye called the rods and cones; and it has been suggested by von Kries that of these the rods are involved in producing the sensation of brightness, the cones the sensation of colour (see Lummer, *Wied. Ann.* 62, 1897). If this be so, and if the rods are the more sensitive to feeble radiations, it is probable that they also respond more quickly to any particular stimulus. Hence the sensitiveness of the eye to flickering may depend ultimately on the rods, or at least on the structure that has to do with the luminosity sensation. Whatever truth there may be in this speculation, it is clear that flickering depends on the duration of the sensation after stimulation of the eye; and according to Ferry (*Am. Jour. Sci.*, 1892), the duration depends on the luminosity and not on the wave-length. See also a paper on persistence of vision by Allen (*Physical Review*, vol. xi., 1900), which contains important results bearing upon the theory of vision.

Spectro-photometer.

The spectrophotometer is an instrument which enables us to make photometric comparisons between the similarly-coloured portions of the spectra of two different sources of light. In the earlier forms the difficulty of getting the two spectra actually to *touch* along their contiguous margins—an important condition, greatly increasing the accuracy of the comparison—was overcome by special optical contrivances. In the more recent forms the principle embodied in Swan's double prism photometer has been successfully applied. By means of a simple modification in the form of the two prisms, Brace (see *Phil. Mag.*, Nov. 1899) makes the combined prism serve to produce the spectra as well as to effect the desired comparison. The compound prism ABC (Fig. 3) is made up of two equal rectangular prisms ADB and ADC placed with their longer sides in contact, so that the whole forms an equilateral prism with three polished faces. Part of the interface AD is silvered, the silvering forming a narrow central strip running parallel to AD. Along the rest of the interface the two prisms are cemented together with Canada balsam or other material having as nearly as possible the same refractive index as the glass. Now suppose the two rays R S to enter symmetrically from opposite sides of the base of the compound prism as shown in the diagram. The ray R will pass through the prism except where the silver strip intercepts it, and will form a part of a spectrum visible to the eye placed at R′. To the same eye there will be visible the similarly-dispersed ray SS′ reflected from the silvered surface. Thus two systems of incident parallel rays of white light will form on emergence two spectra with corresponding rays exactly parallel. The aim of the experimenter is to make the two spectra of equal intensity by a method which enables him to compare the original intensities of the sources. Now, in spectrophotometric work the relative intensities of the portions of the spectra being compared cannot conveniently be altered by varying the distances of the sources. Recourse is therefore generally had to one of the other methods already mentioned, such as the use of polarizing prisms or of rotating sectors. Under certain conditions Vierordt's method of allowing the two rays to pass through slits of different width leads to good results, but too great confidence cannot be placed upon it.

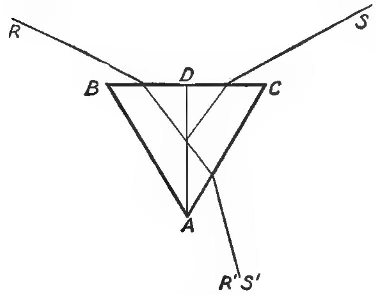

Fig. 3.

An important application of the spectrophotometer is to measure the absorptive powers and extinction coefficients of transparent substances for the differently-coloured rays of light. In such measurements the one spectrum is kept as steady in intensity as possible, though no standard of light has as yet been devised to give a steadiness comparable with the delicacy of the best spectrophotometric measurements. By appropriate means the intensities of chosen corresponding parts of the two spectra are made equal—in other words, a match is established. Into the path of the rays of the second spectrum the absorbent substance is introduced, and a match is again established, and a measure of the loss of luminosity due to the interposition of the absorbent substance is obtained.

It is evident that if the successive parts of two spectra are compared photometrically, we may by a process of summation obtain a comparison of the total luminosities of the lights which form the spectra. This process is far too tedious to be of any practical value, but sufficiently accurate results may in certain cases be obtained by comparison of two or more particular parts of the spectra, for example, strips in the red, green, and blue. Similar in principle is the method suggested by Macé de Lepinay, who matches his lights by looking first through a red glass of a particular tint and then through a chosen green. If R and G represent the corresponding ratios of the intensities, the required comparison is calculated from the formula $I = \frac{R}{1 + 0{\cdot}208\,(1 - GR)}$. Crova, one of the earliest workers in this subject, effects the photometric comparison of differently-coloured lights by matching those monochromatic rays from the two sources which have the same ratio of intensities as the whole collected rays that make up the lights. Careful experiment alone can determine this particular ray, but were it once ascertained for the various sources of light in use the method would have the merits of rapidity and accuracy sufficient for practical needs. Spectrophotometric observations are necessary to determine the position in the spectrum of the particular monochromatic ray, but when it has been determined, a coloured glass may be made which allows light in the neighbourhood of this ray to pass, and the photometric comparison may then be effected by looking through this glass.

Refractometry by total reflection.

Refraction and Dispersion.—The accurate determination of the refractive indices of various substances for rays of definite wave-length, and of the relative refrangibilities of different rays in particular substances, is of the utmost importance, not only in the construction of optical instruments of all kinds, but also in theoretic questions as to the nature of light and the interconnexion of æther and matter. In addition to the direct processes of making these determinations (see *Ency. Brit.* vol. xiv. pp. 590–92; and vol. xvii. pp. 800, 801), there are other processes, somewhat indirect but distinctly valuable and instructive. Some of these are based upon the phenomenon of total reflection, which occurs when a ray travelling in a given medium falls upon the boundary separating it from a less refractive medium at an angle of incidence greater than a particular *critical* angle, whose value depends upon the two refractive indices. The critical angle is such that its sine is equal to the ratio of the smaller to the greater refractive index. Hence any convenient method for determining accurately this critical angle will give at once the ratio of the refractive indices of the two substances for the particular kind of light used. Wollaston was the first to use this method, which has been developed by Terquem, Trannin, Kohlrausch, Pulfrich, and others. One arrangement, which is found to yield results of considerable accuracy, is to form an air cell bounded by two parallel plates of glass of uniform thickness, cemented together at their edges by some material not acted upon by the liquid whose refractive index is to be measured. This cell is then set with the glass walls vertical in the liquid, which is contained in a vessel fitted with parallel glass sides. A beam of parallel rays is passed horizontally through the vessel, liquid, and air cell, and viewed in a telescope placed on the opposite side of the vessel. The air cell is first set so as to receive the rays nearly at right angles to the glass walls, and it is then slowly rotated until the beam as viewed through the telescope vanishes. Another position of vanishing is found by rotating the air cell in the opposite direction. The angle between these two positions can be measured with great accuracy, and is evidently double the value of the critical angle for the liquid and air, since the glass walls of the air cell with their parallel sides in no way affect the *directions* of the rays. When monochromatic light is used the vanishing of the transmitted beam takes place suddenly, so that the critical position of the air cell can be determined with great nicety. With white light the critical angle for the most refrangible rays is first reached; consequently the blue, green, yellow, and red rays are cut off in succession as the air cell is gradually rotated, so that the telescopic field changes first to yellow, then to orange, and lastly to red before disappearing entirely. In a similar way the refractive index of a solid may be determined by immersing it in a liquid of greater refractive power and of known refractive index.

Wollaston's original method has been embodied very skilfully by Pulfrich in his total-reflectometer. To the upper plane horizontal surface of a glass cube or cylinder with axis vertical is cemented a glass tube whose function is to hold the liquid under examination. A slightly converging beam of light is introduced through the wall of the tube so as to impinge at grazing incidence on the upper surface of the glass cube or cylinder, which behaves optically as a right-angled prism (Fig. 4). The rays which suffer refraction at the glass surface will all pass through the glass below a certain line. It is obvious from the diagram that the angle of refraction of this boundary ray as it enters the glass is the critical angle for the glass and the liquid. Its sine therefore measures the ratio of the refractive indices of the liquid and glass. The ray, as it passes on, impinges on the vertical wall of the glass prism, and then emerges into the air, making an angle i with the horizontal. At this second surface the sine of the angle of incidence (within the glass) is equal to the cosine of the angle of refraction at the horizontal surface, that is, to the quantity

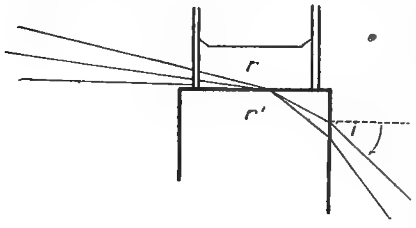

Fig. 4.

$$1-(\mu/\mu')^2$$

where μ, μ' are the refractive indices of the liquid and glass respectively. Hence

$$\sin i=\mu'\sqrt{1-(\mu/\mu')^2}$$

or

$$\mu'^2-\mu^2=\sin^2 i.$$

The angle i can be determined with great accuracy by means of a telescope suitably mounted and directed so as to receive the emerging ray. By first filling the tube with distilled water at a definite temperature, for which μ is known, we can measure μ'; and then knowing μ' we can determine the value of μ for any liquid (and also for any solid) of less refractive power than the glass.

According to the wave theory of light (see *Ency. Brit.* vol. xiv. p. 605), the refractive index of any medium for any particular ray is inversely as the speed of propagation of the ray in the medium. Hence any method of determining directly or indirectly the speed of propagation will also determine the refractive index. The direct measurement of the velocity of light is an operation involving the highest experimental skill in the use of elaborate and delicate apparatus, and practically we infer the value of the speed of propagation in any given case from our knowledge of the value of the refractive index. Nevertheless a very ingenious application of the principle of interference (*Id.* p. 606) has given us a remarkably delicate though indirect method of measuring slight alterations in the speed of propagation, and therefore corresponding slight changes of refractive power. To produce interference phenomena in light we must break up a given ray into two parts, and then bring them together again after the one has described a slightly longer path than the other, or, at any rate, taken a longer time to describe its path. By this means the one set of crests and troughs lags behind the other set with which it was originally coincident. In the fundamental experiments devised by Young and Fresnel, and in the historical form of experiment known as Newton's rings, the interfering pencils of light travel in general along paths of different length. In Jamin's interferential refractometer, on the other hand, the interference effects are produced by a relative retardation of the one ray, which is made to pass through a slightly denser medium than the other.

Refractometry by interference.

Two thick glass mirrors, exactly the same in all respects, are arranged, as shown in Fig. 5, so that their similar surfaces form the opposite sides of a parallelogram whose acute angle is 45°. A ray of light (R) falling on the first mirror at an angle of 45° is partly reflected and partly refracted at the first surface. The refracted part, being reflected at the back of the mirror, emerges (in part) again into the air and pursues a path towards the second mirror parallel to the path pursued by the first reflected ray. These two rays falling on the second mirror suffer various reflections and refractions. It will be seen, however, from the diagram, that the part of the first reflected ray which enters the second mirror and is reflected from its back, finally meets with that part of the second ray which is reflected from the first surface of the second mirror, and both proceed towards the eye of the observer at E. If the mirrors are exactly parallel, these two rays from the time of their separation to the time of their recombination will travel along paths of equal lengths, and since they have experienced the same reflections and refractions, although in different order, will be equally intense when they recombine. If, however, the mirrors are not quite parallel, then, as first observed by Brewster, the two rays will meet after pursuing slightly different lengths of path, and interference bands will be seen. By adjusting the one mirror until the interference bands disappear we get the mirrors accurately parallel. When this has been done let a thin plate (P) of glass or other transparent medium be set in the path of one of the rays. At once interference bands will come into view because of the retardation of the one ray. In like manner we may produce interference bands by introducing into the paths two exactly equal tubes with transparent ends and filled with liquids or gases differing slightly in density. The relative amount of retardation of the one ray is measured by means of a compensator, which retards the other ray by an equal amount so that the interference bands disappear. This is usually a glass plate or a combination of narrow prisms capable of being manipulated so that the thickness of the material traversed by the ray may be varied in a definite manner. With this apparatus Jamin measured the refractive indices of various gases, and of dry and moist air, and studied the change of the refractive index of water with pressure and temperature.

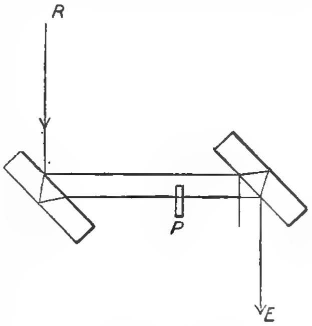

Fig. 5.

In Jamin's apparatus the two rays which produce interference are separated by a distance proportional to the thickness of the mirrors, and since there is a practical limit to this thickness, it is not possible to separate the two rays very far. In Michelson's form of refractometer this limitation is quite removed, and at the same time the experimenter is able to introduce any relative retardation within wide limits, and so to observe interference phenomena corresponding to large differences of path. The essential parts of Michelson's instrument are shown in Fig. 6. P Q are two exactly similar glass plates set parallel to one another, and usually at an angle of 45° to the direction of the ray coming through the slit S. P is silvered on the back with a semi-transparent film, so that the part of the ray reflected internally at this filmed surface is approximately of the same intensity as the part which passes through the film. The reflected ray, deflected through a right angle, falls perpendicularly on the plane mirror M, placed at a convenient distance, and is consequently sent back along the original course to the plate P. The transmitted ray is similarly received by a mirror N, which we shall suppose placed at the same distance as M from the point where the ray splits into two. Since the reflected ray, as it goes and comes, passes twice through the plate P, the paths of the two rays from their point of separation to their point of meeting would not be of the same effective length unless the transmitted ray had also to pass twice through the same thickness of glass. This is the reason for the presence of the plate Q, which simply acts as a compensator. The two rays having thus travelled the same length of path, meet again at the silvered surface of the plate P, and experience once more reflections and refractions. To an eye placed at E there will be transmitted through P part of the ray originally reflected at A, and there will be reflected part of the ray originally transmitted through P. Thus the two rays SAMAE, SANAE, having described paths of equal length, will be in a condition to produce interference phenomena, which will become apparent if any slight alteration in either path is made. Since the one ray has suffered reflection within the denser medium, and the other suffered reflection within the rarer medium, the phases of all the component vibrations will differ by half a period. Darkness will be produced, the conditions being the same as those which give rise to the black spot in Newton's rings. Any slight to or fro motion of either mirror will make the paths travelled by the two rays unequal, and interference bands will come into view. To facilitate the adjustment and make the instrument an instrument of precision one of the mirrors is provided with a fine screw, by which it can be moved through known distances perpendicular to its face. After the paths have been adjusted to equality, which is accomplished by slowly moving the one mirror so as to produce a widening out and final disappearance of the interference bands obtained with monochromatic light, let a slight alteration be made in the density of the medium through which the one ray passes. At once the interference bands will come into view, but they may be made to disappear again by moving the one mirror through the proper distance. This distance is measured in terms of the number of rotations that must be given to the screw by means of which the slow motion of the mirror is effected. The retardation or acceleration of phase is thus accurately determined, with the corresponding change of velocity and density. The instrument has been applied by Michelson and others to a great variety of problems, some of which will be referred to later.

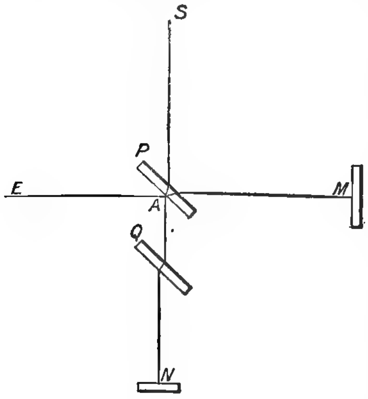

Fig. 6.

Refraction and density.

Of recent years a great deal of experimental work has been done in regard to the effect of changed physical conditions, such as pressure and temperature, on refraction and dispersion in transparent bodies. These effects are too small to have any practical influence upon the optical properties of telescopes and microscopes, but the results are of high importance from a theoretical point of view. The wave theory of light would lead us to expect that any increase in the density of a substance should cause a decrease in the speed of propagation of light through it—that is, an increase in the refractive index. Gladstone and Dale long ago established a simple empirical law connecting the refractive index of a substance and its density, namely, that the refractive index diminished by unity is proportional to the density. The ratio of the two $(\mu-1)/\mathrm{D}$ is frequently called the molecular index, a name which is not, however, altogether satisfactory, since it suggests the rather crude theory that the molecules of a substance have a refractive index analogous to that possessed by the combined system of molecules which build up the substance. Laplace showed that the corpuscular theory of light required the density to be proportional to the excess of the *square* of the refractive index over unity, and more recently H. A. Lorentz and L. Lorenz have independently deduced from special forms of the wave theory the formula—

$$\frac{\mu^2-1}{\mu^2+1}\,\frac{1}{\mathrm{D}}=\text{constant},$$

the investigations of the former being based upon Maxwell's electromagnetic theory of light. If we take a substance, say water, and measure the refractive indices at two different pressures, any one of the three expressions enables us to calculate theoretically the ratio of the densities. But these may be measured directly by a purely dynamic process. Hence by comparing the measured change of density with that calculated from the assumed optical relation, we may test the applicability of this relation. This has been done with great elaboration by Quincke for water, glycerine, rape oil, almond oil, olive oil, oil of turpentine, carbon bisulphide, petroleum, alcohol, ether, and other substances; and in all Gladstone's empirical formula gave most satisfactory agreement. Lorentz's formula has, however, a much wider applicability, for it alone gives the same value for a given substance whether that substance be in the liquid or in the gaseous state.

Refraction and temperature.

It has not been found possible to establish any simple law connecting temperature and refractive index. If it were a mere question of density, then we should expect the refractive index of water at 4° C. (the temperature of the maximum density) to be a maximum also, but this it is not. According to Rühlmann, the refractive index of water decreases steadily as the temperature rises from 0° C., and shows no peculiarity at or near the maximum density point. Müller, Vogel, Offret, Arzruni, Dufet, and others have measured with great care the changes with temperature of the refractive indices of different kinds of glass and the more important crystals. In this direction one fact of a general nature seems to have been established by Pulfrich (*Wied. Ann.*, 1892). Working with several kinds of glass, rock-salt, quartz, and fluorspar, he finds that the dispersion always increases with rise of temperature, in the cases in which the refractive index increases as well as in those in which it diminishes. In other words, when the refractive index increases with temperature, the change in the blue rays is greater than the change in the red rays, and when the refractive index diminishes with rise of temperature the change in the blue is less than in the red. As a general rule the dispersion in liquids and gases diminishes with rise of temperature. In seeking for an explanation of these differences Pulfrich points out that in all cases of change of temperature not only must the accompanying change of density be taken into account, but there is also a probable change in the absorptive power of the body. As will be discussed more fully below, in connexion with anomalous dispersion, there is a close relation between absorption and dispersion. To bring out more clearly the nature of the argument, let us take the case of heavy flint glass as given by Pulfrich. In the first row of the following table, under the letters C D F G′, which represent the red, yellow, and blue rays corresponding to the so-named Fraunhofer lines in the solar spectrum, there are entered the observed rates of increase per degree centigrade of the refractive indices of the four rays. In the second line are given the calculated values of what these refractive indices would be according to Gladstone's law—in other words, the density effect. The third row contains the differences of the corresponding figures in the first and second rows, these being regarded as due to increase in absorptive power at the higher temperature. The increase of absorptive effect as we pass towards the more refrangible end of the spectrum is, according to the various theories of the inter-relation of absorption, refraction, and dispersion, in harmony with an increase of refraction increasing towards the violet end—that is, with an increased dispersion.

Increase per Degree of the Refractive Index.

	C.	D.	F.	G′.
Observed value . . .	+ ·00001204	+ ·00001447	+ ·00002090	+ ·00002810
Density effect, calculation	−2662	−2699	−2799	− 2889
Absorption effect . .	+3866	−4146	+4889	+5699

In general, then, when a rise of temperature takes place, the refractive index is diminished because of diminution of density, but is increased because of increase of absorptive power. The net result will be decrease or increase, according as the former preponderates or is overbalanced. In cases in which the cubical dilatation is small, the probability is that the effect due to increase in absorptive power will preponderate; and this is the case in the glasses and crystals studied by Pulfrich. Later experiments by Reed (*Wied. Ann.* 65, 1898) bear out these conclusions. For example, the increase with temperature of dispersion in fluorspar is very small, a fact in agreement with the small absorbing power of this mineral, the blue and violet parts of the spectrum remaining sharp and distinct even to the highest temperatures. In the case of two kinds of glass experimented with, the dispersion increased only up to a certain limit, and began to decrease at high temperatures approaching the temperature at which softening set in.

Refractive index for metals.

The wave theory of light in its most elementary form shows that a very close connexion must exist between the refractive index and the speed of propagation, and although practically no refracted ray is considered as existing in the case of opaque substances such as metals, nevertheless there may be in these cases also a truly refracted ray penetrating a short but measurable distance into the material. The simplest proof of this fact is that metallic films can be obtained thin enough to be transparent. First, however, it is convenient to draw attention to a phenomenon first observed by Newton and described by Stokes in these words: "When Newton's rings are formed between the under surface of a prism and the upper surface of a lens, or of another prism with a slightly convex face, there is no difficulty in increasing the angle of incidence on the under surface of the first prism till it exceeds the critical angle. On viewing the rings formed in this manner, it is found that they disappear on passing the critical angle, but that the central black spot remains." In other words, the phenomenon of total reflection seems to be fundamentally modified when the layer of air behind the reflecting surface is very thin. The explanation is that the disturbance in the air layer which, under ordinary conditions, penetrates a fraction of a wave-length into the rarer medium, is able to be transmitted as a progressive disturbance into the medium on the other side when the air layer is excessively thin. What takes place in this comparatively simple case of total reflection at the boundary of two transparent media will certainly occur, but with more complex accompaniments, at the boundary of a transparent medium and a highly absorbent and generally opaque metallic substance.

As already stated, metallic films when thin enough become transparent; and by direct measurements with thin metallic prisms of very acute angle Kundt obtained values of the refractive indices of the metals silver, gold, copper, platinum, iron, nickel, and bismuth, and also of some of their oxides. From these it appears that silver, gold, and copper are in general characterized by the possession of refractive indices less than unity, that there is very little dispersion in the case of silver, but that in the case of gold and copper the refractive index increases distinctly from the red to the blue end of the spectrum, becoming unity or very nearly unity for blue light. On the other hand, the refractive indices for the remaining four metals are greater than unity, and diminish in value as the wave-length of the incident light decreases. In other words, these four metals exhibit dispersion, but it is in the opposite direction to that exhibited by ordinary transparent media. Some of these results had already been indicated by indirect methods of testing the refractive powers of metal (see *Ency. Brit.* vol. xiv. p. 613). One of these methods may be briefly referred to. Brewster's law asserts that the tangent of the polarizing angle is equal to the refractive index of the reflecting surface. Now, although metallic surfaces do not possess a polarizing angle in the strict sense of the term, there is a certain angle of incidence for which the intensity of light polarized perpendicularly to the plane of incidence is a minimum. The circumstance that the angle is found to increase with the wave-length of the incident light suggests that the refractive index is greater for the red than for the blue ray. These indications become precise on the now universally adopted theory of metallic reflection, in which the speed of propagation is taken as a complex constant; and their most elaborate unification hitherto made has been in Drude's measurements of the optical constants of metals (*Wied. Ann.* 39, 1890). Experiment shows that if too thin films are used the optical properties and optical constants theoretically deducible from these become quite changed. This is, of course, not surprising. Whatever particular view be taken of the process of reflection of waves of light, the results of experiment will depend sensibly on the state of the transition layer, or on the presence of a thin layer of foreign matter, such as grease on the surface of water. According to Rayleigh's results, the deviation from theory would seem to be naturally accounted for by the effects of such tarnish, without the need of further assumptions.

Selective reflection.

The characteristic feature of metallic reflection is that it is selective. For example, gold leaf which has been beaten out so thin as to be transparent continues to retain its characteristic metallic lustre, but the light transmitted through it is green. Coloured glass, on the other hand, or the translucent petal of a flower, has the same colour, whether studied by means of reflected or transmitted light. In these and similar cases the light thrown back to the eye has been robbed by absorption of certain of its constituents, but in the case of metallic reflection the light that is thrown back contains rays which are not merely the residuum remaining after the absorption of their fellows, but have been selectively reflected before absorption has taken place. This selectively reflected light is but partially polarized by reflection; hence there is no true polarizing angle in the case of metallic reflecting surfaces, but only an angle for which a maximum polarization is obtained.

The property of "metallic reflection" is, however, not confined to metals only, and it was from a study of certain substances showing similar characteristics of what has been called surface colour that Stokes was led to some conclusions of far-reaching importance. The aniline dyes are the most familiar of these non-metallic substances which exhibit metallic reflection. In such cases the metallic reflection is confined to rays of a limited range of colour and wave-length, each substance being moderately transparent to rays of other colours. For these rays of selectively reflected light there is no true polarizing angle, but at considerable angles of incidence the light polarized perpendicularly to the plane of incidence becomes usually of a richer colour in consequence of the removal in great measure of the rest of the reflected light. This portion of the reflected light may also be removed or greatly weakened by the substance being brought into optical contact with a transparent substance of nearly the same refractive index, the rays due to metallic reflection being thus more strongly brought out. For example, when safflower-red (carthamine) is deposited on glass by means of water, and the water is allowed to evaporate, the film obtained reflects a yellowish-green light from the surface in contact with air, but from the surface in contact with the glass a "fine green inclining to blue." Another substance studied by Stokes was crystallized permanganate of potash. When light reflected from a crystal at the polarizing angle is viewed through a Nicol prism, so placed as to extinguish the rays polarized in the plane of incidence, the appearance is green, and analysis by a prism shows five bright bands corresponding to the five dark bands in the spectrum of the light transmitted through a solution of the substance. When the Nicol is turned through a right angle so as to extinguish the rays polarized perpendicularly to the plane of incidence, the bright bands are hardly or not at all perceptible. In many cases the reflected light or surface colour and the transmitted light or substance colour of substances exhibiting metallic reflection are approximately complementary. For example, fuchsine transmits red and violet light and reflects green. As pointed out by Stokes, an accurate complementary relation between the reflected and transmitted lights could be looked for only in the case of excessively thin films of the substance.

Non-luminous rays.

Although in this article we are mainly concerned with the radiant energy which affects our organs of vision, it must not be forgotten that there are other rays which, though invisible, are physically identical in nature with the visible rays. It is important occasionally to refer to these as presenting characteristics fundamentally the same as those of light. Thus, with regard to these other rays—the dark heat or infra-red rays with longer wave-lengths than those of red light, and the invisible actinic or ultra-violet rays with wave-lengths shorter than those of violet—substances may be transparent or opaque, or may exhibit selective reflection. Rock-salt, glass, quartz, and fluorspar are all approximately equally transparent to ordinary light, but experiment shows that rock-salt is very transparent to the dark heat rays to which glass is powerfully opaque, and that quartz and fluorspar are remarkably transparent to the ultra-violet rays, a comparatively large fraction of the energy of which is absorbed by glass. Glass seems to behave towards certain of the infra-red rays as an intensely opaque substance, for, after the radiation has been cut down by passage through a thin glass plate, a second glass plate interposed has very little further effect. The principal absorption occurs at the first glass surface across which the radiations pass; here the glass becomes strongly heated, and becomes itself a radiator for heat rays of comparatively low intensity. It is possible, however, that some of the incident heat rays are reflected without evident absorption, just as in the case of metallic reflection for light. Selective reflection has not, so far, been established for glass, but it has been observed in the case of certain transparent minerals, such as quartz, mica, sylvine, and fluorite. In the experiments of Rubens and E. F. Nichols the selectively reflected rays were isolated from the others by successive reflections from three or more surfaces of the material. By this process all the rays which do not suffer metallic reflection are diminished so greatly in their intensity as to be practically non-existent, while those which do are left in sufficient intensity to be measurable by means of a delicate thermoscope, such as a bolometer or radio-~~micro~~meter meter (see *Physical Review*, vols. iv. and v., 1896–97). They found that in quartz there are three narrow regions of metallic reflection, the maxima corresponding to wave-lengths 0·0085, 0·0090, and 0·0208 mm. These are also, of course, corresponding regions of apparent absorption in the transmitted radiations. The shortest wave-length of the three is about 11·2 times the wave-length of the light corresponding to Fraunhofer's line A in the dark red of the solar spectrum. In mica there are also three narrow regions of metallic reflection not far removed from those in quartz, and in fluorite (Rubens, *Wied. Ann.*, 1899) there are two regions of metallic reflection in the neighbourhood of rays of wave-lengths 0·0244 mm. and 0·032 mm. No evidence of metallic reflection was found in the case of rock-salt, crown glass, flint glass, sulphur, potassium, alum, shellac, and Iceland spar. If it exist it must be for radiations of wave-length greater than 0·025 mm., beyond which, under the conditions of the experiment, it was impossible to go. For these heat rays of long wave-length metal surfaces reflect perfectly, whereas for green rays of wave-length 0·0005 mm. the percentage of the incident light which suffers reflection varies from about 55 for copper to 88 for silver. By direct comparison with silver, Rubens and Nichols determined the percentage of reflection of these heat rays of long wave-length, from which, by the use of Fresnel's formula for reflection, the refractive indices for these rays could be calculated. In the case of rock-salt, sylvine, and chloride of silver the refraction could be studied directly by means of transmission through a prism.

Refractive index and dielectric constant.

The measurement of the refractive indices of transparent substances for rays of long wave-length is of great theoretic interest in its bearing on Clerk Maxwell's electromagnetic theory of light. According to this theory, light is an electromagnetic phenomenon, and one of the simplest relations required by the theory is the numerical identity of the specific inductive capacity of an insulating substance and the square of its refractive index for disturbances of long period. This particular refractive index cannot, of course, be determined directly, but we may gain some indication of its value from a knowledge of the refractive indices for rays of long wave-length in the neighbourhood of the lowest region of heavy absorption (see below, under *Anomalous Dispersion*). The result of the comparison is given in the adjoining table, in which the top row of figures gives the calculated values of the refractive indices of the different substances for rays of infinite wave-length, and the bottom the means of various determinations of the specific inductive capacity or dielectric constant.

Flint Glass.	Fluorite.	Quartz.	Rock-Salt.	Sylvine.
6·77	6·09	4·58	5·18	4·55
7·9	6·7	4·58	5·99	4·94

The remarkable agreement between the values for quartz, as compared with the corresponding values for the other substances, is explained by the fact that the positions of the chief absorption bands in the dark heat rays spectrum had been specially well determined, and is evidence that there are no more in still lower regions. In his paper on the properties of quartz for rays of great wave-length, Nichols has given reasons for the conclusion that for wave-length 0·0074 mm. the refractive index of quartz becomes unity, and rapidly diminishes for longer wave-lengths until the value falls to 0·366 for wave-length 0·00805 mm., this result indicating the existence of a definite region of anomalous dispersion in the dark heat rays of long wave-length. Experimenting on the same lines Aschkinass has demonstrated the existence of regions of anomalous dispersion for infra-red rays in a number of substances, including quartz, mica, fluorite, gypsum, alum, sylvine, rock-salt (*Drude's Annalen*, i., 1900).

Dispersion.

The broad fact of dispersion is that the differently-coloured rays of light suffer different refractions as they pass at oblique incidence from one transparent medium to another. If the wave theory of light be adopted, this fact means that the speed of propagation of a particular ray of light through a material medium depends upon the wave-length associated with that ray. With all approximately colourless transparent media, such as water, glass, quartz, &c., the refrangibility increases as the wave-length diminishes; this relation has consequently come to be regarded as the normal one. The fact that the character and amount of dispersion vary considerably as we pass from medium to medium, and have no necessary relation to the amount of refraction, is of the greatest practical importance in the construction of achromatic lenses (see *Ency. Brit.* vol. xiv. p. 595 and xvii. p. 804). Whatever form of the wave theory be adopted, whether the electromagnetic or the more purely elastic theory, the phenomena of refraction and dispersion must find their explanation in the discontinuity introduced into the æther by the presence of matter. There must be between the molecules of matter and the neighbouring portions of æther a mutual action of some kind, for only by such a supposition can we explain the phenomena of the emission and absorption by different substances of their characteristic rays, or the less prominent but very striking phenomena of fluorescence, surface colour, and anomalous dispersion.

Fluorescence.

Stokes has shown that some idea of the action of the mechanism involved in the phenomenon of fluorescence (*Ency. Brit.* vol. xiv. p. 602) may be obtained from the study of a comparatively simple vibrating system of particles acted on by a periodic disturbing force. If the period of the disturbing force be greater than the natural period of the system the disturbance is transmitted along the system and cannot accumulate at the point where the disturbing force is acting. If, on the other hand, the period of the disturbing force be less than the natural period of the system, the disturbance is not transmitted, but assumes a permanent form as a local agitation, and the system will continue to vibrate after the exciting disturbance has ceased, the quickest vibration being the natural period already mentioned. This illustrates the law that the light due to fluorescence is always of slower vibration and longer wave-length than the exciting light (see Tait's *Light*, pp. 161–163).

Anomalous dispersion.

The experimental investigation into the nature of anomalous dispersion is associated mainly with the names of Fox Talbot, Le Roux, Christiansen, and Kundt. The theoretical explanation is associated historically with the names of Rayleigh, Sellmeyer, Ketteler, and Helmholtz, although it now appears that the problem was first formulated and solved by Clerk Maxwell as early as 1869 (*Phil. Mag.*, 1900). The principle at the base of the explanation is that of resonance, the same principle, in fact, which Stokes first applied (about 1850) to explain the sodium absorption lines in the solar spectrum. The facts of spectrum analysis show that the molecules of matter have natural periods of oscillation, and any vibratory motion isochronous with one of these natural periods of vibration is powerfully absorbed by the corresponding molecules. Hence, if one of the natural periods of molecular vibration is identical with that of a particular ray of light, the substance will behave towards this particular ray and towards rays of nearly the same period after a fashion quite distinct from that in which it behaves towards rays not approximately isochronous with it. The general result indicated by the dynamical theory in any of its adopted forms is as follows:—When a train of æthereal disturbances of period t is incident upon a region occupied by a connected group of particles having a period of free vibration t', the speed of propagation of the disturbance through the connected particles is greatly decreased if t is slightly greater than t', and greatly increased if t is slightly less than t'. When t and t' are equal there is almost complete reflection, so that in the transmitted light the ray of vibration period t will be almost entirely absorbed. That is to say, in the neighbourhood of an absorption band we may expect to find an increase of the refractive index immediately below the absorption band (*i.e.*, towards the red) and a decrease of the refractive index above the absorption band. Now this is exactly the law which Kundt established by experiment. The effect has been detected in the neighbourhood of the two conspicuous lines in the spectrum of sodium vapour, the lines which correspond in position with the double D of the solar spectrum. In this case, however, the effect is comparatively small; it is best observed in preparations of fuchsine and other aniline dyes whose absorption spectra are characterized by one or more broad and dark absorption bands. The most recent measurements of the optical constants of fuchsine are those of Pflüger (*Wied. Ann.* 56, 1895) and Bloch (*Journ. de Phys.* vii., 1898). The former worked with thin prisms of the material formed by evaporation of the alcohol from an alcoholic solution which had been dropped into the fine angle contained between a plane plate of glass and a small portion of a glass tube laid on it. His aim was to obtain direct measurements of deviations of rays passed through the semi-transparent substance. Bloch's aim, on the other hand, was to study the phenomenon of metallic reflection and absorption, and he prepared thin collodion films saturated with fuchsine. By means of interference bands he obtained some beautiful illustrations of the difference in the law of change of phase for reflection from transparent materials like glass and from surfaces showing metallic reflection. Thus, in the neighbourhood of the characteristic absorption band of fuchsine, the surface reflected in this respect like a metal, whereas towards the red and violet ends the reflection was of the ordinary vitreous character. Confining our attention more particularly to the phenomenon of anomalous dispersion, we may reproduce Pflüger's results for his fuchsine prisms.

The refractive indices were measured for eight well-known rays of definite wave-length, namely, the hydrogen lines *h*, and G, the strontium blue, the hydrogen F, the thallium green, the sodium D, the lithium red, and the darkest observable red (about wave-length 0·000671 mm.). The mean values obtained with four fuchsine prisms are given in the second row of the following table, the first row containing the wave-lengths of the corresponding rays, measured in millionths of a millimetre.

Wave-length,	410	434	461	486	535	589	671	703
Refractive index,	1·17	1·04	0·83	1·05	1·95	2·64	2·34	2·30

The absorption band extends from between the F and G lines in the blue to beyond the D line in the yellow, and in some of the prisms it was not possible to obtain measurements with the rays of wave-lengths intermediate to these extremes. The results are shown graphically in Fig. 7, from which at a glance will be seen the broad features of anomalous dispersion. Thus the refrangibility of the blue and violet light is less than that of red and yellow. There is, in accordance with Kundt's law, a decrease of refractive index above the absorption band and an increase below the absorption band, the position of which in the diagram is shown by the thick line below the dispersion curve. An interesting feature is the measurement of a refractive index less than unity, just at the more refrangible end of the absorption band. For this particular cluster of rays the speed of propagation is greater in the substance than in æther, a result which recalls the similar property possessed by silver. It is just here also that fuchsine shows surface colour and reflects like a metal. The possibility of the refractive index becoming less than unity in the case of bodies like metals which are powerfully absorptive was shown by Helmholtz to be a natural result of the dynamic theory of light. Pflüger investigated similarly a number of other substances, but of these Hofmann's violet was the only other one which gave a refractive index less than unity. He also described some beautiful colour phenomena obtained by reflecting light at various incidences from the surface of fuchsine in contact with glass. The layer of fuchsine was prepared by allowing a hot solution of it in alcohol to harden on to the surface of a strongly heated glass plate or prism. As the angle of incidence was increased the green surface colour obtained with smaller angles of incidence suddenly changed to the clear blue of the totally reflected rays at the higher angles of incidence.

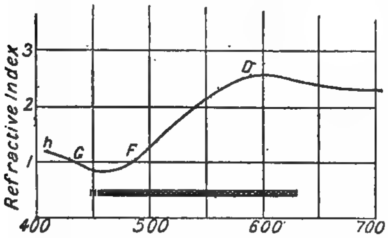

Fig. 7.

As already pointed out, the explanation of anomalous dispersion depends upon the principle of resonance. For ordinary dispersion the first theory, that of Cauchy, depended simply on static discreteness of the medium; but Kelvin showed that the number of molecules per wavelength (10^3) is far too great to account for dispersion so intense as actually occurs. Thus a complete theory must from the start take into account not only the nature of the stresses acting between the different parts of the molecular and æthereal system—whether they be due to relative motion, as in the case of frictional forces, or to relative configuration—but also the free vibration periods of these parts. The conditions when written down in the form of a differential equation lead mathematically to certain conclusions which give a sufficient explanation of the facts of anomalous dispersion. Take as an example the mode of attack from the standpoint of the electromagnetic theory.

The fundamental assumption is that the disturbance which is propagated as light is an electric disturbance, or rather a series of electric waves of definite wave-lengths and periodic times. In any material medium the molecules or molecular groups respond in some way to the periodic electric force acting in their immediate neighbourhood. Whatever the precise character of this action, it can at all events be mentally imaged as producing a displacement of electric charge. We may form the concrete conception of atomic charges or ions, each individual charge being associated always with a definite molecular mass, or we may think of the electric displacement as occurring within the molecular group, but in such a manner as to involve movements of mass. The former conception is more easily grasped and is capable of simpler treatment. The problem may then be stated thus. As the train of waves passes, a periodic electromotive force acts upon each ion, which has a period of its own about its position of equilibrium. This assumption taken along with the general equations of the electromagnetic field (see ELECTRICITY: *Electric Waves*) leads to an expression for the refractive index of the form

$$\mu=\mu_0+\frac{M_1}{\lambda^2-\lambda_1^2}+\frac{M_2}{\lambda^2-\lambda_2^2}+\frac{M_3}{\lambda^2-\lambda_3^2}+\ldots$$

where $\lambda_1, \lambda_2, \lambda_3\ldots$ are the wave-lengths which correspond in period to the times of free vibration of the different sets of ions, λ is the wave-length of the transmitted ray, and μ_0 and the M's are constants to be determined by experiment, but depending ultimately upon the electrical properties of the medium. Through any range of values of λ which is included between two of the values $\lambda_1, \lambda_2, \lambda_3\ldots$, the dispersion is normal, and in the special case in which the values $\lambda_1, \lambda_2, \lambda_3\ldots$ are much smaller than λ the formula takes the form obtained by Cauchy. On the other hand, when the range of values of λ includes one or more of the quantities $\lambda_1, \lambda_2, \lambda_3\ldots$ the dispersion becomes anomalous, for in this case the expression $M/(\lambda^2-\lambda_1^2)$ changes abruptly from $+\infty$ to $-\infty$ as λ diminishes through the value λ_1. But physically the region in the neighbourhood of λ_1 is a region of selective absorption. Hence, as we approach this region (supposed drawn out as a spectrum) from the side of longer wave-lengths the refractive index is abnormally increased, whereas if we approach from the side of shorter wave-lengths the refractive index is abnormally decreased. This is the law established experimentally by Kundt (see above).

Rotational Effects in Polarized Light.—The main characteristics of plane, circularly, and elliptically polarized light are fully expounded in the *Ency. Brit.* vol. xiv. pp. 611–13, where the usual methods are described by which these peculiar conditions are obtained. Of special importance for our present purpose is the discussion of the purely kinematical process by which the vibrations which constitute two rays of plane polarized light combine under suitable conditions to produce in general elliptic polarization. It thus appears that both circular and plane polarization are limiting forms of elliptic polarization. For the co-ordination of many phenomena this kinematical view suffices, and without committing ourselves to any dynamic theory of the constitution of the æther we may assume the simplest conception of a transverse vibration of a simple harmonic type, and consider how far this assumption can lead us in discussing the various phenomena of what is called in somewhat elliptic language Rotatory Polarization. Under this term we group a variety of phenomena, the common feature of which is that the plane of polarization of a plane polarized ray is rotated when the ray is passed through a particular medium or reflected from a particular surface.

It was discovered by Arago in 1811 that when a plate of quartz cut perpendicularly to the optic axis is inserted between two crossed Nicols (that is, two Nicol prisms adjusted for complete extinction of light) a certain amount of light passes through. Should the plate of quartz be thick, say an inch or more, the transmitted light will not be changed appreciably in colour, but if it is thin enough an originally white beam of light will after transmission emerge coloured. The thinner the plate the more saturated the colour, which will change if either of the Nicols is rotated round the axis of the beam. The true nature of the phenomenon is at once demonstrated if instead of ordinary light we use homogeneous light, say, the yellow sodium light obtained by burning common salt in a spirit flame. Let the Nicols be adjusted for extinction and the quartz plate inserted between them. Then as before a certain amount of light will be transmitted, but there will be no change of colour. By rotation of either Nicol through an angle depending on the thickness of the quartz plate this yellow light will be extinguished. For example, with a quartz plate 1 mm. thick it will be necessary to rotate the one Nicol through an angle of about 21·7° before the light disappears. For plates of other thicknesses the required rotation is proportional to the thickness. The direction in which the second Nicol or analyser must be turned depends upon the kind of quartz, which may be either right-handed or left-handed in its rotational effect. The distinction is important, but the nomenclature is to some extent conventional. It is usual now to define right-handed quartz as that kind which produces rotation of the plane of polarization in the direction which is right-handed with reference to the direction of propagation of the ray.

This experiment shows that the plane of polarization of a plane polarized ray of homogeneous light which has been transmitted through a piece of quartz in a direction parallel to the optic axis of the crystal suffers a definite rotation for every unit thickness travelled through. With the further experimental fact that the angle of rotation increases with the refrangibility of the light used we are able at once to understand the change of colour of the transmitted beam when white light is used. There is, in fact, a rotational *dispersion* of composite light. When a plane polarized beam of composite light is passed through the quartz plate the planes of polarization of the differently-coloured constituents are rotated through different angles. Let the emergent beam be viewed through a second Nicol which polarizes light in a plane making angle α with the plane of polarization of the light before it entered the quartz; and let θ be the angle of rotation produced by the quartz upon the plane of polarization of a particular constituent of intensity I, which we assume to be proportional to the square of the amplitude of the associated vibration. Then the intensity of this kind of light transmitted through the second Nicol will be $I \cos^2 (\alpha - \theta)$. Hence a greater proportion of the light of a given colour will pass the nearer $(\alpha - \theta)$ is to zero or to any multiple of two right angles. Consequently the prevailing tint will be determined by the rays for which $(\alpha - \theta)$ has the smallest value, or has values in the neighbourhood of even multiples of a right angle. As the second Nicol is rotated the prevailing tint will change, passing up the spectrum towards violet or down the spectrum towards red according to the direction of rotation. A beautiful and instructive method of making the experiment is to view the emerging beam through a spectroscope, the original beam having been passed through a narrow slit so as to obtain a fairly pure spectrum. When the quartz plate is inserted between the polarizer and analyser the spectrum will be seen crossed by a dark band, the centre of which marks by its position the particular coloured ray whose plane of polarization has been rotated so as to be perpendicular to the plane of polarization corresponding to the position of the second Nicol or analyser. If a thicker piece of quartz be used two or more bands may be seen, and if a very thick plate be interposed the spectrum will appear to be crossed by a large number of narrow bands.

Rotatory dispersion.

In the following table for quartz (abridged from Winkelmann's *Physik*) the authority for the infra-red rays is Hussel, for the luminous and actinic rays Soret and Sarasin. The wave-lengths of the rays are given in the second column, and the rotations of the plane of polarization in the third:—

Ray in Solar Spectrum.	Wave-length 10^{-6} mm.	Rotation in Degrees.	
σ	950	8·467	infra-red.
Y	899	9·117	
X	849·7	10·167	
Z	822·6	10·939	
A	759·4	12·668	visible spectrum.
B	686·7	15·746	
C	656·3	17·318	
D	589·6	21·684	
D	589·0	21·727	
E	527·0	27·543	
F	486·1	32·773	
G	430·8	42·604	
h	410·2	47·481	
H	396·9	51·193	
K	393·3	52·155	ultra-violet.
L	382·1	55·625	
M	372·7	58·894	
N	358·1	64·459	
O	344·1	70·587	
P	336·1	74·571	
Q	328·7	78·579	
R	318·0	84·972	

Biot's law that the rotation is inversely as the square of the wave-length is only approximately true. Tait suggested a series of inverse even powers; and Peddie showed (*Proc. R. S. E.*, 1882) that with three terms the rotation could be represented with great accuracy.

Similar rotatory power is possessed by other crystals, of which may be mentioned cinnabar (32·5°), benzil (24·84°), hyposulphate of potash (8·39°), hyposulphate of lead (5·53°), chlorate of sodium (3·16°), and hyposulphate of calcium (2·09°). In these and similar cases the effect depends upon the crystalline arrangement of the molecules, for in amorphous conditions most of the substances lose their rotatory power. Thus fused quartz or quartz dissolved in potash has no rotatory effect on plane polarized light. Sulphate of strychnine and alum of amylamine are exceptions to this rule, being active in both the crystallized and fused condition. The rotatory power is, however, much feebler in the fused condition.

In remarkable contrast to the action of crystals is the action of certain solutions which cannot be regarded as being other than isotropic in mass, but which yet have the same power as quartz in rotating the plane of polarization of light passed through them. The effect is distinctly smaller than with quartz, but it occurs to equal degree in all possible directions through the solution. With quartz and most other rotatory crystals, on the other hand, the rotation is greatest when the light is transmitted along the optic axis, and is zero when the ray is passed perpendicular to the axis. Obviously the phenomenon in the case of solutions must depend upon the construction of the molecule, and Le Bel and van 't Hoff have connected it with the manner in which the carbon atom enters into combination with the other constituents of the molecule. The following table gives the rotation on red light produced by a few of these active substances, the thickness being one decimetre. The positive sign means right-handed rotation, and the negative left-handed.

Rotation in liquids.

Essence of Seville orange	+78·94
,, citron	+55·3
,, lavender	+ 2·02
,, aniseed	− 0·7
,, mint	−16·14
,, turpentine	−29·6
Solution of cane sugar, 50 per cent. in water	+33·64
,, quinine, 6 per cent. in alcohol	−30

In none of these cases does the rotation amount to 1° per millimetre thickness. For sufficiently dilute solutions the rotation is approximately proportional to the quantity of the active substance contained in unit volume.

If unit mass of the solution contains m grammes of the active substance, and s is the density of the solution, ms will be the density of the active substance in the solution. Let a thickness t of the solution produce a rotation r, then the specific rotatory power is defined by the ratio r/tms. What is known as the *molecular rotatory power* is obtained from this by multiplying by the molecular weight W of the dissolved substance and dividing by 100, or

$$\rho = \frac{W}{100} \cdot \frac{r}{tms}.$$

In sugar solutions this quantity is approximately independent of the concentration. In no case, however, is it found to be absolutely constant, and in many cases it varies both with the concentration of the solution and with the nature of the solvent. Anomalous effects have also been obtained when two active substances have been mixed in one solution. In cane sugar solutions the specific rotatory power is about 66° for yellow light; in quartz it is 830°. According to Nasini, the specific rotatory power is especially great in solutions of santonin (202°), santonid (700°), and para-santonid (890°).

Various special forms of polarimeters, usually called saccharimeters, have been constructed to facilitate the measurement of the rotation in the case of sugar solutions, the method being one of great practical importance in sugar analysis. The end aimed at in all these instruments is to obtain an accurate determination of the position of the plane of polarization. A description of the ingenious combinations associated with the names of Stavart, Jellett, Laurent, Soleil, Wild, and others, will be found in books specially devoted to the subject of saccharimetry. There is, however, one important piece of apparatus, namely, the biquartz, which demands more than a passing mention. The biquartz consists of two semicircular discs of quartz placed in juxtaposition so as to form one circular disc. Both are cut perpendicular to the axis and are of the same thickness, but they produce opposite rotations upon the plane of polarization of a given ray transmitted through them. The particular thickness chosen is that for which the plane of polarization of the brightest part of the spectrum, namely, the yellow, is turned through an angle of 90°. When such a biquartz is inserted between two parallel Nicols, this particular yellow light will be cut out by both halves of the biquartz, and the tint will be the same grayish violet all over the field of view. A slight rotation of the analysing Nicol in either direction will cause a change of tint in both halves of the field, but it will be a change towards blue in the one and towards red in the other. Thus the position in which the uniform tint is observed is determined with great precision, and we then know that the plane of polarization of the light incident on the biquartz is perpendicular to the principal plane of the analyser.

Theory of rotatory polarization.

Fresnel's explanation of the rotation of the plane of polarization depends on the fact that a plane polarized ray of light may be decomposed into two circularly polarized rays polarized in opposite directions. Suppose, for example, that the æther vibration is taking place with simple harmonic motion along the line AOA′ (Fig. 8), and that OP is the displacement at any instant. If we take O′ so that $OO' = O'P = \frac{1}{2}OA$, then OO′ and O′P will rotate at the same rate in opposite directions. O′ will describe a circle about O, and P will describe an equal circle, but in the opposite direction, about O′. These two circular motions combine to produce a resultant rectilinear motion along AA′. When a plane polarized ray falls perpendicularly upon the face of a disc of quartz cut perpendicular to the optic axis, the supposition is that the ray is decomposed into two circularly polarized components, polarized in opposite directions, and that these travel with different speeds through the quartz. If we follow in imagination the progress of the one circularly polarized ray and compare the *simultaneous* disturbances due to the two rays as they exist at any one place, we shall find that the difference in phase has changed by an amount which increases with the distance travelled. Consequently on emergence from the quartz the two circularly polarized rays which begin again to travel with the same speed will combine to form once more plane polarized light, but polarized in a plane which is displaced relatively to the original plane of polarization through an angle proportional to the thickness of the quartz plate. Thus if OO′ and O′P represent the combination that would have occurred had the two circularly polarized rays travelled with the same speed through the quartz, and if the angle PO′Q is the relative phase retardation produced as explained above by the different speeds of propagation of the two rays, then on emergence the combination will be OO′ and O′Q, and, since the corresponding circular motions will thereafter be propagated with the same speed, they will conspire to produce the rectilinear motion BOB′. The angle of rotation of the plane of polarization will evidently be $AOB = POQ = \frac{1}{2}PO'Q$ = half the relative phase retardation.

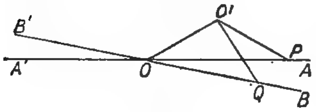

Fig. 8.

The peculiar action on which this explanation is based is the transmission through the crystal or other active substance of a circularly polarized ray with a speed which depends on the direction of rotation of the concomitant vibration. By a simple combination of quartz prisms, alternately right-handed and left-handed, Fresnel decomposed and dispersed a plane polarized ray into two parts which were found to be circularly polarized in opposite directions, thus demonstrating the real existence of the decomposition. The explanation given by Fresnel is of course purely kinematical, but in all more ultimate theories which strive to exhibit optical phenomena as a direct result of dynamical reasoning based on some plausible assumptions as to the forces which act between æther and matter, the only simple wave trains that can be propagated without change are two circularly polarized ones. The modification is attained by introducing into the equations of motion forces which have a rotational effect. Airy and MacCullagh were the first to show how this might be done so as to co-ordinate the rotatory phenomena exhibited by quartz and solutions of active substances. To Airy also we owe the discussion of the remarkable phenomena of coloured rings and spirals, which are produced when polarized light is transmitted through quartz in a direction slightly inclined to the optic axis of the crystal. As the direction of transmission deviates from parallelism to the axis, Fresnel's circularly polarized components become elliptically polarized, the major axes of the two associated vibrations being at right angles to each other. Airy established the fact by direct experiment, and found that the ratio of the minor to the major axis rapidly diminishes as the deviation from parallelism to the optic axis increases. So rapid is this diminution that when the angle of deviation exceeds 10° the elliptic polarization can with difficulty be distinguished from plane polarization. To put it otherwise:—A circularly polarized ray is transmitted unchanged parallel to the optic axis, and a plane polarized ray is unchanged when transmitted perpendicular to the axis. For any other direction of transmission there are two particular elliptically polarized rays which are transmitted unchanged. These have the same ellipticity, which rapidly diminishes as the direction of transmission deviates from coincidence with the optic axis, they are polarized in opposite directions, and the major axes are perpendicular to each other. On these principles, and with the further assumption that the wave surface in quartz consists of a spherical sheet wholly surrounding a prolate spheroidal sheet, Airy very successfully co-ordinated the remarkable phenomena observed when a convergent beam of polarized light is passed through a plate of quartz cut perpendicularly to the axis and then viewed through a Nicol's prism. As an illustration of the nature of the phenomenon, take the case in which the quartz plate is interposed between two crossed Nicols, the transmitted beam being convergent. Coloured rings are at once observed, recalling at first glance the similar phenomenon when a doubly refracting but non-rotating crystal is used instead of the quartz (see *Ency. Brit.* vol. xiv. p. 613). But the central black cross is absent. At a considerable distance, however, from the centre, the colour of which is determined by the thickness of the plate, four faint brushes make their appearance intersecting the rings in the same directions as the black cross in Iceland spar. When the one Nicol is rotated a small cross begins to appear in the centre, the brushes get fainter, and the rings change form and colour, becoming approximately square when the Nicols are half way between the crossed and parallel positions. If the rotation is continued until the Nicols are parallel, the rings pass back into their circular form, while the brushes come out bright. When the incident light is circularly polarized the appearance is that of two spirals intertwined. Pocklington (*Phil. Mag.* vol. ii., 1901) has observed the spirals in crystals of sugar, a theoretical investigation based upon the electromagnetic theory of light having led him to look for such effects in bi-axal crystals of substances possessing rotatory power in the state of solution.

Airy's spirals.

No natural bi-axal crystal is known to possess the power of rotating the plane of polarization. It has, however, been shown, especially through the experiments of Reusch, that a pile of thin layers of mica suitably arranged over one another possesses optical properties

Reusch's pile of mica plates.

analogous to those of quartz. On the basis of these experiments Mallard has elaborated a theory of rotatory polarization applicable to crystals with one axis of geometric symmetry. When a plane polarized ray falls perpendicularly on a plate of mica, it is in general decomposed within the crystal into two components which travel with different speeds, and in consequence the emerging light is in general elliptically polarized. More generally, an elliptically polarized ray, passed through a very thin layer of mica, will emerge still elliptically polarized, but with the ellipticity and the azimuth of the major axis slightly altered. Suppose now that a pile is formed of a number of similar sheets of mica so arranged that the principal sections of each successive pair make with one another the same angle measured in the same sense as we pass through the pile. Also let the number of sheets be such that one more, if added according to the same rule, will have its principal sections parallel to those of the first. Under these conditions it is found that a ray of elliptically polarized light of the kind just described will after transmission through the pile continue as an elliptically polarized ray of practically the same ellipticity, but with the azimuth of the major axis rotated through an angle which increases with the number of sheets of mica. A plane polarized ray will emerge slightly elliptical, but the ellipticity will be less pronounced the thinner the sheets that make up the pile. According to this theory, quartz is to be regarded as built up of doubly refracting layers, none of which possesses individually the rotatory power, but which collectively do possess that power by virtue of an arrangement similar to the arrangement in Reusch's piles of mica sheets. This theory implies that no bi-axal crystal can produce rotatory polarization, for the arrangement required necessarily involves uni-axal symmetry. It is able to explain all the phenomena as they are found in quartz and similar crystals, but it fails of direct application to the case of cubical crystals, such as chlorate or sulpho-antimoniate of sodium, in which the rotatory effect is produced in all directions. For the same reason it is inapplicable to the case of solutions. Rotatory power may also be induced in a substance by subjecting it to a torsional strain. According to Ewell (*American Journal of Science*, vol. viii., 1899), the rotational effect in twisted glass and in gelatine is opposite to the twist.

Magnetic rotatory polarization.

Faraday's discovery in 1845 of the rotatory polarization associated with the magnetic field opened up a new line of research of deep theoretic importance. With the powerful magnetic fields now at our disposal there is no difficulty in repeating Faraday's experiment. Broadly stated, the general result is that when a ray of plane polarized light is transmitted through a substance set in a magnetic field codirectional with the ray, the plane of polarization is rotated by an amount which depends upon the nature of the substance, and which increases with the strength of the field and with the thickness of material passed through. The sense of the rotation is, with comparatively few exceptions, the same as the sense of revolution of the current which establishes the field—that is, it is right-handed with reference to the direction of magnetization. In this particular the law of the phenomenon is essentially different from that which holds in the case of quartz, sugar, and other naturally active substances. In these instances of rotatory polarization the sense of rotation is the same relatively to the direction of propagation of the ray; but in magnetic rotatory polarization the sense of rotation is determined by the direction of the magnetization. Thus, if the ray is by reflection at the one end made to pass to and fro along the active medium so as to emerge at the end through which it entered, there is no final change in the position of the plane of polarization when the substance is one that possesses the rotatory power naturally; but when, on the other hand, the effect is due to magnetization, the plane of polarization of the doubly transmitted ray is rotated through double the angle through which it is rotated by single transmission through the magnetized substance. The phenomenon may be explained along the lines of Fresnel's hypothesis as due to a difference in the speeds of propagation in a magnetic field of two circularly polarized rays polarized in opposite directions. As a rule the greater speed is possessed by the circularly polarized ray whose associated vibration is executed in the same sense as the helical current that establishes the field. Righi has experimentally demonstrated the existence of double refraction of circularly polarized light in a magnetized medium. The most powerful rotational effects per unit thickness of material have been obtained, as might have been expected, from thin transparent films of iron, nickel, and cobalt, the three ferromagnetic metals. Kundt estimates the rotation per millimetre in strongly magnetized iron to be 20,900°, and du Bois finds for nickel and cobalt the corresponding numbers 19,800° and 8900°. Another peculiarity in connexion with these metals is that the rotation is greater for red rays than for blue rays—in other words, the dispersion is "anomalous."

The Kerr effect.

Rotational effects are also produced, as was first shown by Kerr, when polarized light is reflected from the surface of these metals strongly magnetized. Even under the most favourable conditions the rotation is small and difficult to observe. The sense and amount of rotation depend upon the relation of the magnetization to the aspect of the reflecting surface and to the angle of incidence of the ray, and upon the relation of the plane of polarization to the plane of incidence. In these experiments the effect is not a simple rotation of the plane of polarization, for a certain amount of elliptic polarization is produced even in the cases in which the plane of polarization is either perpendicular or parallel to the plane of incidence. The full discussion of the results belongs rather to magnetism than to light. The phenomena of the magnetic rotatory polarization of light are of great theoretic importance, forming as they do a strong argument in favour of Maxwell's theory that light is an electromagnetic phenomenon.

In the original form of the electromagnetic theory of light, as it left Maxwell's hands, no explanation was afforded of dispersion, regular, anomalous, or rotatory. To take account of these phenomena it has been found expedient to introduce permanently charged molecules of matter, the so-called ions. A certain number of these are conceived as existing in every body, and as subject to vibratory and translational motions. Since such a moving charge of electricity will be influenced by a magnetic field, it is not difficult to see that the propagation of an electromagnetic disturbance like light may influence and be influenced by the presence of the moving ions. Worked out along these lines, the electromagnetic theory of light has, in the hands of Helmholtz and others, led to formulæ broadly similar to the formulæ obtained on the elastic solid theory by taking into account the vibrations of the molecules.

In his *Lehrbuch der Optik* (1900) Drude assigns on theoretical grounds a formula for the rotatory dispersion of quartz, namely,

$$d=\frac{k_1}{\lambda^2-\lambda_1^2}+\frac{k'}{\lambda^2},$$

where λ is the wave-length of the transmitted ray, λ_1 the wave-length of the light whose period of vibration is equal to the period of the ions of a particular class, corresponding to which k_1 is the dispersion constant. The constant k'

is the dispersion constant associated with groups of ions whose vibration period is too slow to be comparable with the vibration period of any ray within the range of wave-lengths contemplated. When the value chosen for λ_1 is that which has been found from experiments on prismatic dispersion, the formula just given represents very satisfactorily the observed rotations. This is shown in the following table, condensed from Drude, λ_1^2 being equal to 10,627, and the constants having the values $k = 12,200,000$, $k' = 5,046,000$:—

Wave-length.	Dispersion. Observed.	Dispersion. Calculated.
2140	1·60	1·57
1450	3·43	3·43
670·8	16·54	16·56
589·3	21·72	21·70
480·0	33·67	33·60
344·1	70·59	70·61
219·4	220·72	220·57

The Zeeman effect.

In 1896 Zeeman discovered that the spectral lines emitted by a flame charged with sodium vapour are altered when the flame is placed in a strong magnetic field. The effect as first observed was that the lines became broader; but improved experimental means have shown that the effect is essentially a triplication or even higher multiplication of each line. The triplication is evident when the luminous source is viewed at right angles to the direction of the magnetic force acting on it, and in such a case the central line is polarized at right angles to the magnetic field, while the outer lines have their plane of polarization parallel to the magnetic field. Duplication only is seen when the light is viewed along the direction of the magnetic field, and the two lines so observed belong to rays of light circularly polarized in opposite directions. These are the main facts, but there are various modifications determined by the nature of the radiating substance. The amount of separation between the limiting lines produced by triplication or multiplication of each originally single line of the spectrum of any one substance (*e.g.*, cadmium) depends upon the wave-length as well as upon the strength of the magnetic field (Preston, *Phil. Mag.* vol. xiv., 1898). The general explanation of the phenomenon follows at once from Maxwell's electromagnetic theory of light, taken in conjunction with the obvious hypothesis, that in the molecules whose vibrations are the source of the radiations there are *electrical* vibrations which will respond to a magnetic force brought to bear upon them. Taking the simplest hypothesis as to the constitution of the ions, we may consider one of these to be describing a small orbit about a position of equilibrium, and subject to a force directly as the distance from this position. If no extraneous force be in action, this orbit will be an ellipse described in a definite period, which will correspond to the period of one of the rays emitted. When a magnetic force is brought into action the ion will be acted upon by a force perpendicular both to the magnetic force and to the direction of motion of the ion, and proportional to the strength of the magnetic force and the speed of the ion conjointly. These conditions lead mathematically to the approximate result that the vibration period will be tripled. This very simple case cannot, of course, be expected to apply generally, but it indicates the character of the perturbation produced by the magnetic force upon the orbital motion of the ions, or whatever corresponds to them, in the electrical constitution of the radiating body. Corresponding changes are observed in the absorption spectra of gases subjected to a strong magnetic field. Theoretic considerations led Tait and others to look for such an effect, with less powerful instruments, many years ago (*Proc. Roy. Soc. Edin.*, 1876).

Relative Motion of Matter and Æther.—The phenomenon of aberration of light depends (*Ency. Brit.* vol. xiv. p. 584) upon the ratio of the earth's orbital speed to the speed of propagation of light as it enters the eye of the observer. The direction of propagation of a ray in an isotropic medium, such as we believe the æther to be, is at right angles to the wave-front, and to an observer passing *through the æther* parallel to this wave-front, the apparent direction of the ray will be deflected forwards in the direction of the observer's motion. The simplest assumption is that the earth moves through a quiescent æther. According to the view which regards the æther as transmitting vibrations like an elastic solid—a view which for present purposes may be taken as including Fresnel's theory—the speed of propagation is inversely as the square root of the density. If V is the speed of light in free æther, of which we take the density as unity, and if V′ is the speed of light in a transparent material medium such as glass or water, that is, in æther loaded with matter so that its effective density as a transmitter of elastic vibration is D, then we have $(V/V')^2 = D/1$. Or, since V/V′ measures the refractive index n, we find $D = n^2$. In words, the effective density of æther is increased by the presence of matter in the ratio of the square of the refractive index to unity. What is the mechanism of this increase? Is the æther really condensed, so that unit volume contains more of it within a region occupied by matter, or is the greater effective density the result of the entanglement of matter and æther, the former exerting a drag upon any motions that may exist in the latter? Both of these views can be made consistent with the hypothesis of a quiescent æther outside the material substance, which the fact of aberration seems to demand. Now, experiment shows that the laws of reflection and refraction of light at and across the boundary of a transparent body moving with the earth, and therefore moving relatively to the æther outside it, are exactly the same as if there were no relative motion. The simplest explanation of this fact would, of course, be that the æther is partaking of the earth's motion—is, in short, at rest relatively to the earth. But this contradicts the hypothesis suggested by the fact of aberration. Fresnel showed, however, that it was possible to keep the hypothesis of the quiescent æther, and yet satisfy the condition that reflection and refraction take place as if there were no relative motion of matter and æther. The nature of the argument may be indicated by taking a simple example. Suppose a ray of light (Fig. 9) to be passing through a transparent slab, which is moving parallel to itself with speed v, and suppose the observer to be moving with the slab. This is the same thing as if the slab were at rest and the æther moving with an equal but opposite velocity. For simplicity of calculation we may take the thickness of the slab to be measured by the quantity $V'(=V/\mu)$, the speed of light in the slab when there is no relative motion of the slab and the æther. Let V be the speed of light in free æther, and let v' be the speed of the æther itself within the substance, v being its speed outside. Take the point A at a distance V from the slab, and consider the path of a ray of light moving through the æther in a direction perpendicular to the velocity v. The ray will travel along AB, which makes with the normal to the surface a small angle whose tangent is v/V.

Speed of light in moving medium.

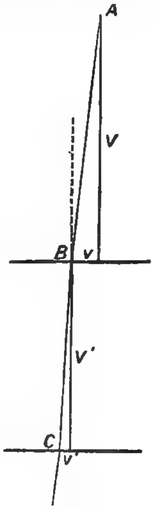

Fig. 9.

Its future course will be along BC, which makes with the normal an angle whose tangent is v'/V'. These angles are very small, and to this order of small quantity there is no experimental evidence of a change of the law of refraction due to relative motion of matter and æther. Consequently the ratio of the sines of the angles of incidence and refraction is equal to the refractive index, or

$$\frac{v}{V}\bigg/\frac{v'}{V'}=\mu=\frac{V}{V'}, \text{ whence } v=\mu^2v'.$$

Now superpose upon the system a velocity v in the direction in which the slab was originally regarded as moving. This reduces the æther to rest, but the velocity of light through the moving slab is increased by an amount equal to $(1-\mu^{-2})v$ in the direction of the velocity v of the slab. We may follow Fresnel and speak of this as indicating a drag of æther with the body, but that view is not a necessity. There is no difficulty in conceiving the possibility of the speed of propagation of a disturbance in æther being influenced by the action of matter through it. Poincaré in his *Théorie mathématique de la lumière*, vol. i. chap. viii., has shown how this may occur. Larmor has more recently discussed the problem on the basis of the electromagnetic theory of light (see *Æther and Matter*, 1900), and has obtained Fresnel's expression on the assumption that there is a material polarization current depending partly on the motion of the substance, together with an æthereal displacement current depending on strain in a fixed æther. (See ÆTHER.)

Fizeau's experiment.

The accuracy of Fresnel's expression was proved experimentally by Fizeau, who found that the velocity of light was accelerated in running water, but that the amount of increase fell short of the velocity of the water. The interference method used was that described in the *Ency. Brit.* vol. xiv. p. 607. The experiment has been repeated in an improved form by Michelson, who finds that the fraction of the velocity of the water by which the velocity of light is increased is 0·434 with a possible error of ± 0·02. The value according to Fresnel's expression is $(1-\mu^{-2})$ or 0·437.

Drag of æther on matter.

Direct experiments have been made to determine whether any real drag of æther takes place when matter moves swiftly through it. Lodge (*Phil. Trans.* vol. clxxxiv., 1893) studied the behaviour of a beam of light which was divided into two portions by a semi-transparent mirror as in Michelson's interferometer, these portions being made to travel by means of suitable reflections along equal paths, but in opposite directions, several times round the circumferential region enclosed between two large parallel steel discs which could be set in rapid rotation. Any appreciable drag of the æther in this narrow region between the discs would declare itself by an interference effect due to the one half of the original beam being accelerated with respect to the other. The result was negative, there being no appreciable drag of æther in the neighbourhood of small bodies in rapid motion near the earth. Zehnder (*Wied. Ann.* Bd. lv., 1895) attempted to obtain a variation in the density of the æther by the rapid to-and-fro motion of a piston in a chamber from which the air had been removed. To detect this possible variation an interference method was used. The result was negative. In these experiments, and others of a similar character, the sensitiveness is not sufficient unless the effect looked for depends on the first order of small quantities, those namely of the order v/V, and the hypothesis of a quiescent æther, which the fact of aberration seems to require, can be brought into harmony with these negative results by taking into account the one other positive result verified by Fizeau and Michelson as to the acceleration of the velocity of light in a moving medium. A further important step was taken in this inquiry when Michelson and Morley (*Amer. Jour. of Sci.* vol. xxxi., 1886, vol. cliii., 1897; *Phil. Mag.*, 1887) devised a method by which, on the assumption of a quiescent æther, an effect depending on quantities of the order $(v/V)^2$ would be appreciable.

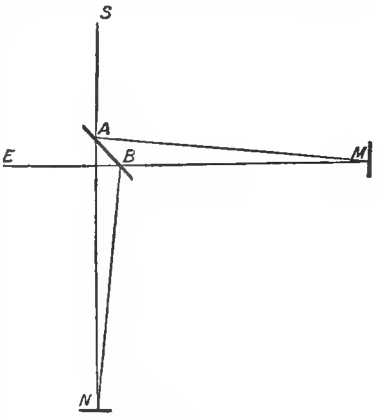

Fig. 10.

The principle of the experiment is to study the interference changes produced in the instrument sketched in Fig. 6, as it is moved into different orientations. This will make the assumed relative motion of the earth and the æther affect differently the rays travelling along AM and AN. Let there be a drift of æther of velocity v in the direction AM. Then the ray from S which passes through P is reflected at N, and finally reflected at P will pursue a path SANBE (Fig. 10), and the ray that interferes with it will pursue the path SAMBE. The speed of the first ray is $\sqrt{(V^2+v^2)}$, and the distance travelled is ANB or 2D, where D is the distance of both M and N from the middle point of P. Hence the time for the ray to travel over the path ANB is $2D/\sqrt{(V^2+v^2)}$. The ray AMB travels with speed $V+v$ along $AM\left(=D+D\frac{v}{V}\right)$, and with speed $V-v$ along $MB\left(=D-D\frac{v}{V}\right)$. Hence the time taken to travel over the whole course is simply $2D/V$. The difference of these two times will give the time retardation of the one ray with respect to the other. The value to a first approximation is

$$\frac{2D}{V}\left\{1-\left(1+\frac{v^2}{V^2}\right)^{-\frac{1}{2}}\right\}=\frac{2D}{V}\left\{1-1+\frac{v^2}{2V^2}\right\}=\frac{D}{V}\cdot\frac{v^2}{V^2}.$$

Now superpose the velocity $-v$ upon the whole system so as to reduce the æther to rest and set the apparatus in motion through the æther. Then the two paths will differ in length by the product of V and the time retardation, that is, by $D\frac{v^2}{V^2}$. While this motion through the æther is continuing, let the apparatus be rotated through a right angle, so that the path which was the longer in the first position now becomes the shorter. Then as the apparatus moves from the one orientation to the other there will occur a shift of the interference bands corresponding to a change $2Dv^2/V^2$ in the length of one path relative to the other. The ratio v^2/V^2 is about 10^{-8} if we take v to be the earth's orbital velocity, and a wave-length of yellow light is 60×10^{-8} metres. Hence the interference fringes will be displaced by an amount which will bear to the width of the fringe the ratio 2D/60. In Michelson's second arrangement the distance D was multiplied by a series of reflections from sets of parallel mirrors until it was equal to about 11 metres, giving a displacement of nearly 0·4 of a fringe. When all precautions were taken in carrying out this excessively difficult experiment, there was not the slightest indication of a displacement of the fringes as the apparatus was steadily veered round into different orientations. The simplest explanation is that the æther in the vicinity of the earth moves with it, a conclusion which seems to be inconsistent with the fact of aberration. In other words, the hypothesis of the quiescent æther is inconsistent with Michelson's and Morley's experiment unless there be some compensating cause not taken into account. Fitzgerald and Lorentz have pointed out that a slight change in the dimensions of a body due to its motion through space would meet all difficulties.

If we consider Michelson and Morley's experiment to prove that the earth and the æther near it have the same motion, then the phenomenon of aberration requires an explanation. Stokes as early as 1845 pointed out how one might be given by supposing the motion of the æther generated by the motion through it of the earth and other cosmical bodies to be of the kind known in hydrodynamics as irrotational. As Stokes himself recognized, there are grave physical difficulties in giving this theory all-round consistency. Such difficulties, however, must almost certainly arise in any incomplete theory of the constitution of the æther; and there can be little doubt that no theory can be complete which does not take into account electrical and magnetic phenomena. (See ÆTHER.)

The literature of light and optics has grown enormously within recent years, chiefly in the form of scattered memoirs. Of English treatises may be mentioned PRESTON'S *Theory of Light* (2nd ed., 1895); BASSET'S *Treatise on Physical Optics*, 1892; and HEATH'S *Geometrical Optics*. LARMOR'S *Æther and Matter* (1900) is an important discussion of the inter-relations of matter and æther, and DRUDE'S *Lehrbuch der Optik* (1900) is the most complete work we have in which the physical side of the subject is treated consistently throughout from the standpoint of the electromagnetic theory. (C. G. K.)

Lightfoot, Joseph Barber (1828–1889), English theologian and bishop of Durham, was born at Liverpool on 13th April 1828. His father was a Liverpool accountant. He was educated at King Edward's School, Birmingham, under Dr James Prince Lee, afterwards bishop of Manchester, a great schoolmaster, who had under him, at the same time with Lightfoot, not only Westcott, Lightfoot's successor at Durham, but Benson, afterwards archbishop of Canterbury. In 1847 Lightfoot went up to Trinity College, Cambridge, and there read for his degree with Westcott, who had preceded him thither. He took a brilliant degree, being senior classic and 30th wrangler, and was elected a fellow of his college. In 1857 he became tutor. His fame as a scholar grew rapidly. He was made Hulsean professor in 1860, and shortly afterwards, in rapid succession, chaplain to the Prince Consort and honorary chaplain in ordinary to the Queen. In 1866 he was Whitehall preacher, and in 1871 he became canon of St Paul's. His sermons were not remarkable for eloquence, but a certain solidity and balance of judgment, an absence of partisanship, a sobriety of expression combined with clearness and force of diction, attracted hearers and inspired them with confidence. As was written of him in *The Times* after his death, "his personal character carried immense weight, but his great position depended still more on the universally recognized fact that his belief in Christian truth and his defence of it were supported by learning as solid and comprehensive as could be found anywhere in Europe, and by a temper not only of the utmost candour but of the highest scientific capacity. The days in which his University influence was asserted were a time of much shaking of old beliefs. The disintegrating speculations of an influential school of criticism in Germany were making their way among English men of culture just about the time, as is usually the case, when the tide was turning against them in their own country. It was quite impossible, however, to assume that the verdict of real learning was on the side of the Tübingen school, when such a scholar as Dr Lightfoot, supported by his friend Dr Westcott, was convinced that it was on the side of the old beliefs. The peculiar service which was rendered at this juncture by the 'Cambridge School' was that, instead of opposing a mere dogmatic opposition to the Tübingen critics, they met them frankly on their own ground; and instead of arguing that their conclusions ought not to be and could not be true, they simply proved that their facts and their premisses were wrong. It was a characteristic of equal importance that Dr Lightfoot, like Dr Westcott, never discussed these subjects in the mere spirit of controversy. It was always patent that what he was chiefly concerned with was the substance and the life of Christian truth, and that his whole energies were employed in this inquiry because his whole heart was engaged in the truths and facts which were at stake. He was not diverted by controversy to side-issues; and his labour was devoted to the positive elucidation of the sacred documents in which the Christian truth is enshrined."

In 1872 a work appeared entitled *Supernatural Religion*, in which the evidences of religion generally, and those for the authenticity of the New Testament in particular, were somewhat roughly handled. This work created considerable sensation. It was written anonymously, and attributed to various celebrities of the day. In a series of masterly papers in the *Contemporary Review*, between December 1874 and May 1877, Dr Lightfoot undertook the defence of the New Testament canon; and the writer of the book, though never discourteously treated, was handled with some severity, and, in the opinion of most impartial judges, overthrown. About the same time Lightfoot was engaged in contributions to the *Dictionary of Christian Biography* and the *Dictionary of the Bible*, and he also joined the committee for revising the translation of the New Testament. In 1875 he became Lady Margaret Professor of Divinity in the place of Dr Selwyn. He had previously, in addition to the work mentioned above, written most able and learned commentaries on the Epistles to the Galatians, Philippians, and Colossians, the notes to which were distinguished by sound judgment and enriched from his large stores of theological learning. These commentaries may be described as to a certain extent a new departure in New Testament exegesis. Previously to Lightfoot's time commentaries, especially on the epistles, had not unfrequently consisted either of short homilies on particular portions of the text, or of endeavours to enforce foregone conclusions, or of attempts to decide with infinite industry and ingenuity between the interpretations of former commentators. Lightfoot, on the contrary, while not despising the labours of his predecessors, endeavoured to make his author interpret himself, and by considering the general drift of his argument to discover his meaning where it appeared doubtful. Thus he often recovered for the Church the meaning of a passage which had long been buried under a heap of contradictory glosses, and he founded a school in which English sobriety and common-sense were added to the industry and ingenuity of former commentators. Such services to the Church could not long remain unrewarded. Accordingly, in 1879 Lightfoot was elevated to the bishopric of Durham. His moderation, good sense, wisdom, temper, firmness, and erudition made him as successful in this position as he had been when professor of theology, and he speedily surrounded himself with a band of intelligent and scholarly young men, who aided him in the work of his diocese. The bishop endeavoured to combine his habits of theological study with the practical work of government of an important diocese. He continued to work at his editions of the *Apostolic Fathers*. In 1885 he published an edition of the Epistles of Ignatius and Polycarp, and he collected a large store of valuable materials for an edition of Clemens Romanus, which was published after his death. His defence of the authenticity of the Epistles of Ignatius is one of the most important contributions to that very difficult controversy. His unremitting labours impaired his health and shortened his splendid career at Durham. That diocese enjoyed only nine years of his wise, fatherly, and sympathetic rule, and of an influence for good felt as much by the pitmen as by their more cultivated and more educated fellow-citizens. At the age of 65 he was prematurely snatched away from the diocese he had ruled so well and wisely. He died at Bournemouth, 21st December 1889, and was succeeded in the episcopate by Westcott, his school-fellow and lifelong friend. (J. J. L*.)

LIGHTHOUSES.

THIS article is supplementary to that in the earlier volumes of this Encyclopædia (ninth edition, vol. xiv.), and describes the principal developments which took place in lighthouse engineering—including fog-signalling, the construction of buoys and beacons, light-vessels, and subsidiary branches of coast lighting—during the last quarter of the 19th century. It will be convenient to divide the subject into sections as follows:—

1. Lighthouse structures.
2. Optical apparatus for lighthouses.
3. Lighthouse illuminants.
4. Unattended lights and beacons.
5. Light-vessels.
6. Illuminated buoys.
7. Fog signals.
8. Lighthouse administration.

1. *Lighthouse Structures.*

During the period under review comparatively few isolated and wave-swept lighthouses on rock foundations were constructed, but among these are one or two of paramount importance. The general design of such structures has differed but slightly from preceding examples of the class, but in important details considerable alterations and improvements have been effected. The following are among the chief examples of this branch of work:—

Eddystone Lighthouse.—The Corporation of Trinity House in 1877 determined on the erection of a new lighthouse in place of Smeaton's famous structure upon the Eddystone reef, near Plymouth. The site selected was 120 ft. south-south-east from Smeaton's lighthouse, where a suitable foundation was found, although a considerable section of the lower courses had to be laid below the level of low water. The vertical base is 44 ft. in diameter and 22 ft. in height. The tower is a concave elliptic frustum, and is solid, with the exception of a fresh-water tank, to a height of 25 ft. 6 in. above high-water level. The walls above this level vary in thickness from 8 ft. 6 in. to 2 ft. 3 in. under the gallery. All the stones are dovetailed, both horizontally and vertically and on all inner faces, the stones of the foundation course being secured to the rock by Muntz-metal bolts. The tower contains 62,133 cub. ft. of Cornish and Irish granite, weighing 4668 tons. The height of the structure from low water ordinary spring tides to the mean focal plane is 149 ft., and it stands 133 ft. above high water. The lantern is a cylindrical helically framed structure with domed roof. The astragals are of gun-metal and the pedestal of cast iron. The optical apparatus consists of two superposed tiers of refracting lens panels, 12 in each tier, of 920 mm. focal distance. The lenses subtend an angle of 92° vertically. The 12 lens panels are arranged in groups of two, thus producing a group flashing light showing two flashes of 2½ seconds' duration every half minute, the apparatus revolving once in 3 minutes. The burners are of the Douglass 6-wick mineral oil pattern, and are supplied with oil from pressure lamps. The intensity of the combined beam of light from the two apparatus is 79,000 candles. At the time of the completion of the lighthouse two bells, weighing 2 tons each, and struck by mechanical power, were installed for fog-signalling purposes, but since that date an explosive gun-cotton fog-signal has been erected, the bells being removed. The driving machinery which rotates the optical apparatus consists of a ½-h.p. caloric engine. At a lower level in the tower are installed two 21-inch parabolic silvered reflectors with 2-wick burners, throwing a fixed light of 12,000 candle-power over a danger known as the Hand Deeps. The work of preparing the foundation was begun on the 17th July 1878, the foundation-stone being laid by the late duke of Edinburgh on the 19th August 1879. The last stone was laid on the 1st June 1881, and the light exhibited for the first time on the 18th May 1882. The upper portion of Smeaton's tower, which was removed on completion of the new lighthouse, was re-erected on Plymouth Hoe, where it replaced the old Trinity House sea mark. One of the principal features in the design of the new Eddystone lighthouse tower is the solid vertical base. This construction was much criticized at the time, but experience has proved that heavy seas striking the massive cylindrical structure are immediately broken up and rush round to the opposite side, spray alone ascending to the height of the lantern gallery. On the other hand, the waves striking the old tower at its foundation ran up the surface, which presented a curved face to the waves, and unimpeded by any projection until arriving at the lantern gallery, were partially broken up by the cornice and then spent themselves in heavy spray over the lantern. The shock to which the cornice of the gallery was exposed was so great that stones were sometimes lifted from their beds. The new Eddystone tower presents one point of dissimilarity from Smeaton's structure, in that the stones forming the floors consist of single corbel stones built into the wall and constituting solid portions thereof. In Smeaton's tower the floors consisted of stone arches, the thrust being taken by the walls of the tower itself, which were strengthened for the purpose by building in chains in the form of hoops. The system of constructing corbelled stone floors was first adopted by Stevenson in the Bell Rock lighthouse.

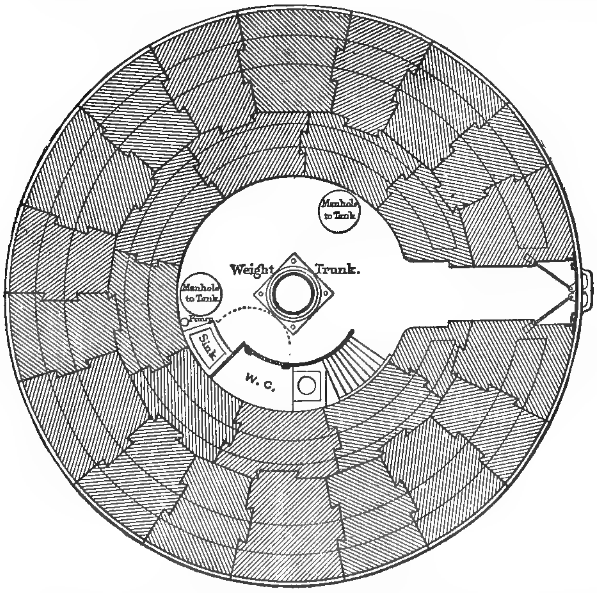

Fig. 1.—Plan of Entrance Floor, new Eddystone Lighthouse.

Bishop Rock Lighthouse.—The lighthouse on the Bishop Rock, which is the westernmost landfall rock of the Scilly Islands, occupies perhaps a more exposed situation than any other in the world. The first lighthouse erected there was begun in 1847 under the direction of the late Mr N. Douglass. The tower consisted of a cast and wrought iron open-work structure having the columns deeply sunk into the rock. On the 5th February 1850, when the tower was ready for the erection of the lantern and illuminating apparatus, a heavy storm swept away the whole of the structure. This tower was designed for an elevation of 94 ft. to the focal plane. In 1851 the erection of a granite tower was begun; the light was first exhibited in 1858. The tower had an elevation to the focal plane of 110 ft., the lower 14 courses being arranged in steps, or offsets, to break up the force of the waves. This structure also proved insufficient to withstand the very heavy seas to which it was exposed. Soon after its completion the 5-cwt. fog bell, fixed to the lantern gallery 100 ft. above high-water mark, was washed away, together with the flagstaff and ladder. The tower vibrated considerably during storms, and it was found that some of the external blocks of granite had been split by the excessive stress to which they had been exposed. In 1874 the tower was strengthened by bolting continuous iron ties to the internal surfaces of the walls. In 1881, when further signs of damage appeared, it was determined to remove the upper storey or service-room of the lighthouse, and to case the structure from its base upwards with granite blocks securely dovetailed to each other and to the existing work. At the same time it was considered advisable to increase the elevation of the light, and place the mean focal plane of the new apparatus at an elevation of 146 ft. above high-water mark. The work was begun in 1883, and the new apparatus was first illuminated on the 25th October 1887. During the operation of heightening the tower it was necessary to install a temporary light, consisting of a cylindrical lightship

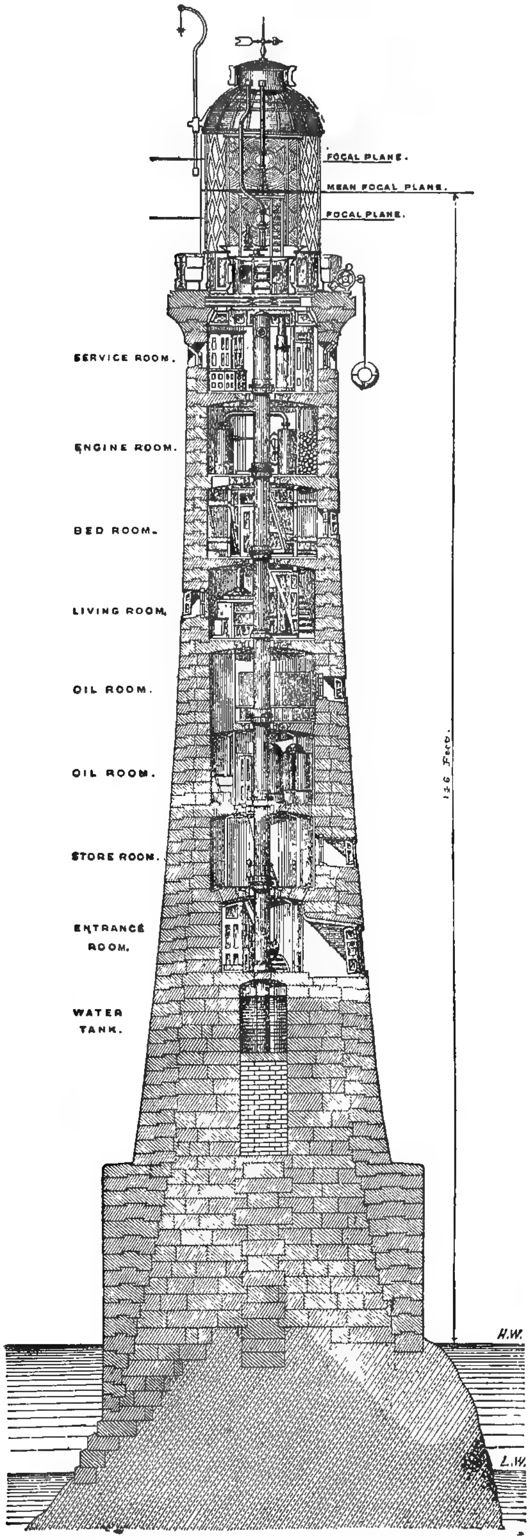

Fig. 2.—Bishop Rock Lighthouse.

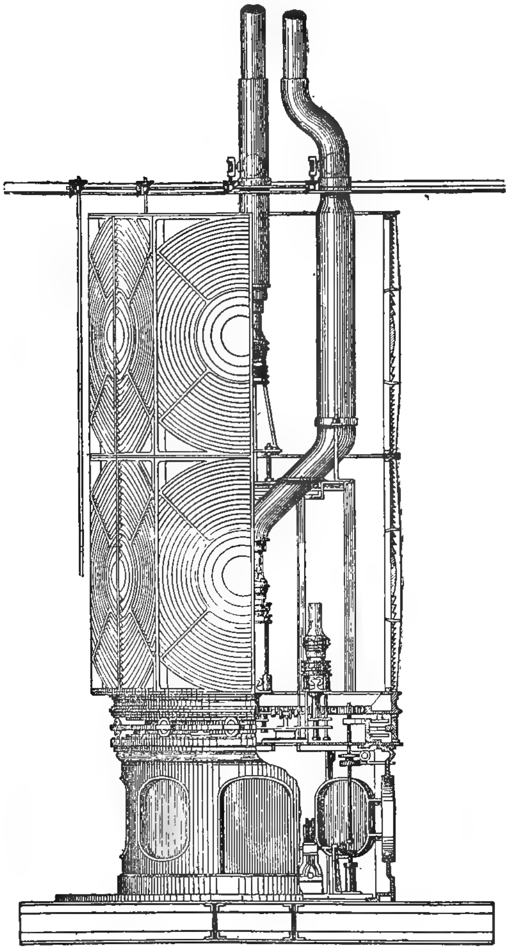

Fig. 3.—Biform Dioptric Apparatus, Bishop Rock Lighthouse.

lantern with catoptric apparatus; this was raised from time to time in advance of the structure as the work proceeded. The additional masonry built into the tower amounts approximately to 3220 tons. Profiting by the experience gained after the construction of the new Eddystone tower, Sir J. N. Douglass decided to build the lower portion of the improved Bishop Rock tower in the form of a cylinder, but with considerably increased elevation (Fig. 2). The cylindrical base is 40 ft. in diameter, and rises to 25 ft. above high-water mark. The lantern is of the usual Trinity House cylindrical helically framed pattern, 14 ft. in diameter, the glazing being 15 ft. in height. The optical apparatus consists of two superposed tiers of lenses of 1330 mm. focal distance, the lenses subtending a horizontal angle of 36° and a vertical angle of 80°. The apparatus consists of 5 groups of lenses, each group producing a double flashing light of one minute period, the whole apparatus revolving once in 5 minutes. The burners are of the 8-wick Douglass pattern. The maximum aggregate candle-power of the flash is 170,500 candles. A gun-cotton explosive fog-signal is attached to the lantern. The cost of the various lighthouses on the Bishop Rock has been as follows :—

1. Cast-iron lighthouse . . .	£12,500	0	0
2. Granite lighthouse . . .	34,559	18	9
3. Improved granite lighthouse .	64,889	0	0
Total	£111,948	18	9

Rattray Head Lighthouse.—This lighthouse was constructed between the years 1892 and 1895 by the Northern Lighthouse Commissioners upon the Ron Rock, lying about one-fifth of a mile off Rattray Head, Aberdeenshire. The focal plane is 91 ft. above high water, the building being approximately 113 ft. in height. In the tower there is a fog-horn worked by compressed air. The optical apparatus, which rotates on a roller carriage, gives 3 flashes in quick succession every 30 seconds. The lenses are arranged in 4 panels, each containing 3 faces, and their focal distance is 920 mm. The optical elements for a vertical height of 68° are the ordinary plano-convex Fresnel profile. Refraction is carried to a vertical height of 80° by means of equiangular prisms. The intensity of the beam is 44,000 candles.

Beachy Head Lighthouse.—A new lighthouse is under construction upon the foreshore at the foot of Beachy Head, near Eastbourne, to replace the existing structure on the cliff, having an elevation of 284 ft. above high-water mark. Experience has proved that this particular light is frequently obscured by banks of mist or fog, while at a lower level the transparency of the atmosphere is considerably less impaired. The Trinity House therefore decided in the year 1899 to proceed with the construction of a granite tower upon the foreshore at a distance of some 570 ft. from the base of the cliff. The foreshore at this point consists of chalk, and the selected site just bares at low water ordinary spring tides. The foundation course has been laid at a depth of 10 ft. below the surface, the area being excavated within a coffer-dam. The tower, which will be 47 ft. in diameter at the base, will have an elevation to the focal plane above high water of 103 ft., or a total height from foundation course to gallery coping of 123 ft. 6 in. The lower or solid portion of the tower has its face stones constructed in vertical offsets or steps in a similar manner to that adopted at the Wolf Rock and elsewhere. The tower is constructed with a facing of granite, all the stones being dovetailed in the usual manner. The hearting of the base is largely composed of concrete.

Fastnet Lighthouse.—A new granite lighthouse is in course of erection upon the Fastnet Rock off the south-west coast of Ireland. In the year 1895 it was reported to the Irish Lights Commissioners that the existing structure, which was completed in 1854 and consists of a circular cast-iron tower 86 ft. in height on the summit of the rock, was considerably undermined. It was subsequently determined to proceed with the erection of a granite structure of increased height and founded upon a sound ledge of rock on one side of the higher, but now considerably undermined, portion of the reef. This lighthouse tower, which was commenced in the year 1899, has its foundation laid near high-water level. The focal plane will be at a level of 160 ft. above high-water mark.

Wolf Trap Lighthouse.—This building was erected during the years 1893 and 1894 on Wolf Trap Spit in Chesapeake Bay, near the site of the old open-work structure which was swept away by ice early in 1893. The new tower is formed upon a cast-iron caisson 30 ft. in diameter sunk 18 ft. into the sandy bottom. The depth of water on the shoal is 16 ft. at low water. The caisson was filled with concrete, and is surmounted by a brick superstructure 52 ft. in height from low water to the focal plane of the light. A somewhat similar structure was erected in 1885–87 on the Fourteen Foot Bank in Delaware Bay, at a cost of £24,700. The foundation was, however, shifting sand, and the caisson was carried to a greater depth.

Minots Ledge Lighthouse.—This tower, although constructed before the period within the scope of this article, is of such interest as to warrant some mention. The tower, which is 89 ft. in height, is built of granite upon a reef off Boston Harbour, Mass., and occupied five years in construction, being completed in 1860, at a cost of £62,500. The rock just bares at low water. The stones are dovetailed vertically but not on their horizontal beds in the case of the lower 40 ft. or solid portion of the tower, bonding bolts being substituted for the horizontal dovetailed joints used in the case of the Wolf and other English towers. The shape of the tower is a conical frustum.

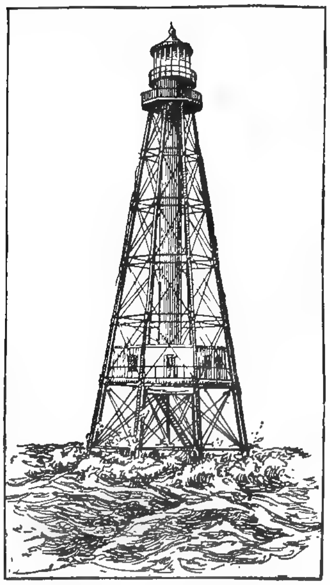

Fig. 4.—Alligator Reef Lighthouse.

Fowey Rocks Lighthouse, Florida.—This iron structure, which was begun in 1875 and completed in 1878, stands on the extreme northern point of the Florida reefs. The height of the tower, which is founded on wrought-iron piles driven 10 ft. into the coral rock, is 110 ft. from high water to focal plane. The iron openwork pyramidal structure encloses a plated iron dwelling for the accommodation of the keepers. The cost of construction amounted to £32,600.

Spectacle Reef Lighthouse, Lake Huron.—This is a structure similar to that on Minots Ledge, standing on a limestone reef at the northern end of the lake. The tower was constructed with a view to withstanding the effects of ice massing in solid fields thousands of acres in extent and travelling at considerable velocity. The tower is in shape the frustum of a cone, 32 ft. in diameter at the base and 93 ft. in height to the coping of the gallery. The focal plane is at a level of 97 ft. above the base. The lower 34 ft. of the tower is solid. The work was completed in 1874, having occupied four years. The cost amounted to approximately £78,000.

St George's Reef Lighthouse, California.—This structure consists of a square pyramidal stone tower rising from the easterly end of an oval masonry pier, built on a rock to a height of 60 ft. above the water. The focal plane is at an elevation of 146 ft. above high water. The site is an exceedingly dangerous one, and the work, which was completed in 1891, cost approximately £144,000.

Alligator Reef Lighthouse, Florida.—This tower is one of the finest iron sea-swept lighthouse structures in the world. It consists of a pyramidal iron framework 135½ ft. in height, standing on the Florida Reef in 5 ft. of water. Its cost was £37,000, and its construction is generally similar to the Fowey Rocks tower.

Rothersand Lighthouse.—This lighthouse, off the entrance to the river Weser (Germany), is a structure of great interest on account of the difficulties met with in its construction. The tower had to be founded on a bottom of shifting sand 20 ft. below low water and in a very exposed situation. Work was begun in May 1881, when attempts were made to sink an iron caisson under pneumatic pressure. Owing to the enormous scour removing the sand from one side of the caisson, it tilted to an alarming angle, but eventually it was sunk to a level of 70 ft. below low-water mark. In October of the same year the whole structure collapsed. Another attempt, made in May 1883, to sink a caisson of bi-convex shape in plan, 47 ft. long, 37 ft. wide, and 62 ft. in height, met with success, and after many difficulties the structure was sunk to a depth of 73 ft. below low water, the sides being raised by the addition of iron plating as the caisson sank. The sand was removed from the interior by suction. Around the caisson foundation were placed 74,000 cubic yards of mattress work and stones, the interior being filled with concrete. Towards the end of 1885 the lighthouse was completed, at a total cost, including the first attempt, of over £65,000. It is an iron structure in the shape of a concave elliptic frustum, its base being founded upon the caisson foundation at about half-tide level (Fig. 5). The light is electric, the current being supplied by cable from the shore. The focal plane is 78 ft. above high water or 109 feet from the sand level. The total height from the foundation of the caisson to the top of the vane is 185 ft.

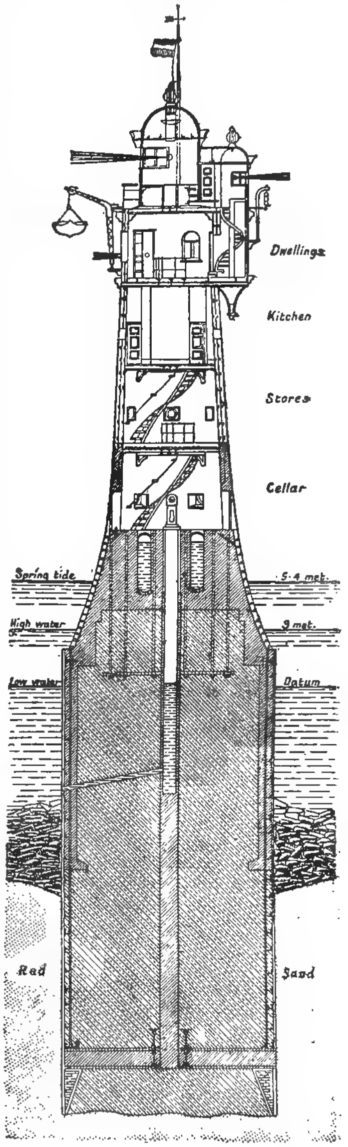

Fig. 5.—Rothersand Lighthouse.

Land Structures for Lighthouses.—The erection of lighthouse towers and other buildings on land presents no difficulties of construction, and they are of ordinary architectural character. It will therefore be unnecessary to refer to them in detail. Attention should, however, be called to one of the most recent of Continental lighthouse towers, that known as the Phare d'Eckmuhl at Penmarc'h (Finistère), completed in 1897. The cost of this magnificent structure, 207 ft. in height from the ground, was largely defrayed by a bequest of £12,000 left by the marquis de Blocqueville. It is constructed entirely of granite, and is octagonal in plan. The total cost of the tower and other lighthouse buildings amounted to £16,000.

The tower at Ile Vierge (Finistère), completed in 1902, has an elevation of 247 ft. from the ground level to the focal plane, and is probably the highest structure of its kind in the world.

Table I.—*Comparative Cost of Exposed Rock Towers.*

Name of Structure.	Total Cost. £	s.	d.	Cub. ft.	Cost per cub. ft. £	s.	d.
Eddystone, Smeaton (1759)	40,000	0	0	13,343	2	19	11½
Bell Rock, Firth of Forth (1811)	55,619	12	1	28,530	1	19	0
Skerryvore, west coast of Scotland (1844)	72,200	11	6	58,580	1	4	7¾
Bishop Rock, first granite tower (1858)	34,559	18	9	35,209	0	19	7½
Smalls, Bristol Channel (1861)	50,124	11	8	46,386	1	1	7¼
Hanois, Alderney (1862)	25,296	0	0	24,542	1	0	7¼
Wolf Rock, Land's End (1869)	62,726	0	0	59,070	1	1	3
Dhu Heartach, west coast of Scotland (1872)	72,584	9	7	42,050	1	14	6
Longships, Land's End (1872)	43,869	8	11	47,610	0	18	5
Eddystone, Douglass (1882)	59,255	0	0	65,198	0	18	2
Bishop Rock, second granite tower (1887)	64,889	0	0	45,080	1	8	9
Great Basses, Ceylon (1873)	63,560	0	0	47,819	1	6	7
Minots Ledge, Boston, Mass., (1860)	62,500	0	0	36,322	1	17	2
Spectacle Reef, Lake Huron (1874)	78,125	0	0	42,742	1	16	2
Ar'men, France (1881)	36,000	0	0	32,453	1	2	1

2. *Optical Apparatus.*

Feux-éclairs.—The most important development in the character of lighthouse illuminating apparatus that has occurred in recent years has been in the direction of reducing the length of flash. The initiative in this matter was taken by the French lighthouse authorities, and in France alone forty lights of this type were established between 1892 and 1901. The *feux-éclairs* which have been designed by the French engineers Bourdelles, Ribière, and others have usually a flash of $\frac{1}{10}$ to $\frac{1}{3}$ of a second duration, the intervals between the flashes being also small, 3 seconds to 7 seconds. In group-flashing lights of this character the intervals between the flashes are about 2 seconds, with periods of 7 to 10 or 15 seconds between the groups. The flashes are arranged in single, double, triple, or even quadruple groups, as in the older forms of apparatus. The use of short flash lights soon spread to other parts of the world, America, British colonies, China, Japan, and Germany and other European countries. In England the lighthouse at Pendeen (completed in 1901) exhibits a quadruple flash every 15 seconds, the flashes being about $\frac{1}{2}$ second duration (Fig. 6), while the bivalve apparatus erected on Lundy Island (1897) shows two flashes of $\frac{2}{3}$ second duration in quick succession every 20 seconds. The *feu-éclair* type of apparatus enables a far higher intensity of flash to be obtained than had hitherto been possible, without any corresponding increase in the luminous power of the burner or other source of light. This result depends entirely upon the greater ratio of condensation of light employed. Panels of greater angular breadth are used with a higher rotatory velocity.

Duration of Flash necessary for Physiological Perception.—The researches of numerous physiologists and physicists, among whom are Plateau, Helmholtz, Wundt, Bloch, and more especially Charpentier, confirm completely the experimental result obtained by M. Blondel at the Dépôt des Phares in Paris, that a flash of $\frac{1}{10}$ second is sufficient for the purpose of impressing a ray of light upon the retina of the eye. His researches proved that the exact time of full perception varies from ·08 to ·125 second. The French Lighthouse Service accordingly fixed the standard minimum duration of flash at $\frac{1}{10}$ second. This length of flash thus represents the standard of maximum efficiency of a light, and any increase in the duration naturally results, *ceteris paribus*, in a corresponding diminution in the intensity. It should be pointed out that sometimes it is advisable to increase the length of flash somewhat on account of local and practical considerations, but such increase need seldom be carried beyond $\frac{1}{4}$ or $\frac{1}{2}$ second. It has been urged that such short flashes are insufficient for taking bearings, but the utility of a light in this respect does not seem to depend so much upon the actual length of the flash as upon its frequent recurrence at short intervals. At the Paris Exhibition of 1900 was exhibited a fifth-order flashing light giving short flashes at 1 second intervals; this represents the extreme to which the movement towards the reduction of the period of flashing lights has yet been carried. Mr Wigham has advocated a pulsating or "scintillating" light emitting a series of flashes in such rapid succession that the luminous impression does not entirely leave the retina in the intervals.

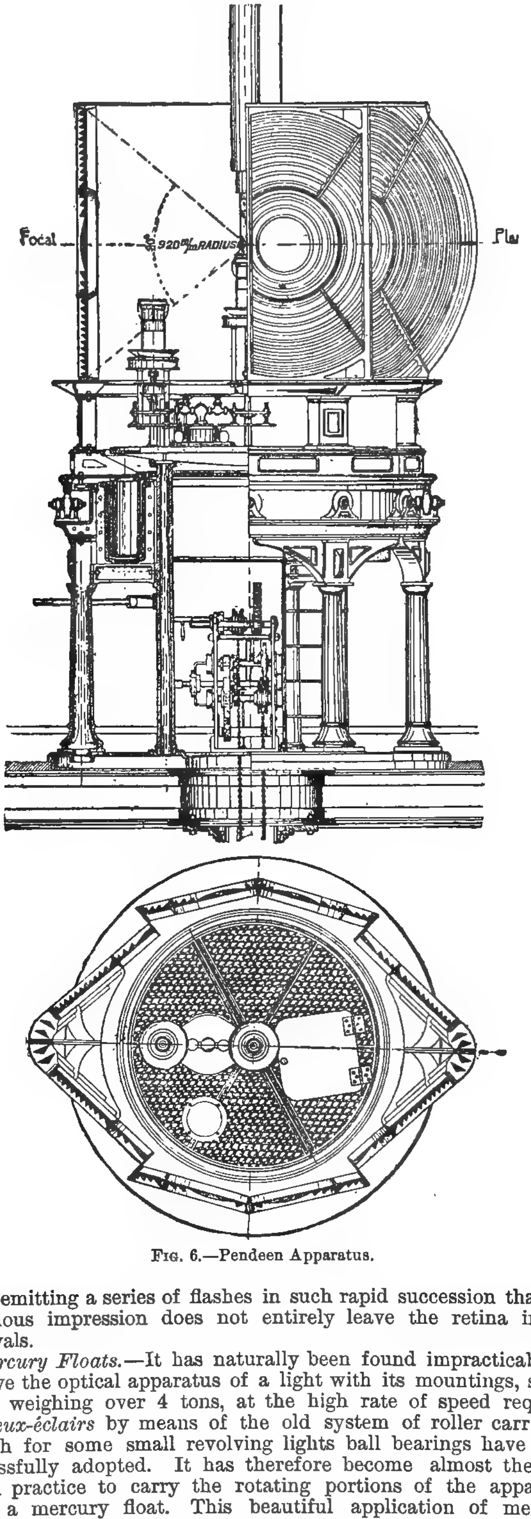

Fig. 6.—Pendeen Apparatus.

Mercury Floats.—It has naturally been found impracticable to revolve the optical apparatus of a light with its mountings, sometimes weighing over 4 tons, at the high rate of speed required for *feux-éclairs* by means of the old system of roller carriages, though for some small revolving lights ball bearings have been successfully adopted. It has therefore become almost the universal practice to carry the rotating portions of the apparatus upon a mercury float. This beautiful application of mercury rotation was the invention of the late M. Bourdelles, and is now utilized not only for the high-speed apparatus, but also generally for the few examples of the older type still being constructed. The arrangement consists of an annular cast-iron bath or trough of such dimensions that a similar but slightly smaller annular float immersed in the bath and surrounded by mercury displaces a volume of the liquid metal whose weight is equal to that of the apparatus supported. Thus a comparatively insignificant quantity of mercury, say 2 cwt., serves to ensure the flotation of a mass of over 3 or 4 tons. Certain differences exist between the type of float usually constructed in France and those generally designed by English engineers. In all cases provision is made for lowering the mercury bath or raising the float and apparatus for examination.

Group-Flashing Lights.—One of the most useful distinctions for lighthouses consists in the grouping of two or more flashes separated by short intervals of darkness, the group being succeeded by a longer eclipse. Thus two, three, or more flashes of say ½ second duration each follow each other at intervals of 2 seconds and are succeeded by an eclipse of say 10 or 15 seconds, the sequence being completed in a period of say 20 or 30 seconds. In 1874 the late Dr John Hopkinson introduced the very valuable improvement of dividing the lenses of a dioptric revolving light and the panels of reflecting prisms above and below them, setting them at an angle to produce the group-flashing characteristic. The first apparatus of this type constructed were those now in use at Tampico, Mexico, and the Little Basses lighthouse, Ceylon (double flashing). The latter was exhibited at the South Kensington Exhibition of 1876. The Casquets apparatus (triple flashing, 1877) was the first of the kind used in England. A group-flashing catoptric light had, however, been exhibited from the *Royal Sovereign* light-vessel in 1875. A group-flashing distinction was proposed for gas lights by Mr Wigham of Dublin, who obtained it in the case of a revolving apparatus by alternately raising and lowering the flame. The first apparatus in which this method was employed was at Galley Head, Co. Cork (1878). At this lighthouse four of Wigham's large gas burners with four tiers of first-order revolving lenses, eight in each tier, were adopted. By successive lowering and raising of the gas flame at the focus of each tier of lenses he produced the group-flashing distinction. This light shows, instead of one prolonged flash at intervals of one minute, as would be produced by the apparatus in the absence of a gas occulter, a group of short flashes varying in number between six and seven. The uncertainty, however, in the number of flashes contained in each group is found to be an objection to the arrangement. This device was adopted at other gas-illuminated stations in Ireland at subsequent dates. Dr Hopkinson's system has been very extensively used, all the group-flashing lights shown in the accompanying tables, except the gas lights and the light at Cape Byron, being designed upon the general lines he introduced. A modification of the system consists in grouping two or more lenses together separated by equal angles, and filling the remaining angle in azimuth by a reinforcing mirror or screen.

Eclipsing Group-Flashing Lights.—In 1898 Dr Purvis proposed the use of single or double-panel apparatus combined with an occulting screen or eclipser to obscure the burner at certain intervals. By rotating the apparatus at high speed, a series of flashes are thrown on the horizon, and may be interrupted for any desired time by automatically closing the occulter and thus obscuring the light. In a 2-panel optic, revolving once in 5 seconds, the flashes are at intervals of 2½ seconds. If the occulter is closed during every alternate revolution, a group-flashing characteristic of two flashes in quick succession every 10 seconds is obtained, which effect could only be produced otherwise by the use of a 4-panel group-flashing apparatus, or some similar combination of the Hopkinson system considerably less efficient in luminous power than the 2-panel bivalve. A practical difficulty was found to exist with this arrangement in that the single occulting screen made it possible for an incorrect characteristic to be observed from certain positions in azimuth except within the limited angle of about 145°. To overcome this defect Dr Purvis and Mr A. Brebner independently invented an eclipsing screen constructed in two or more portions according as the apparatus is bivalve, trilateral, and so on. This device preserves the true characteristic of the light over the whole horizon, and was introduced in the first-order bivalve apparatus constructed in 1900–01 for New South Wales, and erected at Cape Byron lighthouse. In this apparatus, which consists of a 920-mm. focal distance bivalve, each lens having a horizontal angle of 152°, a double or divided eclipser is used which occults the light during every alternate revolution. The apparatus revolves once in 10 seconds, thus producing a characteristic of two flashes of ⅕ second duration and 5 seconds apart every 20 seconds. The light has an intensity of 145,000 candles, being illuminated by a 6-wick mineral-oil burner.

Flashing Lights indicating Numbers.—Captain F. A. Mahan, late Engineer-Secretary to the United States Lighthouse Board, has devised for that service a system of flashing lights to indicate certain numbers. The apparatus installed at Minots Ledge lighthouse near Boston Harbour, Massachusetts, has a flash indicating the number 143, thus: - ---- ---, the dashes indicating short flashes. Each group is separated by a longer period of darkness than that between successive members of a group. The flashes in a group indicating a figure are about 1½ seconds apart, the groups being 3 seconds apart. An interval of 16½ seconds' darkness occurs between each repetition. The number is repeated every 30 seconds. Two examples of this system were exhibited by the United States Lighthouse Board at the Chicago Exhibition in 1893, viz., the second-order apparatus just mentioned and a similar light of the first order for Cape Charles on the Virginian coast. The lenses are arranged in a somewhat similar manner to an ordinary group-flashing light, the groups of lenses being placed on one side of the optic, while the other is provided with a catadioptric mirror. This system of numerical flashing for lighthouses has been frequently proposed in various forms, notably by Lord Kelvin. The installation of the lights described is, however, the first practical application of the system to large and important coast lights, and after eight years of actual service the lights have apparently given much assistance to navigators, who consider the system desirable. The great cost involved in the alteration of the lights of any country to comply with the requirements of a numerical system is an impediment to its general adoption.

Hyper-radial Apparatus.—In 1885 Messrs Barbier of Paris constructed the first hyper-radial apparatus (1330 mm. focal distance) to the designs of Messrs Stevenson. This had a height of 1812 mm. It was tested during the South Foreland experiments in comparison with other lenses, and found to give excellent results with burners of large focal diameter which would be unsuited for use with smaller apparatus. Apparatus of similar focal distance (1330 mm.) were subsequently established at Round Island, Bishop Rock, and Spurn Point in England, Fair Isle and Sule Skerry (Fig. 7) in Scotland, Bull Rock and Tory Island in Ireland, Cape d'Antifer in France, and at Pei Yü-shan in China. At the Paris Exhibition of 1900 a fine example of a trilateral hyper-radial apparatus was shown, consisting of three lenses 11 ft. 6 in. in diameter, each subtending a horizontal angle of 120°, the whole being mounted upon a mercury float. The total weight of the revolving part of the light amounted to 8½ tons, while the motive clock weight required to rotate this large mass at a speed of four complete revolutions a minute is only 11 cwt., and the weight of mercury required for flotation 594 lb. The complete apparatus weighed 13 tons. The introduction of incandescent and other burners of focal compactness and high intensity has rendered the use of optics of such large dimensions as the above, intended for burners of great focal diameter, unnecessary. It is now possible to obtain with a second-order optic (or one of 700 mm. focal distance), having a powerful incandescent petroleum burner in focus, a beam of equal intensity to that which would be obtained from the above-described apparatus having a 10-wick oil burner or 108-jet gas burner at its focus.

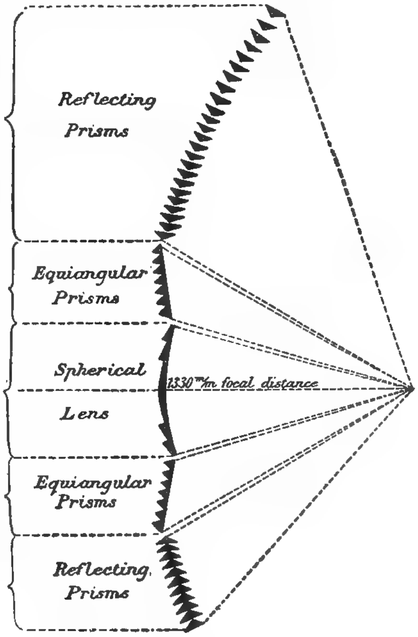

Fig. 7.—Sule Skerry Apparatus.

Stevenson's Spherical Lenses and Equiangular Prisms.—Mr C. A. Stevenson in 1888 designed a form of lens spherical in the horizontal and vertical sections. This admitted of the construction of lenses of long focal distance without the otherwise corresponding necessity of increased diameter of lantern. A lens of this type and of 1330 mm. focal distance was constructed in 1890 for Fair Isle lighthouse (1892). The spherical form loses in efficiency if carried beyond an angle subtending 20° at the focus, and to obviate this loss Mr Stevenson designed his equiangular prisms, which have an inclination outwards. It is claimed by the inventor that the use of equiangular prisms results in less loss of light and less divergence than is the case when either the spherical or Fresnel form is adopted. An example of this design is seen (Fig. 7) in the Sule Skerry apparatus (1895).

High-Angle Vertical Lenses.—Messrs Chance of Birmingham have manufactured lenses having 92° of vertical amplitude, but this result was only attained by using dense flint glass of high refractive index for the upper and lower elements. The St Catherine's lenses have even greater vertical angle prisms, 97°. Lenses of 92° angle were utilized for the apparatus established at Anvil Point (1881), the Eddystone (1882), and a few other stations. It is doubtful, however, whether the use of refracting elements for a greater angle than 80° vertically is attended by any material corresponding advantage.

Occulting Lights.—During the last twenty-five years of the 19th century the disadvantages of fixed lights became more and more appreciated, and at the present day the practice of installing such, except occasionally in the case of the smaller and less important of harbour or river lights, has practically ceased. The necessity for providing a distinctive characteristic for every light when possible has led to the conversion of many of the fixed-light apparatus of earlier years into occulting lights, and often to their supersession by more modern and powerful flashing apparatus. The occulting apparatus generally adopted consists of a cylindrical screen, fitting over the burner, rapidly lowered and raised by means of a cam wheel at stated intervals. The cam wheel is actuated by means of a weight or spring clock. Varying characteristics may be procured by means of such a contrivance—single, double, triple, or other systems of occultation. The eclipses or periods of darkness bear much the same relation to the times of illumination as do the flashes to the eclipses in a revolving or flashing light. In the case of a first-order fixed light the cost of conversion to an occulting characteristic does not exceed £250 to £300. With apparatus illuminated by gas the occultations may be produced by raising and lowering the gas at stated intervals.

Leading Lights.—In the case of lights intended to act as a lead through a narrow channel or as direction lights, it is undesirable to employ a flashing apparatus. Fixed-light optics are employed to meet such cases, and generally fitted with occulting mechanism. A typical apparatus of this description is that now in course of erection at Gage Roads, Fremantle, West Australia (Fig. 8). The occulting bright light covers the fairway, and is flanked by sectors of occulting red and green light marking dangers and intensified by vertical condensing prisms. A good example of a holophotal direction light was exhibited at the 1900 Paris Exhibition, and afterwards erected at Suzac lighthouse (France). The light consists of an annular lens 500 mm. focal distance, of 180° horizontal angle and 157° vertical, with a mirror of 180° at the back. The lens throws a beam of 3° amplitude in azimuth, and 300,000 candle-power, over a narrow channel. The illuminant is an incandescent petroleum-vapour burner with a mantle of 45 mm. diameter. Holophotal direction lenses of this type can only be applied where the sector to be marked is of comparatively small angle. The use of single direction lights frequently renders the construction of separate towers for leading lights unnecessary.

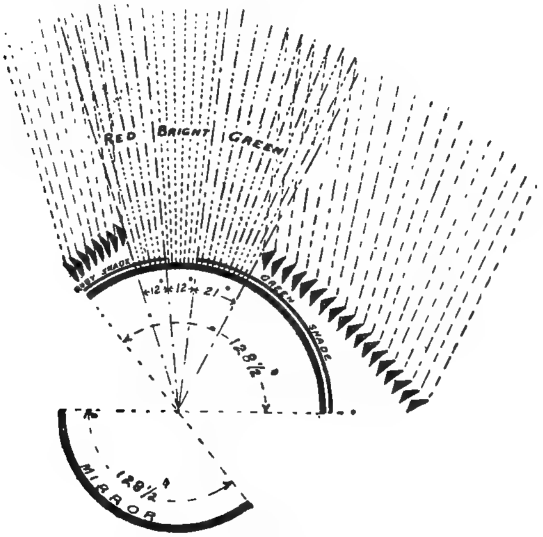

FIG. 8.—Gage Roads Direction Light.

Coloured Lights.—Colour is used as seldom as possible as a distinction in lighthouses, entailing as it does a considerable reduction in the power of the light. It is necessary in some instances for differentiating sectors over dangers and for harbour lighting purposes. The use of coloured lights as alternating flashes for lighthouse lights is not to be commended, on account of the unequal absorption of the coloured and bright rays by the atmosphere. When such distinction has been employed, as in the Wolf Rock apparatus, the red and white beams can be approximately equalized in initial intensity by constructing the lens and prism panels for the red light of larger angle than those for the white beams. With the introduction of group-flashing characteristics the necessity for such distinction disappeared. The Northern Lighthouse Commissioners have, however, perpetuated the alternating red and white characteristic in the new dioptric apparatus now being erected at Bell Rock lighthouse to replace the old catoptric light installed there in 1811. Owing to the absorption by the red colouring, the power of a red beam is only from 30 per cent. to 40 per cent. of the intensity of the corresponding white light. When red or green sectors are employed they should invariably be reinforced by mirrors, azimuthal condensing prisms, or other means to raise the coloured beam to approximately the same intensity as the white light.

3. *Illuminants.*

Electricity.—The first installation of electric light for lighthouse purposes in England took place in 1858 at the South Foreland, where the Trinity House established a temporary plant for experimental purposes. This installation was followed in 1862 by the adoption of the illuminant at the Dungeness lighthouse, where it remained in service until the year 1874, when the electric plant was removed and an oil-lit apparatus substituted. The earliest of the permanent installations now existing in England is that at Souter Point, which was illuminated in 1871. There are in England four important coast lights illuminated by electricity, and one, viz., Isle of May, in Scotland. Of the former St Catherine's in the Isle of Wight is the most powerful. Electricity was substituted as an illuminant for the then existing oil light on the 1st May 1888. The optical apparatus consists of a second-order 16-sided revolving lens giving flashes of 5 seconds' duration at intervals of 30 seconds. De Meritens alternators are installed. The Isle of May lighthouse, situated on an island at the mouth of the Firth of Forth, was first illuminated by electricity in 1887. The optical apparatus consists of a second-order fixed-light lens with refracting prisms, and is surrounded by a revolving system of vertical condensing prisms which split up the vertically condensed beam of light into 8 separate beams of 3° in azimuth. The prisms are so arranged that the apparatus, making one complete revolution in the minute, produces a group characteristic of 4 flashes in quick succession every 30 seconds (Fig. 9). The fixed light is not of the ordinary Fresnel section, the refracting portion being confined to

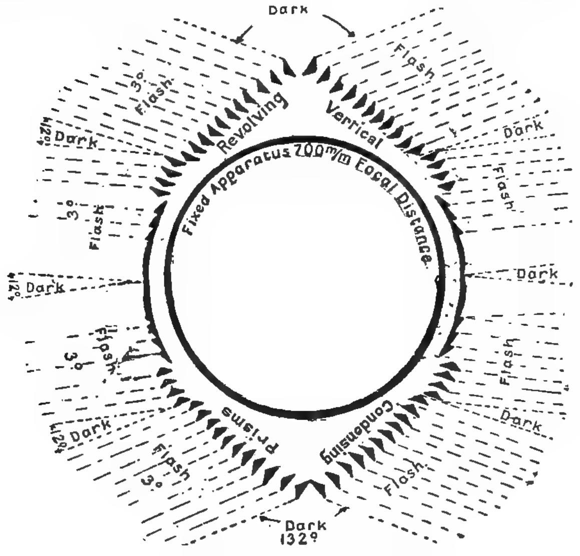

FIG. 9.—Isle of May Apparatus.

an angle of 10°, and the remainder of the vertical section consisting of reflecting prisms. In France the old south lighthouse at La Hève was lit by electricity in 1863, with very satisfactory results. This installation was followed in 1865 by a similar one at the north lighthouse, while in 1902 there were thirteen important coast lights in France illuminated by electricity. In other parts of the world, Macquarie lighthouse, Sydney, was lit by electricity in 1883; Tino, in the Gulf of Spezia, in 1885; and Navesink lighthouse, at the entrance to New York Bay, in 1898. Electric apparatus were also installed in the lighthouse at Port Said in 1869, on the opening of the canal; Odessa in 1871; and at the Rothersand, North Sea, in 1885. There are several harbour and other lights of minor importance in various parts of the world illuminated by electricity.

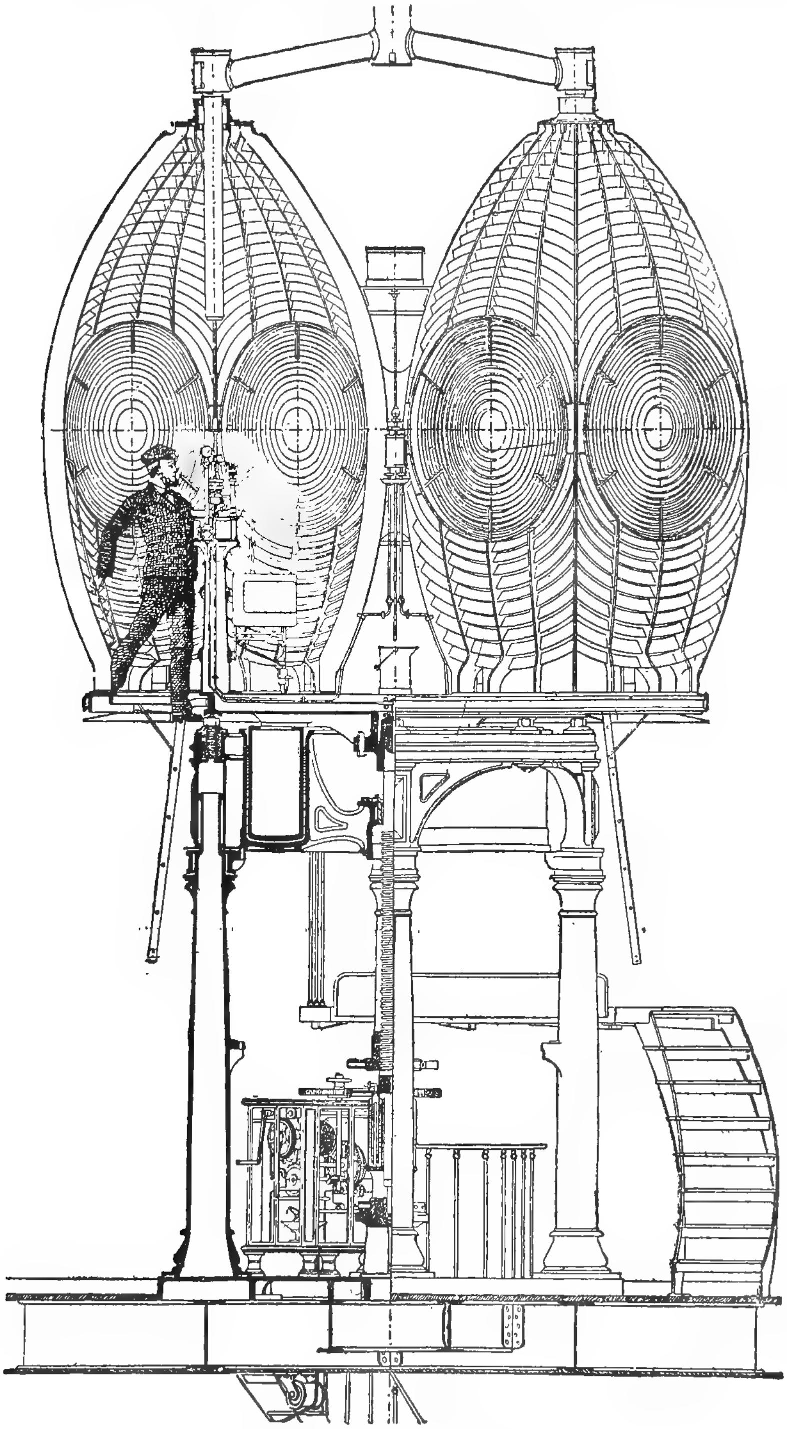

FIG. 10.—Ile Vierge Apparatus.

The table (II.) on the opposite page gives particulars of some of the more important electric lighthouses of the world.

Electric Lighthouse Installations in France.—A list of the 13 lighthouses on the French coast equipped with electric light installations will be found in Table II. It has been already mentioned that the two lighthouses at La Hève were lit by electric light in 1863 and 1865. These installations were followed within a few years by the establishment of electricity as illuminant at Gris-nez. In 1882 M. Allard, the then Director-General of the French Lighthouse Service, prepared a scheme for the electric lighting of the French littoral by means of 46 lights distributed more or less uniformly along the coast line. All the apparatus were to be of the same general type, the optics consisting of a fixed belt of 300 mm. focal distance, around the outside of which revolved a system of 24 faces of vertical lenses. These vertical panels condensed the belt of fixed light into beams of 3° amplitude in azimuth, producing flashes of about $\frac{3}{4}$ second duration. To illuminate the near sea the vertical divergence of the lower prisms of the fixed belt was artificially increased. These optics are very similar to that in use at the Souter Point lighthouse, Sunderland. The intensities obtained were 120,000 candles in the case of fixed lights and 900,000 candles with flashing lights. As a result of a nautical inquiry held in 1886, at which date the lights of Dunkirk, Calais, Gris-nez, La Canche, Baleines, and Planier had been lighted, in addition to the old apparatus at La Hève, it was decided to limit the installation of electrical apparatus to important landfall lights—a decision which the Trinity House had already arrived at in the case of the English coast—and to establish new apparatus at six stations only. These were Créac'h d'Ouessant (Ushant), Belle-Ile, La Coubre at the mouth of the river Gironde, Barfleur, Ile d'Yeu, and Penmarc'h.[1] At the same time it was determined to increase the powers of the existing electric lights. The scheme as amended in 1886 is now almost complete, the last lights of the series being in course of erection (1902). In 1901 one of the lights decided upon in 1886 and installed in 1888—Créac'h d'Ouessant—was replaced by a still more powerful twin apparatus exhibited at the 1900 Paris Exhibition. Of the lights established under the Allard scheme, Gris-nez, La Canche, and Planier have been replaced by similar apparatus to that at Créac'h.

All the electrically lit apparatus, in common with nearly all other new optics established in France since 1893, have been provided with mercury rotation. The four most recent electric lights have been constructed in the form of twin apparatus, two complete and distinct optics being mounted side by side upon the same revolving table and with corresponding faces parallel. It has been found that a far larger aggregate candle-power could be obtained from two lamps with 16 mm. carbons and a currant of 50 amperes than with one carbon of 23 mm. diameter in conjunction with a current of 100 amperes. A somewhat similar circumstance led to the choice of the twin forms for the two very powerful non-electric apparatus at Ile Vierge (Figs. 10 and 11) and Ailly, particulars of which will be seen in Table III.

For the present it is intended to retain the De Meritens magnito-electric machines which were laid down some years ago at the French electric lighthouses. All these machines have

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[1] The apparatus at Dunkirk has been replaced by the old Belle-Ile (1890) lens. At Barfleur and Belle-Ile are now being installed twin apparatus of the new Créac'h type.

TABLE II.—*Electric Lighthouse Apparatus.*

Name.	Characteristic.	Period.	Duration of Flash.	Candle-power.	Focal Distance of Lens.	Ratio of Angular Breadth of Panel to Whole Circle.	Current.	Voltage.	Carbons.	Electric Generators.	Lamps.	Engines.	Elevation above High Water.	Year Established.	Remarks.
UNITED KINGDOM—		Secs.	Secs.		mm.		Amps.		mm.				Feet.		
Souter Point (Durham)	Single flash	30	5	Candle-power not officially determined.	500	1:8	..	40	17	Holmes machines, alternating (400 revs.)	Serrin	Steam	150	1871	Fixed light apparatus, with revolving vertical condensing lenses in eight panels.
South Foreland (Kent)	Fixed light	..	..		500	..	..	40	21	do. (800 revs.)	Serrin	Steam	374 290	1872	Two lighthouses, high and low. Vertical condensing and strengthening prisms.
Lizard (Cornwall)	Fixed light	..	..		500	..	..	40	40 to 50	De Meritens alternators (600 revs.)	Modified Berjot-Serrin	Browne's caloric motors and oil	230 230	1878	Two lighthouses; apparatus similar to those at South Foreland.
St Catherine's (Isle of Wight)	Single flash	30	5		700	1:16	175 350	40	40 50	do. (600 revs.)	do.	Steam	134	1888	Lens elements only, 97° vertical angle.
Isle of May (Firth of Forth)	4 flash	30	2/5		700 (Fixed apparatus)	1:8	220	40	40	do.	Berjot-Serrin	do.	240	1886	Fixed light apparatus with revolving vertical condensing lenses.
Cumbrae (Firth of Clyde)	2 flash	30	2/5	158,000	700	..	..	115	Incandescent filament	Shunt-wound dynamos with cells	Swan-Edison	Oil	115	1900	Incandescent electric light. Lundell motors used for rotating apparatus.
FRANCE—															
Calais (Strait of Dover; Baleines similar)	4 flash	15	3/4	900,000	300	1:24	60	45	18	De Meritens alternators (550 revs.)	Improved Serrin	Semi-portable steam	190	1883	Fixed light apparatus with revolving vertical condensing lenses.
Cape Gris-nez (Strait of Dover)	Single flash	5	1/10	15,000,000 to 30,000,000	300	1:4	30 60	45	14 18	do. (550 revs.)	French Service pattern (1902)	Steam	226	1899	Twin optic mercury rotation. (This light superseded a triple-flashing electric light with intermediate red flash, of the Calais type, established in 1885. The first installation of the electric light at this station was in 1869.)
La Canche (Strait of Dover)	2 flash	10	1/10	15,000,000 to 30,000,000	300	1:4	30 60	45	14 18	do. (550 revs.)	do.	do.	174	1901	Twin optic, mercury rotation. (This light superseded a fixed electric light established in 1884.)
Cape la Hève (Havre, English Channel; Ile d'Yeu similar)	Single flash	5	1/10	10,000,000 to 20,000,000	300	1:4	25 50 100	45	11 16 23	do. (550 revs.)	Improved Serrin	do.	397	1893	Mercury rotation. (The first installation of electric light at this lighthouse was in 1863.)
Barfleur (English Channel; Dunkirk similar)	2 flash	10	1/5 to 2/5	3,500,000 to 6,500,000	300	1:12	25 50 100	45	11 16 23	do. (550 revs.)	do.	do.	236	1893	Twelve panels in groups of two. (In 1902 this apparatus was replaced by one similar to that at d'Ouessant.)
Créac'h d'Ouessant (Ushant) (Finistère; Belle-Ile similar)	2 flash	10	1/10	15,000,000 to 30,000,000	300	1:4	30 60	45	14 18	do. (550 revs.)	French Service pattern (1902)	do.	225	1901	Twin optic, mercury rotation. (This light superseded a double-flashing electric light similar to that at Barfleur, established in 1888.)
Penmarc'h (Finistère) (Phare d'Eckmuhl)	Single flash	5	1/10	15,000,000 to 30,000,000	300	1:4	25 50	45	11 16	Two-phase Labour alternators (810 to 820 revs.)	do.	do.	197	1897	Twin optic, mercury rotation.
La Coubre (Bay of Biscay)	2 flash	10	1/10	10,000,000 to 20,000,000	300	over 1:3	25 50 100	45	11 16 23	Single-phase Labour alternators (800 to 900 revs.)	Improved Serrin	do.	197	1895	Mercury rotation; two panels with mirror.
Planier (near Marseilles)	Single flash	5	1/10	15,000,000 to 30,000,000	300	1:4	30 60	45	14 18	De Meritens alternators (550 revs.)	French Service pattern (1902)	do.	207	1902	Twin optic, mercury rotation. (This light superseded an electric light established in 1881, showing a group of three white flashes separated by one red flash of the Calais type.)
ITALY—															
Tino (Gulf of Spezia)	3 flash	30	2	Undetermined	700	1:24	50 110 200	..	15 25 35	De Meritens alternators (830 revs.)	Berjot-Serrin	Caloric	386	1885	Eight panels of three lenses each, no mirror.
AMERICA—															
Navesink (Entrance to New York Bay)	Single flash	5	1/10	90,000,000 estimated maximum	700	nearly 1:2	max. 100	50	10, 16, 25, 30, 40	Alternating dynamos (800 revs.)	Modified Serrin	Oil, 25 h.p.	246	1898	Mercury rotation. Bivalve of 165°.
AUSTRALIA—															
Macquarie (Sydney, N.S.W.)	Single flash	1 min.	8	'Undetermined	920	1:16	55 110	..	15 25	De Meritens alternators (830 revs.)	Serrin	Gas	346	1883	16-panel revolving apparatus with 180° fixed mirror.

Note.—The methods of calculation adopted for determining the luminous intensities of lighthouse lights by the English and French authorities differ somewhat; the latter base their calculations upon data which give sometimes values 25 per cent. in excess of the figures arrived at by the English methods.

five induction coils, which, upon the installation of the twin optics, were separated into two distinct circuits, each consisting of $2\frac{1}{2}$ coils. This modification has enabled the old plants to be used with success under the altered condition of lighting entailed by the use of two lamps. The generators adopted in the French Service for use at the later stations, where twin optics have been installed, differ materially from the old type of De Meritens machine. The Phare d'Eckmuhl (Penmarc'h) installation serves as a type of the more modern machinery. The dynamos are alternating current two-phase machines, and are installed in duplicate. The two lamps are supplied with current from the same machine, the second dynamo being held in reserve. The speed is 810 to 820 revolutions per minute. Plant of a similar description will in all probability be laid down at a future date in all the electric lighthouses of this type.

The cost of a first-class electric lighthouse installation of the most recent type in France, including optical apparatus, lantern, dynamos, engines, air compressors, siren, &c., but not buildings, amounts approximately to £5886. The lamp generally adopted is a combination of the Serrin and Berjot principles, with certain modifications. Clockwork mechanism with a regulating electro-magnet moves the rods simultaneously and controls the movements of the carbons so that they are displaced at the same rate as they are consumed. It is usual to employ currents of varying power with carbons of corresponding dimensions according to the atmospheric conditions. In the French Service two variations are used in the case of twin apparatus produced by currents of 25 and 50 amperes at 45 volts with carbons 11 mm. and 16 mm. diameter (in some cases 30 and 60 ampere currents with 14 and 18 mm. carbons), while in single optic apparatus currents of 25, 50, and 100 amperes are utilized with carbons of 11 mm., 16 mm., and 23 mm. diameter. In England fluted carbons of larger diameter are employed with correspondingly increased current. Alternating currents have given the most successful results in all respects. Attempts to utilize continuous current for lighthouse arc lights have up to the present met with little success.

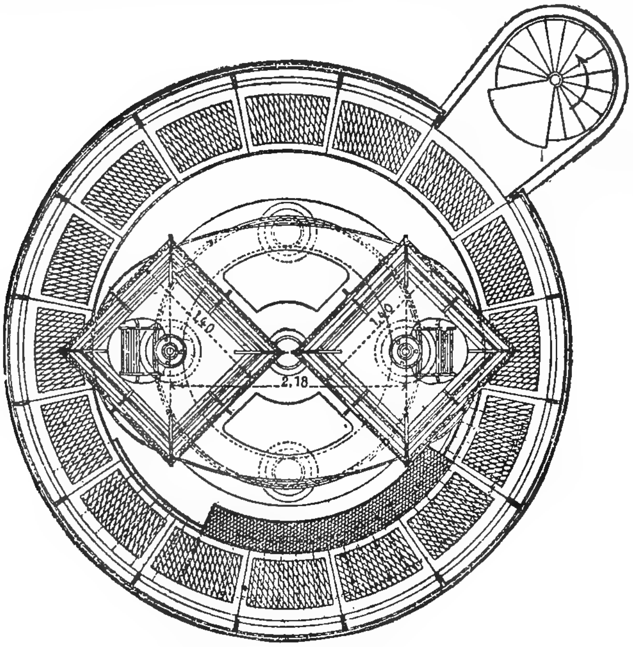

Fig. 11.—Plan of Ile Vierge Lantern.

Efficiency of the Electric Light.—In 1883 the lighthouse authorities of Great Britain determined that an exhaustive series of experiments should be carried out at the South Foreland with a view to ascertaining the relative suitability of electricity, gas, and oil as lighthouse illuminants. The experiments extended over a period of more than twelve months, and were attended by representatives of most of the lighthouse authorities of the world. The results of the trials tended to show that the rays of oil and gas lights suffered to about equal extent by atmospheric absorption, but that oil had the advantage over gas by reason of its greater economy in cost of maintenance and in initial outlay on installation. The electric light was found to suffer to a much larger extent than either oil or gas light per unit of power by atmospheric absorption, but the infinitely greater total intensity of the beam obtainable by its use, both by reason of the high luminous intensity of the electric arc and its focal compactness, more than outweighed the higher percentage of loss in fog. The final conclusion of the committee on the relative merits of electricity, gas, or oil as lighthouse illuminants is given in the following words:—"That for ordinary necessities of lighthouse illumination, mineral oil is the most suitable and economical illuminant, and that for salient headlands, important landfalls, and places where a very powerful light is required, electricity offers the greatest advantages."

Incandescent electric lighting has been adopted for the illumination of some light-vessels in the United States, a few small harbour and port lights, beacons, and in some cases buoys. The Cumbrae lighthouse in the Firth of Clyde is also lighted by incandescent electric lamps.

Coal gas had been introduced in 1837 at the inner pier light of Troon (Ayrshire), and in 1847 it was in use at the Heugh lighthouse (West Hartlepool). In 1878 cannel coal gas was adopted for the Galley Head lighthouse, with 108-jet Wigham burners. Sir James Douglass introduced gas burners consisting of concentric rings perforated on the upper edges, and from two to ten in number. These gave excellent results and high intensity of candle-power, 2600 in the case of the 10-ring burner with a flame diameter at the focal plane of $5\frac{5}{8}$ inches. These are in use at Bull Rock lighthouse, Haisboro' in Norfolk, and several other stations in England and Scotland. The use of multiple gas burners is not being further extended. Gas for lighthouse purposes generally requires to be specially made; the erection of gasworks at the station is thus necessitated and a considerable outlay entailed, which is avoided by the use of oil as an illuminant.

Incandescent Burners.—The invention of the Welsbach mantle places at the disposal of lighthouse authorities the means of producing a light of high intensity combined with great focal compactness. For lighthouse purposes other gaseous illuminants than coal gas are as a rule more convenient and economical, and give better results with incandescent mantles. Mantles have, however, been used with ordinary coal gas in many instances when a local supply is available.

Mineral Oil Burners.—Until the year 1846 the oil usually employed for lighthouse lamps was sperm. In that year colza or vegetable oil was introduced, and became the chief illuminant until the early 'seventies, when mineral oil was largely substituted in Great Britain for lighthouse purposes. In 1872 mineral oil was introduced at the Flamborough Head lighthouse, and since that date it has been utilized almost universally in cases where gas or electric light has not been installed. The large majority of lighthouses all over the world are now lit by mineral oil having a flash-point of over 140° F. The "Doty" burner was the first successful form of the multiple-wick type consuming mineral oil. Other improved oil burners have since been introduced, notably the patterns used in the English and French services, which are made in several sizes, varying from 1 to 8 concentric wicks, and in intensity from 20 to over 1800 candle-power. The improved 5-wick (1894) pattern used by the Trinity House gives a flame $3\frac{1}{2}$ inches diameter at the focal plane, and of 800 candle-power. The lamps used for supplying oil to the burner are of two general types, viz., those in which the oil is maintained under pressure by mechanical action, and the constant level lamp.

Incandescent Mineral Oil Burners.—Incandescent lighting with high-flash mineral oil was first introduced by the French Lighthouse Service in 1898 at L'Ile Penfret lighthouse. The burners employed are all made on the same principle, but differ slightly in details according to the type of lighting apparatus for which they are intended. The principle consists in injecting the liquid petroleum in the form of spray mixed with air into a vaporizer heated by the mantle flame or by a subsidiary heating burner. A small reservoir of compressed air is used—charged by means of a hand-pump—for providing the necessary pressure for injection. On first ignition the vaporizer is heated by a spirit flame to the required temperature. A reservoir air pressure of 85 lb per square inch is employed, a reducing valve supplying air to the oil vessel at 28 lb per square inch. The consumption of petroleum is as low as ·015 oz. per hour per candle of light intensity in the mantle. The intensity of the mantle flame varies from 400 candles in the case of 30 mm. diameter mantles to over 1200 candles with 55 mm. mantles. Experimental burners similar to those described have been constructed by the Trinity House and by the Irish Lighthouse Board with satisfactory results.

The following table (prepared by Baron Q. de Rochemont) gives the intrinsic brightness in a horizontal direction of various lighthouse illuminants employed in France. The values are expressed in carcels (9·5 candles) per centimetre of the mean horizontal focal plane of the luminous source:—

1 wick French mineral oil burner	0·35	carcels
2 ,, ,, ,,	0·50	,,
3 ,, ,, ,,	0·80	,,
4 ,, ,, ,,	0·95	,,
5 ,, ,, ,,	1·10	,,
6 ,, ,, ,,	1·18	,,
Incandescent lighting with compressed oil gas	2·00	,,
Incandescent lighting with petroleum vapour	2·50	,,
Incandescent lighting with acetylene	4·00	,,
Crater of the electric arc	900·00	,,

The luminous intensity of a beam from a dioptric apparatus is, *ceteris paribus*, proportional to the intrinsic brightness of the luminous source of flame, and not to the total luminous intensity. The intrinsic brightness of the flame of oil lamps increases only slightly with their focal diameter, consequently while the consumption of oil increases, the efficiency of the burner for a given apparatus decreases. The illuminating power of the condensed beam can only be improved to a slight extent, and, in fact, is occasionally decreased, by increasing the number of wicks in the burner. The same argument applies to the case of multiple ring and multiple jet gas burners, which, notwithstanding their large total intensity, have comparatively small intrinsic brightness.

Incandescent Oil Gas Burners.—It has been mentioned that incandescence with low-pressure coal gas produces flames of comparatively small intrinsic brightness. Coal gas cannot be compressed beyond a small extent without considerable injurious condensation and other accompanying evils. Recourse has therefore been had to compressed oil gas, which is capable of undergoing compression to 10 or 12 atmospheres without detriment, and can conveniently be stored in portable reservoirs. The burner employed resembles the ordinary Bunsen burner with incandescent mantle, and the rate of consumption of gas is 27·5 cubic inches per hour per candle. A reducing valve is used for supplying the gas to the burner at constant pressure. The burners can be left for even the whole night without attention. The system was adopted first in France, where it is installed at eight lighthouses, among others the Ar'men Rock light, and has been extended to other parts of the world, including several stations in Scotland. The mantles used in France are of 30 mm. diameter, and occasionally of larger dimensions. The 30 mm. mantle gives a candle-power of 400.

The use of oil gas necessitates the erection of gasworks at the lighthouse, or its periodical supply in portable reservoirs from a neighbouring station. A complete gasworks plant costs about £800. The annual expenditure for gas lighting in France does not exceed £72 where works are installed, or £32 where gas is supplied from elsewhere. In the case of petroleum vapour lighting the annual cost amounts to about £26.

Acetylene.—The high illuminating power and intrinsic brightness of the flame of acetylene makes it a very suitable illuminant for lighthouses, provided the difficulties attending its use can be overcome. At Grangemouth an unattended 21-day beacon has been illuminated by an acetylene flame for some time, and with considerable success. Acetylene has been used also in the United States, Germany, the Argentine, China, &c., for lighthouse and beacon illumination. Many buoys and beacons on the German and Dutch coasts have been supplied with oil gas mixed with 20 per cent. of acetylene, thereby obtaining an increase of over 100 per cent. in illuminating intensity. In France an incandescent burner consuming acetylene gas mixed with air has been installed at the Chassiron lighthouse (1902), the flame intensity being 1300 candles with a 55 mm. mantle. The French Lighthouse Service has perfected an incandescent acetylene burner with a 55 mm. mantle having an intensity of over 2000 candle-power, with intrinsic brightness of 60 candles per square centimetre.

4. *Unattended Lights and Beacons.*

Until recent years no unattended lights were in existence. The introduction of Pintsch's gas system in the early 'seventies provided a means of illumination for beacons and buoys of which large use has been made. Other illuminants are also in use to a limited extent.

Unattended Electric Lights.—In 1884 an iron beacon lighted by an incandescent lamp supplied with current from a secondary battery was erected on a tidal rock near Cadiz. A 28-day clock was arranged for eclipsing the light between sunrise and sunset and automatically cutting off the current at intervals to produce an occulting characteristic. Several small dioptric apparatus illuminated with incandescent electric lamps have been made by the firm of Barbier of Paris, and supplied with current from batteries of Daniell cells, with electric clockwork mechanism for occulting the light. These apparatus have been fitted to beacons and buoys, and are generally arranged for switching off the current during the daytime. They run unattended for periods up to two months. Two separate lenses and lamps are usually provided, with lamp changer, only one lamp being in circuit at a time. In the event of failure in the upper lamp of the two the current automatically passes to the lower lamp.

Oil Gas Beacons.—In 1881 a beacon automatically lighted by Pintsch's compressed oil gas was erected on the river Clyde, and many of these structures have since been installed in Great Britain, America, and other parts of the world. The gas is contained in an iron or steel reservoir placed within the beacon structure, and is refilled by means of a flexible hose on the occasions of the periodical visits of the light tender. The beacons, which remain illuminated for periods up to three months, are charged to five atmospheres, the pressure in the storage receiver on the tender being greater. Many lights are provided with occulting apparatus actuated by the gas passing from the reservoir to the burner automatically cutting off and turning on the supply. The Garvel beacon (1899) on the Clyde is shown in Fig. 12. The burner has seven jets, and is occulting.

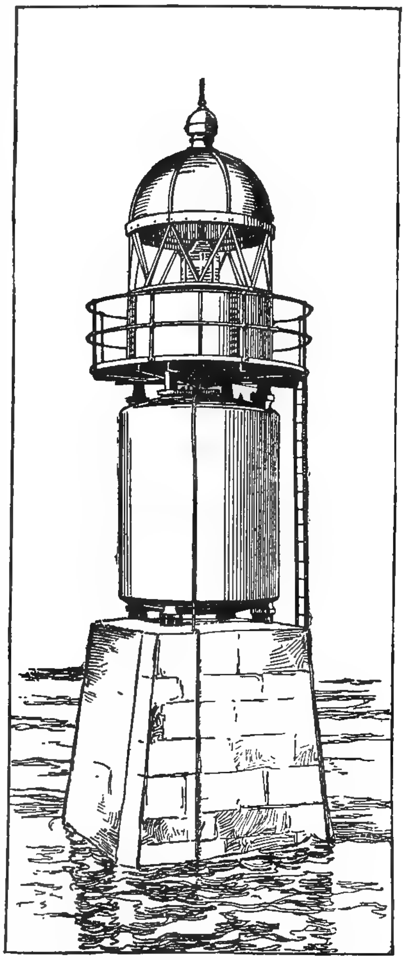

Fig. 12.—Garvel Beacon.

Lindberg Lights.—In 1881–82 several beacons lighted automatically by volatile petroleum spirit on the Lindberg-Lyth and Lindberg-Trotter systems were established in Sweden. Many lights of this type were subsequently placed in different parts of the world. The volatile spirit lamp burns day and night. Occultations are produced by a screen or series of screens rotated round the light by the ascending current of heated air and gases from the lamp acting upon a horizontal fan. The speed of rotation of the fan cannot be accurately adjusted, and the times of occultation therefore are liable to slight variation. The lights run unattended for periods up to fourteen or twenty-one days.

Benson-Lee Lamps.—An improvement upon the foregoing was the Benson-Lee lamp, in which a similar occulting arrangement is often used, but the illuminant is paraffin consumed in a special burner having carbon-tipped wicks which require no trimming. The flame intensity of the light is greater than that of the burner consuming light spirit. The introduction of paraffin also avoids the danger attending the use of the more volatile spirit. Twenty-one of these lights are in use on the Scottish coast, and many in other parts of Great Britain, America, Canada, and other countries.

Permanent Wick Lights.—About 1891 the French Lighthouse Service introduced petroleum lamps consuming ordinary high-flash lighthouse oil, and burning without attention for periods of several months. The burners are of special construction, provided with a very thick wick, which is in the first instance treated in such a manner as to cause the formation of a deposit of carbonized tar on its exposed upper surface. This crust prevents further charring of the wick after ignition, the oil becoming vaporized from the under side of the crust. Many fixed, occulting, and flashing lights fitted with these burners have been established in France, and several in other countries. In the case

TABLE III.—*Typical Non-Electric Lighthouse Apparatus.*

Name.	Locality.	Characteristic.	Period. Secs.	Duration of Flash. Secs.	Candle-power in Standard Candles.	Focal Distance of Lens. mm.	Ratio of Angular Breadth of Panel to Whole Circle.	Illuminant.	Burner.	Service Candle-power of Burner.	Height above High Water. Feet.	Year Established.	Remarks.
Casquets	Channel Islands	3 flash	30	2	40,000 to 60,000	920	1:9	Oil	8 wick 1894 T. H. pattern	1800	120	1877	Dioptric holophote, 121° vertical angle.
Eddystone	South Devon	2 flash	30	2 1/2	26,500 to 79,000	920	1:12	do.	6 wick Douglass	800	133	1882	Biform apparatus, lens elements only, 92° vertical angle.
Bishop Rock	Scilly Isles	2 flash	60	4	57,000 to 170,500	1330	1:10	do.	8 wick Douglass	1200	143	1886	Biform apparatus, lens elements only, 80° vertical angle.
Spurn Point	Yorkshire	Single flash	20	2	120,000 to 179,000	1330	1:8	do.	8 wick 1894 T. H. pattern	1800	128	1895	Lens elements only, 80° vertical angle.
Lundy Island	Bristol Channel	2 flash	20	2/3	81,000 to 121,000	920	Nearly 1:4	do.	5 wick 1894 T. H. pattern	800	165	1897	Mercury rotation, 4-panel bivalve, lens elements only. (St Mary's Isle, Northumberland, is similar.)
Pendeen	Cornwall	4 flash	15	1/2	57,000	920	1:8	do.	do.	800	195	1900	80° vertical angle lens, mercury rotation.
Roker Pier	Sunderland	2 flash	5	1/10	65,000	500	Nearly 1:2	Gas under 8″ pressure	Mantle 50 mm. dia.	400	84	In course of construction	Mercury rotation; univalve 164° in azimuth, with 164° dioptric mirror in rear.
Tarbet Ness	Dornoch Firth	6 flash	30	1/2	22,000	700	1:12	Oil	4 wick Doty	251	175	1892	6 lens panels of 30°, with 180° mirror. (Douglas Head apparatus (Isle of Man) similar.)
Fair Isle (Skroo)	Between Orkneys and Shetlands	2 flash	30	1/2	72,000	1330	1:12	do.	6 wick Doty	530	262	1892	Spherical lens.
Sule Skerry	West of Orkneys	3 flash	30	1/2	90,000	1330	1:9	do.	do.	530	113	1895	Equiangular lenses.
Noup Head	Orkneys	5 flash	60	1/2	51,000	920	1:10	do.	5 wick Doty	384	260	1898	Equiangular lenses, 5 panels with mirror; mercury rotation.
Pladda	South end of Arran Island	3 flash	30	1/2	186,000	1330	1:6	do.	6 wick Doty	530	130	1901	3 equiangular lens panels with mirror in rear; side panels eccentric.
Bell Rock	Near Firth of Tay	Red & white flashes	60	1/2	60,000	1330 and 920	..	do.	do.	530	95	1902	Combined hyper-radial (red) and first-order (white) light, with back prisms.
Galley Head	Co. Cork	6 or 7 flash	60	4	31,000 to 123,000	920	1:8	Gas	Wigham, 28 to 108 jets	250 to 2300	174	1878	Quadriform apparatus; lens elements only; eclipsing burner.
Bull Rock	Near Bantry Bay	Single flash	15	3	83,500 to 333,500	1330	1:6	Oil gas	10 ring Douglass	2300	271	1889	Biform apparatus, 75½° vertical angle lenses.
Howth Baily	Dublin Bay	Single flash	30	2 1/2	200,000	920	13:32	Gas	Wigham, 28 to 108 jets	250 to 2300	134	1902	Mercury rotation. Bivalve apparatus; panels of 147° in azimuth and 122° vertical angle.
Chassiron	Bay of Biscay	Single flash	10	1	70,000	920	1:8	Oil	6 wick	480	164	1891	The old first-order apparatus has been utilized in all cases.
				1/2	180,000	920	1:8	Incandescent oil gas	Mantle 30 mm. dia.	400	164	1895	
				1/2	360,000	920	1:8	Incandescent acetylene	Mantle 55 mm. dia.	1300	164	1902	
Cap d'Antifer	English Channel	Single flash	20	1	160,000 to 220,000	1330	1:6	Oil	6 wick	480	394	1894	Mercury rotation; hyper-radial apparatus with reflecting prisms. This is the only apparatus of this focal distance on the French coast.
Ile de Batz	Finistère	4 flash	25	1/5	250,000	920	1:8	Incandescent petroleum vapour	Mantle 55 mm. dia.	1200	223	1902	Group-flashing apparatus; 4 panels of 45°, with 180° mirror in rear; mercury rotation.
Ar'men	do.	3 flash	20	1/10	250,000	700	1:5	Incandescent oil gas	Mantle 30 mm. dia.	400	94	1897	Mercury rotation.
Villefranche	Mediterranean	Single flash	5	1/5	300,000	700	1:4	Incandescent petroleum vapour	Mantle 55 mm. dia.	1200	230	1902	Mercury rotation.
Ile Vierge	Finistère	Single flash	5	1/5	600,000	700	1:4	do.	do.	1200	246	1902	Twin optic; mercury rotation.
Kennery Island	Bombay	2 flash	10	1/5	250,000	920	Nearly 1:4	do.	Mantle 70 mm. dia.	1250	153	In course of construction	Mercury rotation; bivalve apparatus; 2 double-flashing 170° panels.
Hood Point	South Africa	4 flash	40	1/2	75,000	920	1:8	Oil	5 wick Douglass	800	180	1895	Mercury rotation; 4 panels of 45° in azimuth and 80° vertical angle, with catadioptric mirror in rear.
Cape St Blaze	do.	2 flash	15	1/3	5,000	250	1:4	do.	1 wick Douglass	20	250	1897	Rotates on ball-bearings.
Cape Leeuwin	West Australia	Single flash	5	1/5	145,000	920	Nearly 1:2	do.	6 wick T. H.	730	185	1896	Mercury rotation; bivalve of 123° lenses.
Cape Byron	N. S. Wales	2 flash	20	1/5	145,000	920	Nearly 1:2	do.	6 wick French type	800	384	1901	Mercury rotation; bivalve apparatus; group-flash produced by eclipsing screen.
Norah Head	do.	Single flash	5	1/5	110,000	700	Nearly 1:2	do.	4 wick T. H. pattern	350	153	In course of construction	Mercury rotation; bivalve 172° lenses.
Gray's Harbour	State of Washington, Pacific Coast	Red and white flashes	5	1/10	White 63,000 red 53,000	500	..	do.	3 wick	163	122	1898	Mercury rotation; one (red) lens of 165°, reinforced with two 60° mirrors; one (white) lens of 60°.
Toledo Harbour	State of Ohio, Lake Erie	2 white flashes separated by one red flash	10	1/10	White 26,000 red 25,000	375	..	do.	do.	163	72	In course of construction	Ball bearings; one (red) lens of 180°, reinforced with one mirror of 60°; two (white) lenses of 60°.
Crooked River	St. George's Sound, Florida	2 flash	10	1/10	18,000	250	..	do.	1 wick	52	115	1895	Mercury rotation; one group of 2 lenses, each 123°, reinforced by a mirror of 90°.

of the occulting types a revolving screen is placed around the burner and is carried upon a miniature mercury float. The rotation is effected by means of a small Gramme motor on a vertical axis fitted with a speed governor, and supplied with current from a battery of primary cells. The oil reservoir is placed in the upper part of the lantern and connected with the burner by a tube, to which is fitted a constant level regulator for maintaining the burning level of the oil at a fixed height. In the flashing or revolving light types the arrangement is generally similar, the lenses being revolved upon a mercury float which is rotated by the electric motor. In the flashing apparatus recently established at Saint-Marcouf, the beam intensity is 1000 candle-power, and it is capable of running unattended for three months. The electric current employed for rotating the apparatus is supplied by four Lalande and Chaperon primary cells, coupled in series, each giving about 0·15 amperes at a voltage of 0·65. The power required to work the apparatus is at the maximum about 0·165 ampere at 0·75 volt, the large surplus of power which is provided for the sake of safety being absorbed by a brake or governor connected with the motor.

Wigham Beacon Lights.—Mr Wigham has introduced an oil lamp for beacon and buoy purposes consisting of a vertical container filled with ordinary mineral oil or paraffin, and carrying a roller immediately under the burner case, over which a long flat wick passes. One end of the wick is attached to a float which falls in the container as the oil is consumed, automatically drawing a fresh portion of the wick over the roller. The other end of the wick is attached to a free counterweight keeping it taut. The oil burns from the convex surface of the wick as it passes over the roller, a fresh portion being constantly passed under the action of the flame. The light is capable of burning without attention for thirty days. These lights are also fitted with occulting screens on the Lindberg system. The candle-power of the flame is small.

5. *Light-vessels.*

The earliest light-vessel placed in English waters was that at the Nore in 1732, and before the end of the 18th century several more such ships were in use. Of modern light-vessels, many are built entirely of wood, others are composite, and some of iron. The wood and composite ships are sheathed with Muntz metal. Composite built vessels are considered most suitable for the service. The length of English light-vessels varies from 80 to 105 ft., with beam of from 20 ft. to 23 ft., the tonnage ranging from 155 to 265 tons. The lanterns used in modern English light-vessels and others of the same class are 8 ft. in diameter, circular in form, with glazing 4 ft. in height. They are annular in plan, surrounding the mast of the vessel upon which they are hoisted for illumination; they are lowered to the deck level during the day. Of the eighty-four light-vessels in British waters, including some few unattended light-vessels, eleven are in Ireland and five in Scotland. The others are on the coast of England and Wales. In the United States there are thirty-two light-vessels on the Atlantic seaboard and three on the Pacific coast. At the present time there are nearly 700 light-vessels in service throughout the world. The illuminating apparatus for almost all light-vessels is of catoptric form, the more modern vessels being fitted with a series of 21 in. or 24 in. silvered parabolic reflectors, having 1-, 2-, or 3-wick mineral oil burners in focus. The reflectors and lamps are hung in gimbals to preserve the horizontal direction of the beams.

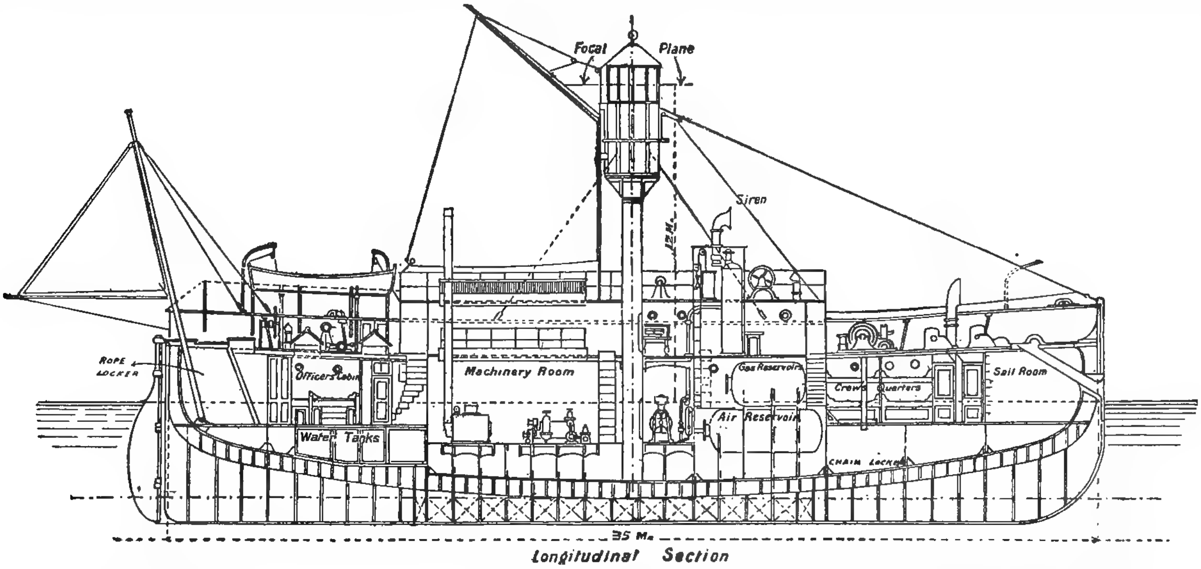

FIG. 18.—Sandettié Lightship.

The following table gives the intensity of beam obtained by means of two types of reflector:—

21-inch Trinity House Parabolic Reflector.

Burners—		Service Intensity of Beam. Candles.
1 wick "Douglass"		2715
2 ,, ,,	(catoptric)	4004
2 ,, ,,	(dioptric)	5722
3 ,, ,,		7528

24-inch Northern Lighthouse Board Parabolic Reflector.

Burners—		Service Intensity of Beam. Candles.
1 wick "Doty"		2177
1 ,, "Douglass"		4293
2 ,, ,,	(catoptric)	4265
2 ,, ,,	(dioptric)	7231

In revolving flashing lights two or more reflectors are arranged in parallel in each face. Three, four, or more faces or groups of mirrors are arranged around the lantern in which they revolve, and are carried upon a turntable rotated by clockwork. The intensity of the flashing beam is therefore equivalent to the combined intensities of the beams emitted by the several mirrors in each face. Group flashing characteristics can be produced by special arrangements of the reflectors. The two most powerful light-vessel lights in the British Isles are the *Spurn* and *Swin Middle*, the latter at the entrance to the Thames, each having a flash intensity of 20,000 candles. At the *Swin Middle* also was placed the first revolving lightship light in 1837.

Fog signals, where provided for light-vessels, are generally in the form of reed-horns or sirens, the smaller reed-horns being of the manual type. In the Trinity House Service many vessels are provided with steam plant for driving the air compressors. Oil engines have been recently introduced for this purpose. The approximate cost of a modern type of Trinity House light-vessel with steam power compressed-air siren is £16,000. The cost of a similar vessel with oil engines is £15,200.

Electrical Illumination.—An experimental installation of electric light was placed in one of the Mersey light-vessels in 1886 by the Mersey Docks and Harbour Board, but unfortunately proved unsuccessful. The United States Lighthouse Board in 1892 constructed a light-vessel provided with a powerful electric light, and moored her on the Cornfield Point station at Long Island Sound. This vessel was subsequently placed off Sandy Hook (1894). Four other light-vessels have since been provided with incandescent electric lights—either with fixed or occulting characteristics—in the United States, at Nantucket Shoals (1896), Fire Island (1897), Diamond Shoals (1898), and Overfalls Shoal (1901).

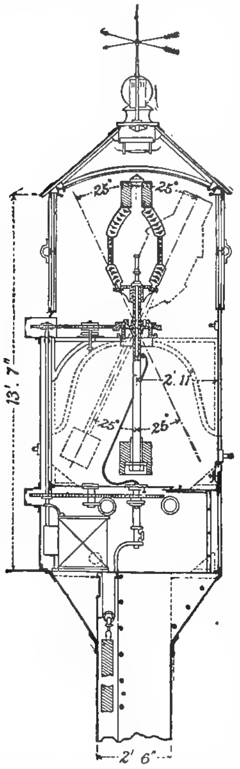

Fig. 14.—Lantern of Sandettié Lightship.

Gas Illumination.—In 1896 the French Lighthouse Service completed the construction of a steel light-vessel (the *Talais*), which was ultimately placed at the mouth of the Gironde. The construction of this vessel was the outcome of a long series of experiments carried out with a view to (1) regulate the stability of a light-vessel by avoiding all synchronism between its period of oscillation and that of the waves; (2) reduce the vessel's oscillations by the employment of main and bilge keels of great depth; (3) produce an efficient light-vessel at moderate cost, and lit by a dioptric flashing light with incandescent oil gas burners. The construction of the *Talais* was followed by that of a second and larger vessel, the *Snouw*, on similar lines, having a length of 65 ft. 6 ins., beam 20 ft., and a draught of 12 ft., with a displacement of 130 tons. The cost of this vessel complete with optical apparatus and gas holders, with accommodation for three men, was approximately £5000, and the annual cost of upkeep is stated to be £400. The candle-power of the beam is 35,000 candles. The vessel was built in 1898–99. A third vessel was constructed in 1901–02 for the Sandettié bank on the general lines adopted for the preceding examples of her class, but of the following increased dimensions: Length, 115 ft.; width at water line, 20 ft. 6 ins.; and draught, 15 ft., with a displacement of 342 tons (Fig. 13). Accommodation is provided for a crew of eight men. The optical apparatus (Fig. 14) is dioptric, consisting of four panels of 250 mm. focal distance, carried upon a "Cardan" joint below the lens table, and counterbalanced by a heavy pendulum weight. The apparatus is revolved by clockwork and illuminated by compressed gas with incandescent mantle. The candle-power of the beam is 35,000. The gas is contained in three reservoirs placed in the hold. The apparatus is contained in a 6 ft. lantern constructed at the head of a tubular mast 2 ft. 6 ins. diameter. A powerful siren is provided, with steam engine and boiler for working the air compressors. The total cost of the vessel, including fog signal and optical apparatus, was £13,600.

Unattended Light-vessels.—In 1881 an unattended light-vessel, illuminated with Pintsch's oil gas, was constructed for the Clyde, and is still in use at the Garvel Point. The light is occulting, and is shown from a dioptric lens fitted at the head of a braced iron lattice tower 30 ft. above water level. The vessel is of iron, 40 ft. long, 12 ft. beam, and 8 ft. deep, and has a storeholder on board containing oil gas under a pressure of six atmospheres capable of maintaining a light for three months. A similar vessel is placed off Calshot Spit in Southampton Water, and several have been constructed for the French Lighthouse Service. The latter are provided with deep main and bilge keels similar to those adopted in the larger French gas-illuminated vessels. In 1901 a light-vessel 60 ft. in length was placed off the Otter Rock on the west coast of Scotland: it is constructed of steel, 24 ft. beam, 12 ft. deep, and draws 9 ft. of water (Fig. 15). The focal plane is elevated 25 ft. above the water line, and the lantern is 6 ft. in diameter. The optical apparatus is of 500 mm. focal distance, and hung in gimbals with a pendulum balance and "Cardan" joint as in the Sandettié light-vessel. The illuminant is oil gas, with an occulting characteristic. The storeholder contains 10,500 cub. ft. of gas at eight atmospheres, sufficient to supply the light for ninety days and nights. A bell is provided, and is struck both by clappers moved by the roll of the vessel and by means of an automatic striking gear actuated by the gas on its passage to the burner. Thus the due action of the bell can be depended upon even in calm weather. The cost of the vessel complete was £2979.

Electrical Communication of Light-vessels with the Shore.—Experiments were instituted in 1886 at the *Sunk* light-vessel off the Essex coast for maintaining telephonic communication with the shore by means of a submarine cable 9 miles in length. The cable was landed at Walton-on-the-Naze. Great difficulties were experienced in maintaining communication during stormy weather, breakages in the cable being frequent. These difficulties have subsequently been overcome by the employment of larger vessels and special moorings. In addition, pile lighthouses and isolated rock and island stations have been placed in electrical communication with the shore. The Fastnet lighthouse has been electrically connected with the shore by means of a non-continuous cable, it being found impossible to maintain a continuous cable in shallow water near the rock owing to the heavy wash of the sea. A copper conductor is carried down from the tower to below low-water mark, and is separated from the cable proper laid on the

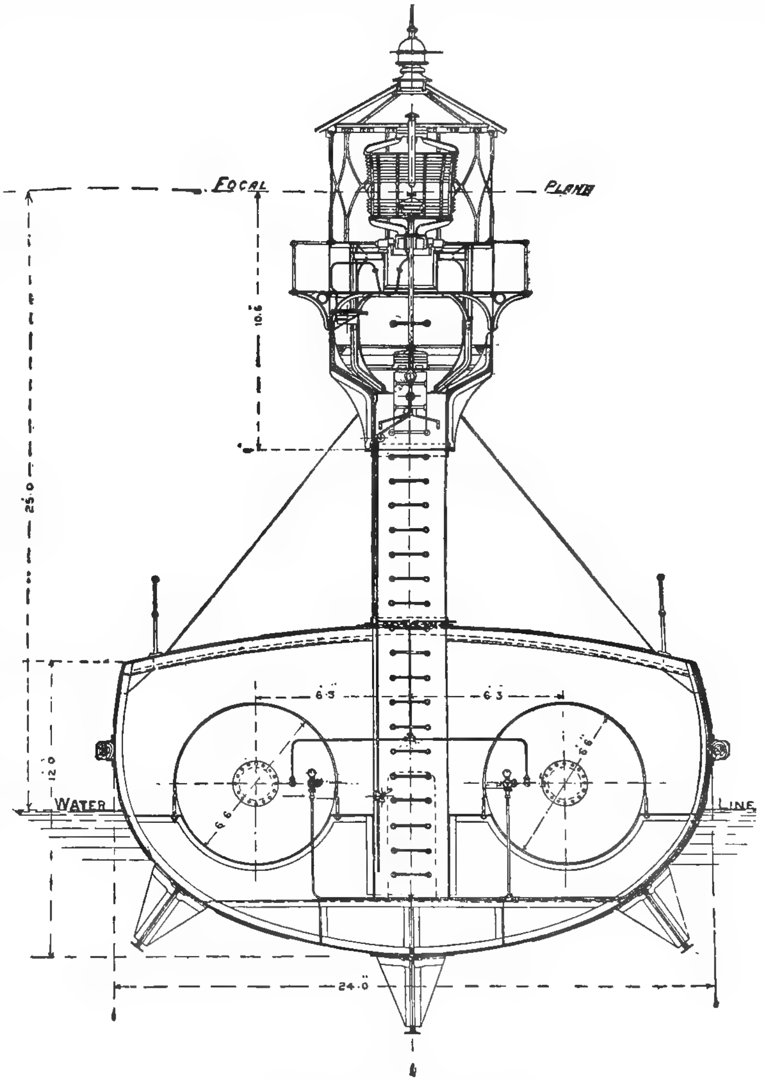

Fig. 15.—Otter Rock Light-vessel.

bed of the sea in a depth of 13 fathoms by a distance of about 100 ft. The lighthouse is similarly connected to earth on the opposite side of the rock. The conductor terminates in a large copper plate, and to the cable end is attached a copper mushroom. Weak currents are induced in the lighthouse conductor by the main current in the cable, and messages can be received in the tower by the help of electrical relays.

The possibilites of ætheric communication between isolated lighthouses and lightships and the shore are as yet undeveloped. It is probable that the solution of the difficulties now attending the maintenance of submarine communication in such cases will be found in some adaptation of the Marconi or other similar system. (See Telegraphy, Wireless.)

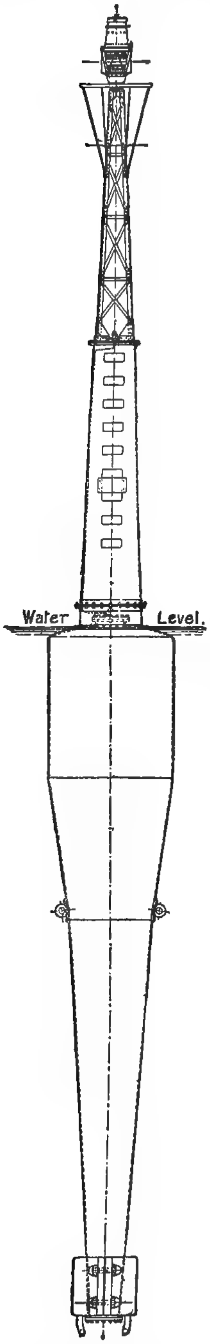

Fig. 16.—Spar Gas Buoy.

6. *Illuminated Buoys.*

The general question of buoying of coasts, rivers, and estuaries has been dealt with in the article Buoy. Pintsch's oil gas has been in use for the illumination of buoys since 1878. In 1883 an automatic occulter was perfected, worked by the gas passing from the reservoir to the burner. The lights placed on these buoys burn continuously for three or more months, and the buoys and lanterns are made in various forms and sizes. The spar buoy (Fig. 16) is sometimes adopted for situations where strong tides or currents have to be contended with. Oil gas lights are frequently fitted to Courtney whistling buoys and to bell buoys. A bell clapper for buoys has been introduced worked automatically by the gas as in the case of the Otter Rock light-vessel bell. One form of clapper actuated by the roll of the buoy (shown in Fig. 17) consists of a hardened steel ball placed in a horizontal phosphor-bronze cylinder provided with rubber buffers. Three of these cylinders are arranged around the mouth of the bell, which is struck by the balls rolling backwards and forwards as the buoy moves.

In the ordinary type of gas-buoy lantern the burner employed is either of the multiple-jet type or an Argand ring of 18 mm. diameter. It has been found impracticable to use incandescent mantles for buoy lights. The lenses employed are of cylindrical dioptric fixed-light form, 100 mm. to 300 mm. diameter. Some of the largest types of gas-buoy in use on the French coast have an elevation from water level to the focal plane of over 26 feet, with a beam intensity of more than 200 candles. Oil gas forms the most trustworthy and efficient illuminant for buoy purposes yet introduced. The system has been largely adopted by lighthouse and harbour authorities, and there are now some 1000 buoys fitted with these apparatus, in addition to 250 beacons, light-vessels, and boats. Several buoys have been fitted with electric light, both fixed and occulting, similar to those designed for beacon purposes. Seven electrically lit spar-buoys were laid down in the Gedney Channel, New York Lower Bay, in 1888. These were illuminated by 100 candle-power Swan lamps with continuous current supplied by cable from a power station on shore. The wear and tear of the cables has caused considerable trouble and expense. In 1894 alternating current was introduced and ten buoys lighted. These are still in service. Wigham's oil lamps have also been in some cases fitted to buoys.

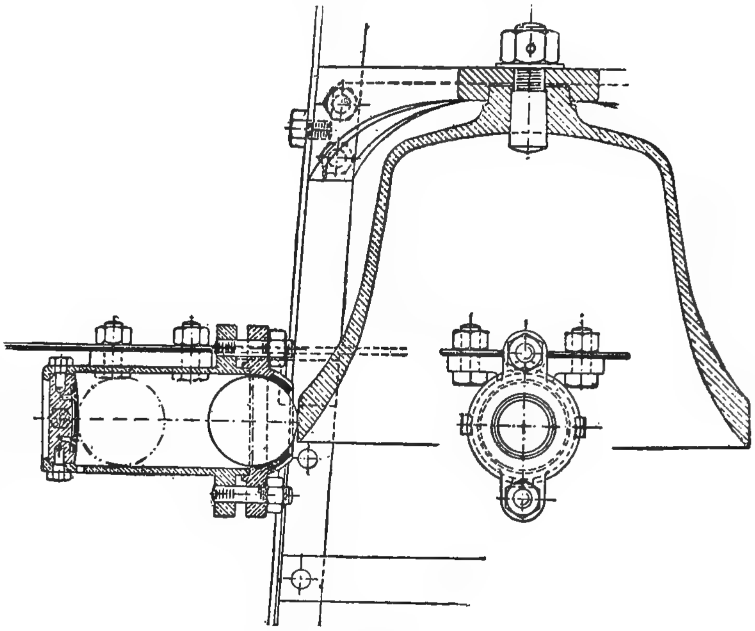

Fig. 17.—Buoy Bell.

7. *Fog Signals.*

The introduction of coast fog signals is of comparatively recent date. They were until the middle of the 19th century practically unknown except so far as a few isolated bells and guns were concerned. The increasing demands of navigation, and the application of steam power to the propulsion of ships resulting in an increase of their speed, drew attention to the necessity of providing suitable signals as aids to navigation during fog and mist. In times of fog the mariner can expect no certain assistance from even the most efficient system of coast lighting, since the beams of light from the most powerful electric lighthouse are frequently entirely dispersed and absorbed by the particles of moisture forming a sea fog of even moderate density, at a distance of less than a quarter of a mile from the shore. The careful experiments and scientific research which have been devoted to the subject of coast fog-signalling have produced much that is useful and valuable to the mariner, but unfortunately the practical results so far have not been so satisfactory as might be desired, owing to (1) the very short range of the most powerful signals yet produced under certain unfavourable acoustic conditions of the atmosphere, (2) the difficulty experienced by the mariner in judging at any time how far the atmospheric conditions are against him in listening for the expected signal, and (3) the difficulty in locating the position of a sound signal by phonic observations.

Bells and *gongs* are the oldest and, generally speaking, the least efficient forms of fog signals. Under very favourable acoustic conditions, however, the sounds may be audible at considerable ranges. On the other hand, the 2-ton bells formerly at the Eddystone have been inaudible at distances of a few hundred yards. The 1893 United States trials showed that a bell weighing 4000 ℔ struck by a 450 ℔ hammer was heard at a distance of 14 miles across a gentle breeze and at over 9 miles against a 10-knot breeze. Bells are frequently used for beacon and buoy signals, and in some cases at isolated rock and other stations where there is insufficient accommodation for sirens and horns. In the Trinity House Service their use is, generally speaking, restricted to these cases, but in other countries they are more frequently employed. Gongs, usually of Chinese manufacture, have been in use at many English lightships until quite recently, and also at other stations. In the Trinity House Service these have been superseded by more powerful sound instruments.

Explosive Signals.—Guns were long used at many lighthouse and light-vessel stations in England, but the Trinity House has substituted other explosive or wind signals for all formerly employed. Several guns are still in use as fog signals at Irish lighthouses and light-vessels, and in many instances abroad. No explosive signals are now in use on the coast of the United States. In 1878 sound rockets charged with gun-cotton were first used at Flamborough Head, and were soon afterwards supplied to many other stations. The nitrated gun-cotton or tonite signals now generally used in preference to all other explosive signals are made up in 4 oz. charges and hung at the end of an iron jib or pole attached to the lighthouse lantern or other structure, and fired by means of a detonator and electric spark. These can be discharged within 12 ft. of a structure without danger. The cartridges may be stored for a considerable period without deterioration and with safety. This form of signal is now very generally adopted for rock and other stations in Great Britain, Canada, Newfoundland, northern Europe, and other parts of the world; one type will be noticed in the illustration of the Bishop Rock lighthouse, attached to the lantern (Fig. 2).

Whistles.—Whistles, whether sounded by air or by steam, are not used in Great Britain, except in two instances of harbour signals under local control. It has been objected that their sound has too great a resemblance to steamers' whistles, and they are wasteful of power. In the United States and Canada they have been, however, largely used. The whistle usually employed consists of a metallic dome or bell against which the high-pressure steam impinges. Rapid vibrations are set up both in the metal of the bell and in the internal air, producing a shrill note. The Courtney buoy whistle, already referred to, is an American invention, and many of these instruments are in use in the United States, France, Germany, and elsewhere.

Reed-Horns.—These instruments in their original form were the invention of Daboll, an experimental horn of his manufacture being tried in 1851 by the United States Lighthouse Board. In 1862 the Trinity House adopted the instrument for seven land and light-vessel stations. For compressing air for the reed-horns as well as sirens, caloric, steam, gas, and oil engines have been variously used, according to local circumstances. The reed-horn was much improved by the late Professor Holmes, and many examples from his design are now in use in England and America. At the Trinity House experiments with fog signals at St Catherine's (1901) several types of reed-horn were experimented with. The best of them was the "Stentor" horn, which ranked second only to the siren instruments under trial. The working pressure is 120 ℔ per square in., and the nickel-steel reed $4\frac{7}{8}$ in. long by $1\frac{5}{8}$ in. wide. The reed made 265 vibrations per second, and the instrument consumed 2 cubic feet of air (measured at atmospheric pressure) per second of blast. The Trinity House Service horn with a somewhat smaller reed also gave satisfactory results, blowing at 15 ℔ pressure with a consumption of ·67 cubic feet per second and 397 vibrations. A small manual horn of the Trinity House type consumes ·67 cubic feet of air at 5 ℔ pressure, and of its class is about the most satisfactory instrument yet produced. The horns or trumpets are of brass. Reed-horns, either power-driven or of the manual pattern, are in use in many Trinity House light-vessels, and are also used in most other lighthouse services. An experimental reed-horn has been recently placed upon an isolated beacon near Vancouver, the reed of which is actuated automatically by electric current conveyed by a cable from a station on shore.

Sirens.—Undoubtedly the most powerful and efficient of all wind fog-signals is the siren. The principle of this instrument may be briefly explained as follows:—It is well known that if the tympanic membrane is struck periodically and with sufficient rapidity by air impulses or waves, a musical sound is produced. Robinson was the first to construct an instrument by which successive puffs of air under pressure were ejected from the mouth of a pipe. He obtained this effect by using a stop-cock revolving at high speed in such a manner that 720 pulsations per second were produced by the intermittent escape of air through the valves or ports, a smooth musical note being given. Cagniard de la Tour first gave such an instrument the name of siren, and constructed it in the form of an air chamber with perforated lid or cover, the perforations being successively closed and opened by means of a similarly perforated disc fitted to the cover and revolving at high speed. The perforations being cut at an angle, the disc was self-rotated by the oblique pressure of the air in escaping through the slots. Dové and Helmholtz introduced many improvements, and Brown of New York patented about 1870 a steam siren with two discs having radial perforations or slots. The cylindrical form of the siren now generally adopted is due to Mr Slight, who used two concentric cylinders, one revolving within the other, the sides being perforated with vertical slots. To him is also due the centrifugal governor largely used to regulate the speed of rotation of the siren. Over the siren mouth is placed a conical trumpet to collect and direct the sound in the desired direction. In the English service these trumpets are generally of considerable length vertically, with bent top and bell mouth. Those at St Catherine's are of cast iron with copper bell mouth, and have a total axial length of 22 ft. They are 5 in. in diameter at the siren mouth, the bell mouth being 6 ft. in diameter. At St Catherine's the sirens are two in number, 5 in. in diameter, being sounded simultaneously, and in unison. Each siren is provided with ports for producing a high note as well as a low note, the two notes being sounded in quick succession once every minute. The trumpet mouths are separated by an angle of 120° between their axes. This double form has been adopted in certain instances where the angle desired to be covered by the sound is comparatively wide. In Scotland the cylindrical form is used generally, either automatically or motor-driven. By the latter means the admission of air to the siren can be delayed until the cylinder is rotating at full speed, and a much sharper sound is produced than in the case of the automatic type. The Scottish trumpets are frequently constructed so that the greater portion of the length is horizontal. The Girdleness trumpet has an axial length of 16 ft., 11 ft. 6 in. being horizontal. The trumpet is capable of being rotated through an angle as well as dipped below the horizon. It is of cast iron, no bell mouth is used, and the conical mouth is 4 ft. in diameter. In France the sirens are cylindrical and very similar to the English self-driven type. The trumpets have a very short axial length, 4 ft. 6 in., and are of brass placed vertically, with bent bell mouth. Steam has been abandoned in France for working sirens, and all are now supplied with air

TABLE IV.

Station.	Description.	Vibrations per Second.		Sounding Pressure in ℔ per Square Inch.	Cubic Feet of Air used per Second of Blast reduced to Atmospheric Pressure.		Remarks.
		High.	Low.		High.	Low.	
St Catherine's (Trinity House)	Two 5″ cylindrical automatically driven sirens.	295	182	25	32	16	The air consumption is for the two sirens.
Girdleness (N.L.C.)	7″ cylindrical siren, motor-driven	234	100	30	130	26	
Casquets (Trinity House)	7″ disc siren, motor-driven	...	98	25	...	36	
French pattern siren	6″ cylindrical siren, automatically driven	326	...	28	14	...	A uniform note of 326 vibrations per second has now been adopted generally in France.

at a pressure of 28 ℔ per square inch. The Trinity House has recently reintroduced the use of disc sirens, with which experiments are still being carried out. The new Casquets siren has discs 7 in. in diameter and is motor driven; satisfactory results have been obtained. For light-vessels and rock stations where it is desired to distribute the sound equally in all directions the mushroom-head trumpet is occasionally used. The Casquets trumpet of this type is 22 ft. in length, of cast iron, with a mushroom top 6 ft. in diameter. In cases where neither the mushroom trumpet nor the twin siren is used, the single bent trumpet is arranged to rotate through a considerable angle. Table IV. gives particulars of a few typical sirens of the most recent form.

Since the first trial of the steam siren at the South Foreland in 1873 a very large number of these instruments have been established in Great Britain both at lighthouse stations and on board light-vessels. In all cases in Great Britain and France they are supplied with air compressed by steam or other mechanical power. In America and some other countries steam sirens are also in use.

The St Catherine's Experiments.—Extensive trials were carried out during 1901 by a committee of the Trinity House at St Catherine's lighthouse, Isle of Wight, with several types of sirens and reed-horns. The committee also experimented with several forms of trumpet, including some elliptical ones, the long axis being placed vertically. The conclusions of the committee may be briefly enumerated as follows:—(1) When a large arc requires to be guarded two fixed trumpets suitably placed are more effective than one large trumpet capable of being rotated. (2) When the arc to be guarded is larger than that effectively covered by two trumpets, the mushroom-head trumpet is a satisfactory instrument for the purpose. (3) A siren rotated by a separate motor yields better results than when self-driven. (4) No advantage commensurate with the additional power required is obtained by the use of air at a higher pressure than 25 ℔ per square inch. (5) The number of vibrations per second produced by the siren or reed should be in unison with the proper note of the associated trumpet. (6) When two notes of different pitch are employed, the difference between these should, if possible, be an octave. (7) For calm weather a low note is more suitable than a high note, but when sounding against the wind and with a rough and noisy sea a high note has the greater range. (8) From causes which cannot be determined at the time or predicted beforehand, areas sometimes exist in which the sounds of fog signals may be greatly enfeebled or even lost altogether. This effect was more frequently observed during comparatively calm weather and at no great distance from the signal station. (It has often been observed that the sound of a signal may be entirely lost within a short distance of the source, while heard distinctly at a greater distance and at the same time.) (9) The siren was the most effective signal experimented with; the reed-horn, although inferior in power, is suitable for situations of secondary importance. (No explosive signals were under trial during the experiments.) (10) A fog signal, owing to the uncertainty attending its audibility, must be regarded only as an auxiliary aid to navigation which cannot at all times be relied upon.

The following table (V.) gives the total numbers of fog signals of each class in use on 1st January 1902 in several countries. When two kinds of signals are employed at any one station, one being subsidiary, the latter is omitted from the enumeration. Buoy and unattended beacon bells and whistles are also omitted, but some local port and harbour signals not under the immediate jurisdiction of the various lighthouse boards are included, more especially in Great Britain.

Table V.

	Sirens.	Horns, Trumpets, &c.		Whistles.	Explosive Signals (Tonite, &c.).	Rockets.	Guns.	Bells.	Gongs.	Total.
		Power.	Manual.							
England and Channel Islands .	32	16	29	2	9	1	2	38	5	134
Scotland and Isle of Man .	23	4	...	1	2	...	...	14	1	45
Ireland	10	2	...	...	7	...	5	12	5	41
France	13	4	2	...	1	...	...	28	...	48
United States (excluding inland lakes and rivers) . .	30	20	1	53	...	...	...	219	...	323
British North America (excluding inland lakes and rivers) .	5	29	63	24	12	...	1	14	...	148

8. *Lighthouse Administration.*

Most countries possess organized and central authorities responsible for the installation and maintenance of coast lights and fog signals, buoys and beacons.

United Kingdom.—In England the Corporation of Trinity House, or according to its original charter, "The Master, Wardens, and Assistants of the Guild, Fraternity, or Brotherhood of the most glorious and undivided Trinity and of St Clement, in the parish of Deptford Strond, in the county of Kent," existed in the reign of Henry VII. as a religious house, with certain duties connected with pilotage, and was incorporated during the reign of Henry VIII. In 1565 it was given certain rights to maintain beacons, &c., but not until 1680 did it own any lighthouses. Since that date it has gradually purchased most of the ancient privately owned lighthouses and has erected many new ones. The Act of 1836 gave the Corporation control of English lights, with certain supervisory powers over the local lighting authorities, including the Irish and Scottish Boards. The Corporation now consists of a master, deputy-master, and 22 elder brethren (10 of whom are honorary), together with a number of younger brethren, who, however, perform no executive duties. In Scotland the lights are under the control of the Commissioners of Northern Lighthouses, incorporated in 1798. There are several local light boards in Scotland, the principal being the Clyde Lighthouse Trustees. The lighting of the Irish coast is in the hands of the Irish Lights Board, though formerly an ancient corporation, the Dublin Ballast Board, had control. The three lighthouse boards of the United Kingdom are subordinate to the Board of Trade, which controls all finances. The coast and harbour lights of Great Britain and Ireland are upwards of 1000 in number, with over 215 fog signals.

United States.—The United States Lighthouse Board was constituted by Act of Congress in 1852. The Secretary of the Treasury is the *ex-officio* President. The Board consists of two officers of the navy, two engineer officers of the army, and two civilian scientific members, with two secretaries, one a naval officer, the other an officer of engineers in the army. The members are appointed by the President of the United States. The coast-line of the States, with the lakes and rivers, is divided into 16 executive districts for purposes of administration.

France.—The Lighthouse Board of France is known as the Commission des Phares, dating from 1792 and remodelled in 1811. It consists of four engineers, two naval officers, and one member of the Institute, one inspector-general of marine engineers, and one hydrographic engineer. The chief executive officers are the Inspector-General of Ponts et Chaussées, who is director of the Board, and another engineer of the same corps, who is engineer-in-chief and secretary. The Board has control of about 700 lights, including those of Corsica, Algiers, &c. A similar system has been established in Spain.

English Colonies.—In Canada the coast lighting is in the hands of the Minister of Marine, and in most other colonies the Public Works Departments have control of lighthouse matters.

Other Countries.—In Denmark, Austria, Holland, and many other countries the Minister of Marine has charge of the lighting and buoying of coasts; in Belgium the Public Works Department.

Authorities.—Renaud. *Les Phares.* Paris, 1881.—Edwards. *Our Sea Marks.* London, 1884.—Heap. *Ancient and Modern Lighthouses.* Boston, 1889.—Allard. *Les Phares.* Paris, 1889.—Rey. *Les Progrès d'Eclairage des Côtes.* Paris, 1898.—De Rochemont and Deprez. *Cours de Travaux Maritimes*, vol. ii. Paris, 1902.—Parliamentary Reports on *Lighthouse Illuminants*, 1883 *et seq.*—*Notice sur les Appareils d'Eclairage* (French Lighthouse Service exhibit at Chicago). Paris, 1893.—*Report on the U.S. Lighthouse Board Exhibit at Chicago Exhibition.* Washington, 1894.—*Notice sur les Appareils d'Eclairage* (French Lighthouse Service exhibit at Paris. Paris, 1900.—*Report of the Trinity House Fog Signal Committee* (Parliamentary Paper), 1901.—*Annual Reports of U.S. Lighthouse Board, passim.*—*Proc. Int. Maritime Congress* (1893, sec. 4). London, 1893.—*Trans. Int. Nav. Congress* (1900, sec. 3). Paris, 1901.—*Proc. Int. Engineering Congress* (1901, sec. 2). Glasgow, 1902.—Douglass. "The New Eddystone Lighthouse," in *Proc. Inst. C. E.* vol. lxxv.; "The Bishop Rock Lighthouses," *ibid.* vol. cviii.—Hopkinson. "Electric Lighthouses of Macquarie and Tino," *ibid.* vol. lxxxvii.—Stevenson. "Ailsa Craig Lighthouse and Fog Signals," *ibid.* vol. lxxxix.; "Lighthouse Refractors,"

ibid. vol. cxvii. — Salmond. "Tory Island Lighthouse," *ibid.* vol. cviii.—Brebner. "Lighthouse Lenses," *ibid.* vol. cxi.; "Powers of Lighthouse Lights," *ibid.* vol. cxxii. — Purves. "Equiangular Prisms," *ibid.* vol. cxxviii.—Douglass and Purves. "Dioptric Apparatus for Lighthouses," *ibid.* vol. cxxxvii.—Stevenson. "Isle of May Lighthouse," *Proc. Inst. Mech. E.*, 1887.—Kenward. "Lighthouse Work, 1837–1887," *Nature*, June 1887.—J. N. Douglass. "Beacon Lights and Fog Signals," *Proc. Royal Inst.*, 1889.—Ribière. "Propriétés Optiques des Appareils de Phares," *Annales des Ponts et Chaussées*, 1894.—Preller. "Coast Lighthouse Illumination in France," *Engineering*, 1896; "New Electric Lighthouse of Penmarc'h," *ibid.* 1898.—"Lundy Island Lighthouse," *Engineering*, 1898.—"Lighthouse Engineering at the Paris Exhibition," *The Engineer*, 1900–1901.—Gedye. "Coast Fog Signals," *ibid.* 1902.

(W. T. D.)

Liguria, a territorial division of northern Italy, lying between the Ligurian Alps and Apennines on the N. and the Mediterranean on the S., and extending from the frontier of France in the W. to the Gulf of Spezia in the E. It embraces the two provinces of Genoa and Porto Maurizio, which have an area of 2037 square miles. Population (1881), 892,373; (1901), 1,080,944. Its principal products are wheat, maize, wine, oranges, lemons, fruits, olives, and potatoes, though the olive groves are being rapidly supplanted by flower-gardens, to grow flowers for export. Copper and iron pyrites are mined. The principal branches of industry are iron works, foundries, iron shipbuilding, engineering, and boiler works (Genoa, Spezia, Sestri, &c.), the production of cocoons, the manufacture of cottons and woollens. Owing to the sheltered situation and the mildness of their climate, many of the towns along this part of the Italian coast are chosen by thousands of foreigners for winter residence, whilst the Italians frequent them in summer for sea-bathing. The history is comprised under Genoa (*q.v.*) and in the art. Liguria (9th edition).

See also Riviera; also W. H. Bullock Hall, *The Romans on the Riviera and the Rhone* (London, 1898).

Li Hung Chang (1823–1901), Chinese statesman, was born on 16th February 1823 at Hofei, in Anhui. From his earliest youth he showed marked ability, and when quite young he took his bachelor degree. In 1847 he became a *Chinshih*, or graduate of the highest order, and two years later was admitted into the Imperial Hanlin College. Shortly after this the Central Provinces of the Empire were invaded by the Taiping rebels, and in defence of his native district he raised a regiment of militia, with which he did such good service to the Imperial cause that he attracted the attention of Tsêng Kwofan, the generalissimo in command. In 1859 he was transferred to the province of Fuh-kien, where he was given the rank of Taotai, or Intendant of Circuit. But Tsêng had not forgotten him, and at his request Li was recalled to take part against the rebels. Fortunately for him, he found his cause supported by the "Ever Victorious Army," which, after having been raised by an American named Ward, was finally placed under the command of Gordon. With this support Li gained numerous victories over the rebels, ending in the surrender of Soochow and the capture of Nanking. For these exploits he was made governor of Kiangsu, was decorated with a Yellow Jacket, and was created an earl. One incident connected with the surrender of Soochow, however, has left a lasting stain upon his character. By an arrangement with Gordon the rebel Wangs, or princes, yielded the city on condition that their lives should be spared. In spite of the assurance given them by Gordon, Li ordered their instant execution. This breach of faith so aroused Gordon's indignation that he seized a rifle, intending to shoot the falsifier of his word, and would have done so had not Li saved himself by flight. On the suppression of the rebellion (1864) Li took up his duties as governor, but was not long allowed to remain in civil life. On the outbreak of the Nienfei rebellion (1866) he was ordered again to take the field, and after some misadventures he succeeded in suppressing the movement. A year later he was appointed viceroy of Hukwang, in which post he remained until 1870, when the occurrence of the Tientsin massacre necessitated his transfer to the scene of the outrage. He was, as a natural consequence, appointed to the viceroyalty of the metropolitan province of Chihli, and soon justified his appointment by the energy with which he suppressed all attempts to keep alive the anti-foreign sentiment among the people. For his services in this respect he was made Imperial Tutor and member of the Grand Council of the Empire, and was decorated with many-eyed peacocks' feathers. To his duties as Viceroy were added those belonging to the Superintendent of Trade, and from that time to the day of his death, with some few intervals of retirement, he practically conducted the foreign policy of the Government. He concluded the Chefoo Convention with Sir Thomas Wade (1876), and thus brought to a close the incident of the murder of Mr Margary in Yunnan; he arranged treaties with Peru and Japan, and he actively directed the Chinese policy in Korea. On the death of the Emperor T'ungchih in 1875 he, by suddenly introducing a large armed force into the capital, effected a *coup d'état* by which the Emperor Kwang Sü was put on the throne under the tutelage of the two Dowager Empresses; and in 1886, on the conclusion of the Franco-Chinese war, he arranged a treaty with France. Li was always strongly impressed with the necessity of strengthening the Empire, and when viceroy of Chihli he raised a large well-drilled and well-armed force, and spent vast sums both in fortifying Port Arthur and the Taku Forts and in increasing the navy. For years he had watched the successful reforms effected in Japan, and had

Li Hung Chang.
(*From a photograph by J. Russell and Sons, London.*)

a well-founded dread of coming into conflict with that empire. But in 1894 events forced his hand, and in consequence of a dispute as to the relative influence of China and Japan in Korea, war broke out. The result proved the wisdom of Li's fears. Both on land and at sea the Chinese forces were ignominiously routed, and in 1895, on the fall of Wei-hai-wei, the Emperor sued for peace. With characteristic subterfuge his advisers suggested as peace envoys persons whom the Mikado very properly and promptly refused to accept, and finally Li was sent to represent his Imperial master at the council which was assembled at Shimonoseki. With great diplomatic skill Li pleaded the cause of his country, but finally had to agree to the cession of Formosa, the Pescadores, and the Liaotung peninsula to the conquerors, and to the payment of an indemnity of 200,000,000 taels. By a subsequent arrangement the Liaotung peninsula was restored to China, in exchange for an increased indemnity. A regrettable incident occurred during the peace discussions at Shimonoseki. As Li was being borne through the narrow streets of the town a would-be assassin fired a pistol point-blank in his face. Happily the wound inflicted was not serious, and after a few days' rest he was able to take up again the suspended negotiations. In 1896 he was appointed to represent the Emperor at the coronation of the Tsar, and on that occasion he visited Germany, Belgium, France, England, and the United States of America. For some time after his return to China his services were demanded at Peking, where he was virtually constituted Minister for Foreign Affairs; but in 1900 he was transferred to Canton as viceroy of the two Kwangs. The Boxer movement, however, induced the Emperor to recall him to the capital, and it was mainly owing to his exertions that, at the conclusion of the outbreak, a protocol of peace was signed in September 1901. For many months the health of the veteran statesman had been failing, and the difficulties he encountered in bringing about the terms of the settlement increased his indisposition. As the autumn advanced his medical advisers recognized that the end was near, and he died on the 7th of November 1901. He left three sons and one daughter. (R. K. D.)

See also CHINA, *History*.

Lille, capital of French Flanders and the department of Nord. It is both a fortified place of the first order and an important industrial and commercial city, situated in a district remarkable for its natural fertility and for the high development of its agriculture. It is at the junction of several important railway lines, 153 miles from Paris. The Deule Canal places the river boats of neighbouring ports and Belgium in communication with the town. Flax-spinning occupies 31 factories, with 205,000 spindles, 12,000 workpeople, and an annual production valued at £2,000,000; cloth, table-linen, damask, ticking, canvas, linen tape, and flax velvet for upholsterers' use are manufactured to the value of £3,200,000 per annum; 15 establishments, employing 3000 workpeople, manufacture flax-thread for sewing and lace-making, valued at £1,200,000 per annum; woollen fabrics represent £160,000 to £200,000 a year; and cotton-spinning and the making of cotton-twist (750,000 spindles) of especially fine quality occupy 10,000 persons, who annually produce £2,000,000 worth of goods. Lille also possesses a very important printing establishment with more than 500 workpeople, a tobacco manufactory (1200 workpeople), and 29 breweries; while chemical, oil and sugar works, bleaching grounds, dye-works, and establishments for the making of machinery employ 12,000 workmen. Great quantities of plant for sugar-works and distilleries, military stores, machinery, and bridges of all kinds are further notable manufactures. Lille is also an interesting town on account of its art collections, which rank among the richest in France. They are now collected in the Palais des Artes (1888–93). The church of Notre Dame de la Treille, a resort of pilgrims, is the finest in French Flanders. Its construction was resumed in 1892. There is a monument to General Faidherbe, one of Lille's most illustrious sons and a hero of the war of 1870. Population (1886), 143,135; (1901), 215,431.

Lima, a coast department of central Peru, with an area of 14,760 square miles and a population (1896) of 298,106. It is divided into six provinces: Chancay, Lima,—in which is the capital of the republic, the city of Lima, with its suburbs, Chorrillos (15,000), Miraflores (6000), and Barranca (5000),—Cañete, Canta, Huarochiri, and Jauja. The town of Huancavelica, in the sierra, has a population of 8000.

Lima, the capital of Peru, situated on a sloping plain between the Andes and the Pacific, 5 miles inland from the latter, in about 12° S. lat. The national library suffered severely during the Chilian occupation in 1881–83, but was reopened in 1884. The construction of a new school of medicine was begun in the Botanical Garden in 1899. Lima possesses amongst her public institutions a school of mines and engineering (1874), with good collections and laboratories; an institute for the arts and trades; a mint; a naval and military institute; the national museum of Peruvian antiquities; and a geographical society, founded in 1888. The university was attended by 650 students in 1898. The average summer temperature is 84° Fahr.; the average winter temperature, 56°. During the latter season frequent mists make the air chilly and the streets muddy. In spite of a good system of underground drainage and an improved water-supply, Lima is not on the whole a healthy place: fevers, dysentery, and tuberculosis are all prevalent. Population (1891), 103,556; (1900), estimated at 113,000. Many of the well-to-do inhabitants live wholly or in part at Miraflores, 5 miles south of the city, and Chorrillos, 7 miles south of the city, is much visited in summer for sea-bathing. Lima is the commercial as well as the administrative centre of the country, but its foreign trade is conducted through the port of Callao, on the Pacific, 7 miles to the west. In 1900 this port was entered and cleared by an aggregate of 2752 vessels of altogether 1,338,984 tons. The imports consist principally of coal, wheat and flour, rice, machinery, and textiles; and the exports of chemicals, sugar, salt, hides, wool, and groceries. (See further under CALLAO.)

Lima, a city of Ohio, U.S.A., capital of Allen county, on the Ottawa river, at an altitude of 872 feet and at the intersection of six railways. It is in the heart of the great petroleum and natural gas fields of Ohio and Indiana, and is one of the most important points in the country for the storing, refining, and shipping of petroleum. It has also railway repair works and extensive manufactures. It is the seat of Lima College, a Lutheran institution founded in 1893, which in 1899 had a faculty of 11 instructors and was attended by 171 students. Population (1890), 15,981; (1900), 21,723, of whom 1457 were foreign-born and 731 were negroes.

Limasol. See CYPRUS.

Limbourg (Flemish, *Limburg*), a province of Belgium, bordering on the Dutch provinces of Limburg and Brabant and the Belgian provinces of Antwerp, Brabant, and Liège. Its rivers are the Meuse, forming its eastern frontier, and the Demer, falling into the basin of the Scheldt, to the west. Canals serve the purposes both of navigation and irrigation; the canal from Liège to Maastricht is prolonged northwards by the canal from

Maastricht to Bois-le-duc, whence there branches off a junction canal from the Meuse to the Scheldt, ending at Antwerp. From this latter, again, are detached a branch to the military camp of Beverloo and another branch to Hasselt. Agriculture is followed by more than a third of the population, the crops consisting more particularly of rye, oats, wheat, barley, and beetroot. Other branches of industry are the distillation of gin from grain, the fattening of cattle, the manufacture of sugar from beetroot, and flour-milling. In 1901 a new coalfield was discovered in the north-east of the province, in the district of La Campine. The province is divided into three administrative arrondissements, the capitals of which are Hasselt (15,000), the capital of the province; Tongres (9350); and Maeseyck. At Bourg-Léopold, in the midst of the vast heaths surrounding this commune, is set up the camp of Beverloo, designed for the instruction of the army. Limbourg is the smallest and one of the least populous of the provinces of Belgium. Its area is 931 square miles, and its population, 206,200 in 1875, was 244,139 in 1901, or 262 inhabitants per square mile, an increase of 18·4 per cent., as compared with a 25 per cent. increase during the same period for the whole of Belgium.

Limburg, the southernmost province of Holland, bordering in the east on Rhenish Prussia and in the south on Belgium. The north and the south of the province present a striking contrast. The south is more elevated, by from 300 to 650 feet, culminating near Vaals at 1056 feet. The rich soil (*loess*) around Maastricht and the coalfields in the neighbourhood of St Pietersberg have furnished a basis for a denser and more prosperous population, reminding one of Belgium rather than of Holland. The north of the province, on the other hand, sandy and covered with heath and fens, except near the Meuse, supports a poor and sparse population, of an aspect like that of North Brabant. Altogether about 40 per cent. of the surface is arable, 13 per cent. forest, 11 per cent. meadow and pasture, and 22 per cent. uncultivated. The Meuse being of too impetuous current in winter, and too shallow in summer, there is nowhere in the province any considerable navigation or commerce. There are stone quarries near Maastricht and at Valkenburg. The output of coal in 1899 was 212,972 metric tons. Population (1899), 286,811.

Limerick, a maritime county of Ireland, province of Munster.

Population.—The area of the administrative county in 1900 was 662,973 acres, of which 160,191 were tillage, 427,367 pasture, 293 fallow, 9069 plantation, 9343 turf bog, 4067 marsh, 24,950 barren mountain, and 27,693 water, roads, fences, &c. The new administrative county, under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 180.632, and in 1891, 158,912, of whom 78,607 were males and 80,305 females, divided as follows among the different religions:—Roman Catholics, 150,789; Protestant Episcopalians, 6673; Methodists, 629; Presbyterians, 426; and other denominations, 395. The decrease of population between 1881 and 1891 was 12·02 per cent. The average number of persons to an acre for the whole county was ·23. Of the total population 117,484 persons inhabited the rural districts, being an average of 129 persons to each square mile under crops and pasture. The population in 1901 was 146,018 (Roman Catholics, 138,693; Protestant Episcopalians, 5777; Methodists, 704; Presbyterians, 400; others, 444), being a decrease of 8·1 per cent. The following table gives the degree of education in 1891 (excluding the city of Limerick):—

	Males.	Females.	Total.	Percentage.			
				R.C.	Pr. Ep.	Presb.	Meth.
Read and write	43,002	41,481	84,483	76·0	92·6	95·9	91·8
Read only .	4,052	4,347	8,399	7·7	3·0	2·1	4·7
Illiterate .	8,068	9,505	17,573	16·3	4·4	2·0	3·5

The percentage of illiterates among Roman Catholics in 1881 was 24·9. Excluding the city of Limerick, in 1891 there were 12 superior schools, with 426 pupils (Roman Catholics 425 and Protestant 1), and 258 primary schools, with 21,139 pupils (Roman Catholics 20,678 and Protestants 461). The number of pupils on the rolls of the National schools on 31st December 1900 was 25,072, of whom 24,292 were Roman Catholics and 780 Protestants. The following table gives the number of births, deaths, and marriages in various years:—

Year.	Births.	Deaths.	Marriages.
1881	4484	3529	798
1891	3637	2801	692
1900	3289	3053	651

In 1900 the birth-rate per 1000 was 22·5, and the death-rate 20·9; the rate of illegitimacy was 3·9 per cent. of the total births. The total number of emigrants who left the county between 1st May 1857 and 31st December 1900 was 178,036, of whom 90,369 were males and 87,667 females. The chief towns in the county are Limerick, Newcastle, and Rathkeale.

Administration.—The county is divided into two parliamentary divisions, East and West, the number of registered electors in 1901 being respectively 8226 and 8533. The rateable value in 1900 was £539,052. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises eight rural sanitary districts. The city of Limerick constitutes a separate county.

Agriculture.—The following tables give the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900:—

Year.	Wheat.	Oats.	Barley, Rye, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	7017	22,308	3012	24,175	5605	4047	114,304	180,468
1891	5066	16,620	1037	18,846	4937	5073	109,624	161,203
1895	2202	16,782	475	16,687	5013	4753	119,497	165,409
1900	2669	12,029	231	14,130	3871	4637	122,624	160,191

In 1900 the total value of the cereal and other crops was estimated at £968,047. The number of acres under pasture in 1881 was 405,483; in 1891, 425,256; and in 1900, 427,367.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	17,426	8,330	203,840	49,644	53,136	9,527	436,538
1891	19,950	10,815	241,911	79,600	53,924	14,356	446,074
1895	20,083	11,612	220,995	54,246	49,088	13,128	465,567
1900	18,342	13,144	232,181	58,334	44,696	15,362	509,739

The number of milch cows in 1891 was 101,652, and in 1900 101,312. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £3,169,587. In 1900 the number of holdings not exceeding 1 acre was 4408; between 1 and 5, 1795; between 5 and 15, 2297; between 15 and 30, 3025; between 30 and 50, 2954; between 50 and 100, 2838; between 100 and 200, 1041; between 200 and 500, 242; and above 500, 33—total 18,633. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 1358, amounting to £768,884. The number of loans for agricultural improvements sanctioned under section 31 of the Land Act, 1881, between 1882 and 1901, was 1105, and the amount issued was £82,330. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £397,499, the third largest amount in any county.

Fisheries.—In the salmon-fishery district of Limerick 1742 persons were employed in 1900, and the sum of £2315 was paid as licence duty, the largest amount in any fishery district in Ireland.

(W. H. PO.)

Limerick, a maritime city, county and parliamentary borough (returning one member), at the head of the estuary of the river Shannon, 120 miles west-south-west of Dublin by rail. It is the most important port on the west coast of Ireland, vessels of 3000 tons being able to discharge at the floating dock. The quays extend for about 1600 yards on each side of the river, and vessels of 600 tons can moor alongside at spring tides. In all 435 vessels (423 British and 12 foreign) of 158,240 tons entered in 1900, while 296 (all British except 4) of 78,860 tons cleared. The value of the foreign and colonial imports, which included 1,220,600 cwts. of wheat and 915,100 cwts. of maize, was £868,190. In the same year the number of sailing and steam vessels registered in the port was 27, of 1245 tons. Flour-milling is a flourishing industry, and the greater part of the south-west and north-west of Ireland is supplied with flour from Limerick. There is also an extensive trade in bacon, over 10,000 pigs being slaughtered weekly; and the improvement in dairy-farming has led to the establishment of creameries and a large condensed-milk factory. The great Munster fair is held here four times a year. New waterworks were completed at a cost of £70,000. The salmon fisheries on the Shannon are the most valuable in Ireland, and in 1900 gave employment to 1742 persons. In 1898 Limerick was constituted one of the six county boroughs which have separate county councils. The rateable value in 1900 was £69,008. Population (1881), 38,562; (1891), 37,155; (1901), 38,085. In 1891 there were 10 superior schools with 574 pupils (489 Roman Catholics and 85 Protestants), and 44 primary schools with 5577 pupils (5050 Roman Catholics and 527 Protestants). The percentage of illiterates among Roman Catholics was 19·2, as compared with 25·1 in 1881.

Limnology.—In the last quarter of the 19th century the study of lakes made remarkable progress, and was raised to the rank of a special science, mainly by the exertions of Prof. F. A. Forel, to whom is due the generally accepted name limnology. Limnology includes the complete study of lakes, geographical, physical, chemical, and biological, so conducted as to throw light on the mutual relations of all the natural conditions affecting them. The lakes of Europe and of several of the other continents have been investigated with some approach to completeness. Professor Forel has himself produced the standard monograph on the Lake of Geneva, to the investigation of which in all its aspects he has devoted his life. A Hungarian commission has explored Lake Balaton with equal fulness, and the Lake of Constance has been studied by an international committee of the five states which border it. The investigation of lakes has as a rule been entirely neglected by government surveyors, the departments charged with land and marine surveys alike declining to be responsible for the areas covered by fresh water. Hence in most countries private enterprise has endeavoured to fill the gaps on the large-scale maps. Amongst other workers M. André Delebecque in France has surveyed a large number of the lakes of the Alps, Vosges, and Pyrenees; Professor Richter has surveyed many of those of Austria; Drs Geistbeck, Ule, and Halbfass those of Germany; Professor Anuchin several of those in Russia; O. Marinelli in Italy; while some work has also been done on the lakes of Scandinavia and Finland. In Great Britain the lakes of the English Lake District were sounded and mapped by H. R. Mill and E. Heawood in 1893–94, under the auspices of the Royal Geographical Society; and many of the fresh-water lochs in Scotland have been fully mapped by Sir John Murray and F. P. Pullar. After the death, by drowning, of the last-named worker, a scheme was set on foot in his memory by which Sir John Murray undertook, with the support of Mr Laurence Pullar, to complete the study of all the lakes of the British Islands.

In Asia the lakes of Palestine, and some of those in Asia Minor and the Pamirs, have been sounded by travellers, and preliminary observations of much interest have been made in the great lakes of Africa, the survey of Lake Nyasa, indeed, being fairly complete. Of the lakes of Australia, New Zealand, and South America very little is yet known, but those of North America are being gradually surveyed. In the north of the United States particularly very complete and systematic researches are being made into the geographical and biological nature of the lakes.

Limnology may be looked upon as oceanography in miniature, and its study in many cases throws light on the larger problems of oceanography, which in lakes may be handled almost on the scale of laboratory experiments. But it differs essentially from oceanography on account of the important physical peculiarities of fresh water, and by the immense diversity of the separate objects of study. The ocean is one and uniform, with all its parts in free communication, all at the same level, and affected by the proximity of land only on the margins. Lakes, on the other hand, are diverse and innumerable; they occur at every level, from 1200 feet below that of the sea to over 20,000 feet above it. They are subject to the influence of the land in every part, and each lake, so far as its physical and biological conditions are concerned, is isolated and distinct from every other. Thus every lake has its own clearly-marked individuality, forming a microcosm which must be studied in detail before it can be fully understood. The number of monographs on particular lakes and lake-groups has grown so much in recent years that it is now possible to draw some wide conclusions applicable to all lakes, and thus to afford a surer basis for particular researches. The following are the general considerations set forth by Professor Forel in his *Handbook of Limnology.*

A lake is defined as a depression enclosed by land on every side, and containing standing water which is not in communication with the sea. Tidal lagoons are thus excluded. Lakes are divided into (1) *lakes proper,* which may be of any size if the water be deep enough to prevent the invasion of aquatic plants, (2) *ponds,* which are so shallow that plants may take root on the bottom on any part, and (3) *marshes,* which are ponds almost filled with vegetation.

The geographical conditions which affect a lake are chiefly its position in general, and particularly its latitude and altitude, on which depends the climate, and also to a great degree the character of the organisms living in the water. The area of a lake determines the effect which its waters can exercise upon its banks, as it is only in large lakes that the wind is able to raise waves and currents capable of producing erosion. The depth also exercises an influence on the movement of the waters, and has a bearing on the distribution of life and on the theory of the origin of the lake-basin. If a lake-basin were a uniform funnel-shaped depression, its average depth would be one-third of the maximum, but as a rule a great part of the floor of a lake is a perfectly flat surface of sedimentation, and the average depth is usually one-half, or even a larger fraction, of the maximum. The typical lake-basin has the form of the frustum of an inverted cone. Limnimetric functions to which some importance is attached in classifying lakes are the development of the coast-line and the number and size of the islands. With regard to chemical and thermal conditions, the total volume of a lake is important, and the relation of the tributary drainage area to the area of the lake surface affords some clue to the probable variations of volume and consequent changes in level and in temperature, these being in close relation to the volume and variations of the inflowing streams. As to position in a river course, the fact of a stream flowing through a lake, or ending in it, may greatly affect the active or passive migration of aquatic plants and animals.

Meteorological conditions are even more important. The thermal changes of lake-water depend upon the atmospheric temperature almost entirely. Absolute humidity of the atmosphere determines the dew-point, on the relation of which to the temperature of the surface water the occurrence of condensation or evaporation depends. Relative humidity determines the amount of cloud and the frequency of precipitation, the former dictating the amount of solar radiation to the lake in the daytime and of radiation from the lake at night, the latter being vital to the supply of inflowing water. In the extreme case of dry air and great radiation salt lakes with no outlet are produced. Wind produces waves and currents which mix the water, and it also serves as the agent by which a large lake influences the climate of the surrounding district. The general wind blowing across a lake, or sudden storms descending upon it, are of less interest than the local winds produced by its influence on the atmosphere. Effects analogous to land and sea breezes are produced around large lakes: at night in summer the land breeze blows in towards the centre of the lake, and by day the lake breeze blows outwards towards the land; but in winter the land wind prevails also throughout the day. Local variations of barometric pressure are the cause of the effects known as *seiches*.

It is important to distinguish the different parts of a lake-basin. These typically consist of a flat floor surrounded by a relatively steep slope. The floor and the lower part of the slope form the deep area; the upper part of the slope is the coastal area, and in this we may distinguish the *banks*, which form a ring round the lake and are washed over by the waves in heavy storms; the *beach*, which is intermediate between the banks and the *littoral zone*, or belt in which the action of the waves produces an effect on the bed of the lake.

From whatever causes a lake may arise, the natural processes of its economy, the incoming and outgoing of its affluent and effluent waters, produce changes in its basins—the building of deltas, the scattering of fine sediment over the floor, and the down-cutting of the outlet, all ultimately tending to the extinction of the lake by filling up and natural draining. According to the stage to which these processes have advanced, the lake may be classed as young, mature, old, and finally as dead.

From having been the special study of geologists in its physical aspects, limnology is now rapidly becoming the peculiar study of biologists, and attempts are even being made to limit the meaning of the word to the study of organic life in lakes, which would be denoted more correctly as limno-biology.

Authorities.—F. A. Forel. *Handbuch der Seenkunde; Allgemeine Limnologie.* Stuttgart, 1901.—F. A. Forel. *Le Léman, Monographie limnologique.* 3 vols. Lausanne, 1892–1902.—*Bodensee-Forschungen der wissenschaftlichen Kommission der fünf Ufer-Staaten.* Lindau, 1893 and following years.—*Resultate der wissenschaftlichen Erforschung des Balaton (Platten) Sees.* Vienna, 1897 and following years.—A. Geistbeck. *Die Seen der Deutschen Alpen.* Leipzig, 1885.—A. Magnin. *Les Lacs de Jura.* Paris, 1895.—A. Penck and E. Richter. *Atlas der österreichischen Alpenseen.* Vienna, 1895 and following years.—A. Delebecque. *Les Lacs françaises, avec Atlas.* Paris, 1898.—H. R. Mill. "Bathymetrical Survey of the English Lakes." *Geographical Journal*, vol. vi. 1895.—J. Murray and F. P. Pullar. "Bathymetrical Survey of the Fresh-water Lochs of Scotland," *Geographical Journal*, vol. xv. 1900. (H. R. M.)

Limoges, chief town of department Haute-Vienne, France, 249 miles south-south-west of Paris by rail. It comprises two parts originally distinct—the city occupying the lower slope of the hill, and the town proper the summit. Boulevards now replace the ancient fortifications, and the suburbs are extending. Amongst modern public buildings are the Hôtel de Ville (1882) and the National Establishment of Decorative Art, containing various collections; there is also a statue of Gay-Lussac (1890), besides a monumental fountain (1893). There are about thirty factories for the manufacture of porcelain, and the production averages about £600,000 per annum. This and the cognate industries, together with the working of the quarries and the preparation of kaolin paste for foreign potteries, give employment to about 20,000 persons. The making of boots and shoes and clogs has made great advances as an industry, about 2000 persons being employed in bootmaking and from 300 to 400 in the manufacture of clogs. Population (1881), 55,580; (1891), 60,890; (1901), 83,569.

Limon, or Port Limon, the chief Atlantic port of the republic of Costa Rica, Central America, situated on a bay of the Caribbean Sea, 103 miles from the capital, San José, by rail. The first houses were built in 1871. Large expense has been incurred by the authorities in improving the sanitation of the town. The harbour has also been much improved, and is now protected by a sea-wall built along the low-water line. An iron pier affords accommodation for four large ocean steamers, and all that is required to render the port first-class is a breakwater from the harbour to a small island about 1200 yards distant. There is an excellent water-supply from the hills above the harbour. Almost the entire coffee crop of Costa Rica is sent by rail for shipment at Port Limon to Europe and the United States. The port is now visited by about thirty steamers monthly from the United States, Europe, the Spanish Main, and the West Indian Islands. There are ice factories and a brewery. Population (1897), 4000.

Limoux, chief town of arrondissement, department of Aude, France, 15 miles south-south-west of Carcassonne, on railway to Quillan and on the left bank of the Aude. The town was formerly the fortified capital of the comté of Prasey, and still preserves some vestiges of its ancient ramparts. The St Martin's church is a large Gothic edifice, founded on an earlier Roman one. Two other churches were formerly attached to conventual establishments, and on a hill north of the town is the 14th-century church of Notre Dame de Marceille, with a black marble image of the Virgin. The town has also a general hospital, the asylum for the departments of Aude and Pyrénées-Orientales, and a tribunal of commerce. There is trade in wine, corn, and fodder, besides manufactures of hats and caps: the white wine known as "blanquette de Limoux" is held in high repute. Manganese, building stone, gypsum, and marble are found in the vicinity. Population (1881), 4647; (1891), 4507; (1901), 7045.

Limpopo, a considerable river of South-East Africa, rising on the high plateau of the Southern Transvaal and flowing in a wide semicircular sweep round the northern frontiers of that country, finally entering the Indian Ocean through Portuguese territory in 25¼° S. Surveys of the lower river by Portuguese officers in 1895–96 have shown that this may be utilized as a waterway to the interior by the employment of shallow-draught steamers, at least as far as Gungunyana's ford in 24° 41′ S. The bar has been found less dangerous than was once supposed, but at low water (December) navigation is very difficult at certain points on the river, especially at the Ilha Verde in 24° 53½′. Below Gungunyana's ford (which seems itself to be passable) the passage is almost blocked by a bar of hard micaceous clay, through which, however, there is a channel with 2½ feet of water. The extreme high-water level on the lower course is more than 24 feet above that of low water, and when it is reached the whole plain bordering the Limpopo is flooded. At this period water communication seems to be established with the Nkomati river, which is crossed by the Delagoa Bay railway on the Transvaal frontier.

See *Boletim Soc. Geogr. de Lisboa*, xvi. (1897), p. 561, with map, and also map issued by the Ministerio da Marinha, 1897.—Da Costa. *Gaza, 1897–98.* Lisbon, 1899.—Grandjean in *Bul. Soc. Neuchateloise de Géogr.* 1899. (E. He.)

Linares, a town of Spain, in the province of Jaen. The population is decreasing somewhat, and was only 35,233 in 1897. The lead mine concessions on the register at the close of 1898 were 1075. Four English companies are desilverizers and smelters as well as manufacturers of lead sheets and pipes, and purchase most of the ore raised. The production in 1898 amounted to 81,250 tons of first-class ore and 20,223 tons of second-class ore. There is active trade in wine, oil (28,300 gallons in 1898), wheat (43,000 bushels), and barley (54,000 bushels). There are many new and handsome buildings, including the town hall, the theatre, casinos, the bull-ring, the savings bank, factories, and mining offices.

Linares, a province of southern Chile, situated between 35° 30′ and 36° 30′ S. and 70° 30′ and 72° W., bounded on the N. by the province of Talca, on the S. by that of Ñuble, and on the W. by that of Maule, while on the E. the anticlinal line of the Andes is its border. Its area is 3589 square miles, and in 1895 its population was 101,858. The capital, Linares, has a population of 7331.

Lincoln, a north midland county of England, bounded on the N. by York, on the E. by the North Sea and Norfolk, on the S. by Cambridge, Northampton, and Rutland, and on the W. by Leicester, Nottingham, and York.

Area and Population.—In 1891 the area of the ancient (geographical) county was 1,693,547 acres, and the population 472,878, of whom 233,571 were males and 239,307 females, showing an increase of 2884, or ·7 per cent. since 1881, as compared with an increase of 7·7 per cent. in the ten years 1871–81. There were, in 1891, 0·28 persons to an acre and 3·58 acres to a person. In 1901 the population of the ancient county was 498,781. The area of the registration county in 1891 was 1,659,930 acres, and the population 467,281; and in 1901, 492,948, of whom 242,193 were males and 250,755 females. The subjoined table gives particulars of the birth-rate, death-rate, the number of persons married per 1000 inhabitants, and the illegitimacy-rate per 1000 births :—

	1871–80.	1881–90.	1889–98.	1899.
Birth-rate . .	32·6	30·4	28·4	28·5
Death-rate . .	18·6	17·5	17·1	17·0
Marriage-rate .	14·7	13·6	15·0	17·1
Illegitimacy-rate.	62	58	55	57

In 1891 the county contained 1230 persons of Scottish birth, 1454 of Irish birth, and 1295 foreigners. At the same date there were 385 blind persons, 190 deaf and dumb, and 1271 insane.

Administration.—For parliamentary purposes the county is divided into seven divisions, namely, West Lindsey or Gainsborough, North Lindsey or Brigg, East Lindsey or Louth, South Lindsey or Horncastle, North Kesteven or Sleaford, South Kesteven or Stamford, and Holland or Spalding, and the parliamentary boroughs of Boston, Grantham, Grimsby, and Lincoln, each returning one member. The county embraces the three administrative counties of the parts of Lindsey, parts of Kesteven, and parts of Holland, together with the county boroughs of Lincoln and Grimsby. There are six municipal boroughs, Boston, Grantham, Grimsby, Lincoln, Louth, and Stamford. In the parts of Holland the borough of Boston has a separate commission of the peace, and there are two petty sessional divisions. In the parts of Kesteven the boroughs of Grantham and Stamford have each a separate commission of the peace and separate courts of quarter sessions, and there are 4 petty sessional divisions. In the parts of Lindsey the county boroughs of Grimsby and Lincoln have each a separate commission of the peace and a separate court of quarter sessions, whilst the municipal borough of Louth has a separate commission of the peace, and there are 14 petty sessional divisions. The three administrative counties contain respectively 55, 211, and 458 entire civil parishes, the county borough of Grimsby one entire civil parish, and the county borough of Lincoln 18 entire civil parishes; these administrative divisions taken conjointly also embrace 4 other entire civil parishes and parts of 2 others which are situated partly in other administrative counties. The ancient county contains 581 entire ecclesiastical parishes and districts, and parts of 4 others. It is mostly in the diocese of Lincoln, but in part also in the dioceses of Southwell and York.

Education.—There is a diocesan training college for women teachers at Lincoln. The number of elementary schools in the county on 31st August 1900 was 592, of which 132 were board schools and 460 voluntary schools, the latter including 419 National Church of England schools, 20 Wesleyan, 11 Roman Catholic, and 10 British and "other." The average attendance during the year was 56,459 out of 69,437 on the register. The total school board receipts for the year ending 29th September 1900 were £74,074, of which £5383 was the income under the Agricultural Rates Act.

Agriculture.—Since 1880 there has been an increase in the area of the permanent pasture and of the meadow-land. The area devoted to both bare fallows and corn crops has decreased since 1880. The number of acres farmed by tenants was 1,271,244 in 1889, 1,318,631 in 1895, and 1,358,862 in 1900; the number of acres farmed by the owners being 248,444, 199,058, and 159,333 respectively.

The table immediately following shows the areas under the different kinds of crops for the periods named :—

Year.	Area in Cultivation.	Area under Corn Crops.	Area under Green Crops.	Area of Bare Fallow.	Area under Permanent Grass.
1880	1,494,461	611,684	238,239	37,656	...
1885	1,510,615	601,682	233,556	30,816	464,868
1890	1,522,425	586,749	229,319	28,246	487,761
1895	1,517,689	552,017	241,148	27,966	500,742
1900	1,518,195	562,504	249,247	18,388	499,203

The next table shows the numbers of the live stock for the periods named :—

Year.	Cows and Heifers.	Other Cattle.	Total Cattle.	Horses.	Sheep.	Pigs.
1880	53,023	158,339	211,362	64,510	1,444,867	85,116
1885	61,527	170,875	232,402	66,593	1,270,048	93,107
1890	66,076	175,007	241,083	68,201	1,293,152	107,702
1895	61,606	171,776	233,382	72,698	1,161,958	114,278
1900	70,892	186,050	256,942	73,281	1,159,603	102,392

Industries.—In the year 1897, 29,273 persons were employed in factories and workshops, the majority in engineering, agricultural implement, and similar works, namely 13,052, or 44 per cent. of the whole. Next in importance comes the making of clothing, with 2394 persons; then the metal trades, with 2302; and the preparation of food, with 1646. Iron ore (hæmatite) and building stone are the principal products of the mines and quarries, the number of men employed in these and similar occupations in 1900 being 1231. In the same year 1,924,898 tons of iron ore were extracted, also 178,874 tons of clays, 47,147 tons of limestone, 42,917 tons of chalk, and 5797 tons of gravel. In 1895, 926,440 tons of ironstone, freestone, and sandstone, inclusive of Ancaster freestone, were quarried, to the value of £139,142. In 1900 there were 16 blast furnaces operative in the county; these, together with 3 other furnaces in Leicestershire, yielded 388,745 tons of pig-iron.

AUTHORITIES.—W. MARRAT. *History of Lincolnshire*, 3 vols. and fragments of vols. iv. and v. (Boston, 1814 *et seqq.*), dealing chiefly with the southern or fen parishes. A list of local monographs, some of them, like Thompson's *Boston*, Oldfield's *Wainfleet*, Stone's *Isle of Axholm*, of great value, is given in an appendix to vols. i. and ii. of *Lincolnshire Notes and Queries* (Horncastle, 1888–91). See further under FENS. (J. T. BE.)

Lincoln, a parliamentary, county, and municipal borough of England, on the Witham, 130 miles north by west of London by rail. A monument (Decorated) to Bishop Wordsworth was unveiled in the cathedral in 1888, and the chapter-house was restored in 1889. As regards the other churches, the following have been built or rebuilt since 1870: St Faith's, St Matthias's, St Swithin's, and St Mary Magdalene's; and the following have been enlarged or restored: St John's, St Peter's at Gowts, St Peter's in Eastgate, and St Andrew's. The Roman Catholic church of St Hugh's was consecrated in 1893. The old Assembly Rooms now shelter the Lincoln Public Library (1892) of some 7000 volumes. The public institutions include science and art schools; the county gaol; the county pauper lunatic asylum; the high school for girls (1892); the drill hall; new grammar school, the old buildings being given over to the Boys' Middle School. In the year 1884 the Blue Coat School (Christ's Hospital), was closed, its endowments going to the Middle School, and its buildings sold to the Church Institute. In 1884–91 a Roman burial-place, with funeral urns, was brought to light on the site of the old Angel Inn, a Roman altar under St Peter's at Gowts, a fragment of the east town wall, and remains of a Roman villa in Greetwell. In 1884 the county of Nottingham was transferred from this see to the see of Southwell. The municipal borough is governed by a mayor, 6 aldermen, and 18 councillors. Area, 3747 acres. Population (1891), 41,491; (1901), 48,784.

See E. VENABLES and G. G. PERRY, *Diocesan History of Lincoln* (London, 1898); and *Statutes of Lincoln Cathedral*, arranged by H. BRADSHAW and edited by C. WORDSWORTH, 3 vols. (Cambridge, 1898).

Lincoln, a city of Illinois, U.S.A., capital of Logan county, on the Peoria, Decatur, and Evansville, the Illinois

Central, and the Chicago and Alton railways, at an altitude of 591 feet. It is in an agricultural and coal-mining region. It is the seat of Lincoln University, a Cumberland Presbyterian institution. Population (1890), 6725; (1900), 8962, of whom 940 were foreign-born and 238 were negroes.

Lincoln, a city of Nebraska, U.S.A., capital of Lancaster county and of the state, at an altitude of 1147 feet. Its site is level and in some parts marshy, and its plan is regular, with broad well-shaded streets. The water-supply and sewerage system are good, and the city is divided into seven wards. Lincoln is at the intersection of five great railway systems, the Burlington and Missouri River, the Chicago, Rock Island and Pacific, the Fremont, Elkhorn and Missouri Valley, the Missouri Pacific, and the Union Pacific; and being the collecting and distributing point for a large area of fertile agricultural lands, it has especial importance as a commercial city. Its manufacturing establishments in 1900 numbered 250, with a total capital of $2,608,992. They employed 1736 hands (besides 244 salaried officials and clerks), and their product was valued at $4,105,951. The city has several educational institutions, the principal one being the University of Nebraska, which in 1899 had a faculty of 100 and was attended by 1572 students. Its property was valued at $2,050,000, and its income was $199,500. In 1900 the assessed valuation of real property was $4,144,880, and of personal property $1,080,884—the former on a basis of about one-fifth and the latter of about one-eighth of the full value. The net debt was $1,715,860, and the rate of taxation $77.40 per $1000. Population (1880), 13,003; (1890), 55,154; (1900), 40,169, of whom 5297 were foreign-born and 814 were negroes.

Lincoln Judgment, The.—In this celebrated ecclesiastical law-suit, the bishop of Lincoln (Dr King) was cited before his metropolitan, the archbishop of Canterbury (Dr Benson), to answer charges of various ritual offences committed at the administration of Holy Communion in the church of St Peter's at Gowts, in the diocese of Lincoln, on 4th December 1887, and in Lincoln Cathedral on 10th December 1887. The promoters were Ernest De Lacy Read, William Brown, Felix Thomas Wilson, and John Marshall, all inhabitants of the diocese of Lincoln, and the last two parishioners of St Peter's at Gowts. The case excited general interest while it was in progress, and it has a permanent importance in two respects. First, certain disputed questions of ritual were legally decided. Secondly, the jurisdiction of the archbishop of Canterbury alone to try one of his suffragan bishops for alleged ecclesiastical offences was considered and judicially declared to be well founded both by the Judicial Committee of Privy Council and by the archbishop of Canterbury with the concurrence of his assessors. The proceedings were begun on 2nd June 1888 by a petition presented by the promoters to the archbishop, praying that a citation to the bishop of Lincoln might issue calling on him to answer certain ritual charges, the nature of which will be stated presently. On 26th June 1888 the archbishop, by letter, declined to issue citation, on the ground that until instructed by a competent court as to his jurisdiction, he was not clear that he had it. The promoters appealed to the Judicial Committee of the Privy Council, to which an appeal lies under 25 Henry VIII. c. 19 for "lack of justice" in the Archbishop's Court.

The matter was heard on 20th July 1888, and on 8th August 1888 the committee decided (i.) that an appeal lay from the refusal of the archbishop to the Judicial Committee, and (ii.) that the archbishop had jurisdiction to issue a citation to the bishop of Lincoln and to hear the promoters' complaint, but they abstained from expressing an opinion as to whether the archbishop had a discretion to refuse citation—whether, in fact, he had any power of "veto" over the prosecution. The case being thus remitted to the archbishop, he decided to entertain it, and on 4th January 1889 issued a citation to the bishop of Lincoln.

On the 12th February 1889 the archbishop of Canterbury sat in Lambeth Palace Library, accompanied by the bishops of London (Dr Temple), Winchester (Dr Harold Browne), Oxford (Dr Stubbs), and Salisbury (Dr Wordsworth), and the vicar-general (Sir J. Parker Deane) as assessors. The bishop of Lincoln appeared in person and read a "Protest" to the archbishop's jurisdiction to try him except in a court composed of the archbishop and all the bishops of the province as judges. The court adjourned in order that the question of jurisdiction might be argued. This was done on 12th, 13th, 14th, 20th, 21st, 26th, and 27th March 1889, and on the 11th May the archbishop gave judgment to the effect that whether sitting alone or with assessors he had jurisdiction to entertain the charge. On 23rd and 24th July 1889 a further preliminary objection raised by the bishop of Lincoln's counsel was argued. The offences alleged against the bishop of Lincoln were largely breaches of various rubrics in the communion service of the Prayer Book which give directions to the "minister." These rubrics are by the Acts of Uniformity (1 Elizabeth c. 2, and 13 and 14 Charles II. c. 4) made legally binding. But it was argued that a bishop is not a "minister" so as to be bound by the rubrics. The archbishop, however, held otherwise, and the assessors (except the bishop of Salisbury, who dissented) concurred in this decision. At this and subsequent hearings the bishop of Hereford (Dr Atlay) took the place of the bishop of Winchester as an assessor, and the bishop of Rochester (Dr Thorold), originally appointed an assessor, but absent from England at the outset, was present.

Charges and decisions.

The case was heard on its merits on 4th, 5th, 6th, 7th, 20th, 21st, 22nd, and 25th February 1890, before the archbishop and all the assessors, and the archbishop delivered his judgment on 21st November 1890. The alleged offences were eight in number. No facts were in dispute, but only the legality of the various matters complained of. I. The bishop was charged with having mixed water with wine in the chalice during the communion service, and II. with having administered the chalice so mixed to the communicants. It was decided that the mixing of the water with the wine during service was illegal, because an additional ceremony not enjoined in the Prayer Book, but that the administration of the mixed chalice, the mixing having been effected before service, was in accordance with primitive practice and not forbidden in the Church of England. III. The bishop was charged with the ceremonial washing of the vessels used for the holy communion, and with drinking the water used for these ablutions. It was decided that the bishop had committed no offence, and that what he had done was a reasonable compliance with the requirement of the rubric that any of the consecrated elements left over at the end of the celebration should be then and there consumed. IV. The bishop was charged with taking the eastward position (*i.e.*, standing at the west side of the holy table with his face to the east and his back to the congregation) during the ante-communion service (*i.e.*, the part of the communion service prior to the consecration prayer). The rubric requires the celebrant to stand at the north side of the table. A vast amount of research convinced the archbishop that this is an intentionally ambiguous phrase which may with equal accuracy be applied to the north end of the table as now arranged in churches, and to the long side of the table, which, in Edward VI.'s reign, was often placed lengthwise down the church, so that the long sides would face north and south. It was therefore decided (one of the assessors dissenting) that both positions are legal, and that the bishop had not offended in adopting the eastward position. V. The bishop was charged with so standing during the consecration prayer that the "Manual Acts" of consecration were invisible to the people gathered round. It should be stated that the courts (see *Ridsdale* v. *Clifton*, L.R. 1 P.D. 316; 2 P.D. 276) had already decided that the eastward position during the consecration prayer was legal, but that it might not be so used by the celebrant as to conceal the "Manual Acts." The archbishop held that the bishop of Lincoln had transgressed the law in this particular. VI. The bishop was charged with having, during the celebration of holy communion, allowed two candles to be alight on a shelf or retable behind the altar when they were not necessary for giving light. The archbishop decided that the mere presence of two altar candles burning during the service, but lit before it began, was lawful under the First Prayer Book of Edward VI., and has never been made unlawful, and therefore that the bishop was justified in what he had done. VII. The bishop was charged with having permitted the hymn known as *Agnus Dei* to be sung immediately after the consecration of the elements at a celebration of the holy communion. The archbishop decided that the use of hymns in divine service was too firmly established to be legally questioned, and that there was nothing to differentiate the use of this particular hymn at this point of the service from the use of other hymns on other occasions in public worship. VIII. The bishop was charged with making the sign of the Cross in the air with his hand in the benediction and at other times during divine service. The archbishop held that these crossings were ceremonies not enjoined and therefore illegal, and that the bishop had offended in this particular. The judgment confined itself to the declarations of the law which have been summarized, and pronounced no monition or other sentence on the bishop of Lincoln in respect of the matters in which he appeared to have committed breaches of the ecclesiastical law.

The promoters appealed to the Judicial Committee. The bishop did not appear on the appeal, which was therefore argued on the side of the promotors only. The appeal was heard on 10th, 11th, 12th, 15th, and 16th June, and 2nd, 3rd, 7th, and 8th July 1891, before Lords Halsbury, Hobhouse, Esher, Herschell, Hannen, and Shand and Sir Richard Couch, with the bishop of Chichester (Dr Durnford), the bishop of St Davids (Dr Basil Jones), and the bishop of Lichfield (Dr Maclagan) as episcopal assessors. The points appealed were those above numbered II., III., IV., VI., VII. Judgment was given on 2nd August 1892, and the appeal failed on all points. As to II., III., IV., and VII. the Judicial Committee agreed with the archbishop. As to VI. (altar lights) the Judicial Committee held that as it was not shown that the bishop was responsible for the presence of lighted candles, the charge could not be sustained against him, and so dismissed it without considering the general question of the lawfulness of altar lights dealt with in the archbishop's judgment. The Judicial Committee also held that the archbishop was within his right in pronouncing no sentence against the bishop, who, it should be added, conformed his practice to the archbishop's judgment from the date of its delivery.

(L. T. D.)

Lind, Jenny [MADAME LIND-GOLDSCHMIDT] (1820–1887), the famous Swedish singer, born in Stockholm, 6th October 1820, was the child of a lace manufacturer. It was Mlle Lundberg, an opera-dancer, who first discovered her musical gift, and induced the child's mother to have her educated for the stage; during the six or seven years in which she was what was called an "actress pupil," she occasionally appeared on the stage, but in plays, not operas, until 1836, when she made a first attempt in an opera by Lindblad. She was regularly engaged at the opera-house in 1837, and appeared in a great number of parts in pieces that are now forgotten. Her first great success was in the part of Agathe, in *Der Freischütz*, in 1838, and by 1841, when she started for Paris in order to enlarge her artistic views and to obtain advice upon the subject of her voice, she had already become identified with nearly all the parts in which she afterwards became famous. But her celebrity in Sweden was due in great part to her histrionic ability, and there is comparatively little said about her wonderful vocal art, which was only attained after a year's hard study under Manuel Garcia, who had to remedy many faults that had caused exhaustion in the vocal organs. On the completion of her studies she sang before Meyerbeer, in private, in the Paris Opera-house, and two years afterwards was engaged by him for Berlin, to sing in his *Feldlager in Schlesien;* but the part intended for her was taken by another singer, and her first appearance took place in *Norma*, 15th December 1844. She appeared also in *Euryanthe* and *La Sonnambula*, and while she was at Berlin the English manager, Alfred Bunn, induced her to sign a contract (which she broke) to appear in London in the following season. In December 1845 she appeared at a Gewandhaus concert at Leipzig, and made the acquaintance of Mendelssohn, as well as of Joachim and many other distinguished German musicians. In her second Berlin season she added the parts of Donna Anna (*Don Giovanni*), Julia (*Vestalin*), and Valentine (*Les Huguenots*) to her repertory. She sang in operas or concerts at Aix-la-Chapelle, Hanover, Hamburg, Vienna, Darmstadt, and Munich during the next year, and took up two Donizetti rôles, those of Lucia and "la Figlia del Reggimento," in which she was afterwards famous. At last Lumley, the manager of Her Majesty's Theatre, succeeded in inducing Mlle Lind to visit England, in spite of her dread of the penalties threatened by Bunn on her breach of the contract with him, and she appeared on 4th May 1847, in *Robert le Diable*. Her *début* had been so much discussed that the *furore* she created was a foregone conclusion. Still, it exceeded everything of the kind that had taken place in London or anywhere else, in the genuine enthusiasm the singer made; the sufferings and struggles of her well-dressed admirers, who had to stand for hours to get into the pit, have become historical. She sang in several of her favourite characters, and in that of Susanna in *Figaro*, besides creating the part of Amalia in Verdi's unsuccessful opera, *I Masnadieri*, written for England and performed 22nd July. In the autumn she appeared in operas in Manchester and Liverpool, and in concerts at Brighton, Birmingham, Hull, Edinburgh, Glasgow, Perth, Norwich, Bristol, Bath, and Exeter. At Norwich began her acquaintance with Bishop Stanley, which was said to have caused her final determination to give up the stage as a career. After four more appearances at Berlin, and a short visit to Stockholm, she reappeared in London in the season of 1848, when she sang in *L'Elisire d'Amore* and *I Puritani*, in addition to her older parts. In the same year she organized a memorable performance of *Elijah*, with the receipts of which the Mendelssohn Scholarship was founded, and sang at a great number of charity and benefit concerts. At the beginning of the season of 1849 she intended to give up operatic singing, but a compromise was effected by which she was to sing the music of six operas, performed without action, at Her Majesty's Theatre; but the first, a concert performance of *Il Flauto Magico*, was so coldly received that she felt bound, for the sake of the manager and the public, to give five more regular representations, and her last stage performance was on the 10th May 1849, in *Robert le Diable*. Her decision was not even revoked when the king of Sweden urged her to reappear in opera at her old home. She paid visits to Germany and Sweden again before her departure for America in 1850. Just before sailing she appeared at Liverpool, for the first time in England, in an oratorio of Handel, singing the soprano music in *The Messiah* with superb art. She remained in America for nearly two years, being for a great part of the time engaged by Barnum, the famous speculator. In Boston, on 5th February 1852, she married Mr Otto Goldschmidt, whom she had met at Lübeck in 1850. For some years after her return to England, her home for the rest of her life, she appeared in oratorios and concerts, and her dramatic instincts were as strongly and perhaps as advantageously displayed in these surroundings as they had been on the stage, for the grandeur of her conceptions in such passages as the "Sanctus" of *Elijah*, the intensity of conviction which she threw into the scene of the widow in the same work, or the religious fervour of "I know that my Redeemer liveth," could not have found a place in opera. In her later years she took an active interest in the Bach Choir, conducted by her husband, and not only sang herself in the chorus, but gave the benefit of her training to the ladies of the society. For some years she was professor of singing at the Royal College of Music, and throughout her life devoted herself to the cause of charity. She died at her cottage, Wynd's Point, Malvern, 2nd November 1887. The supreme position she held so long in the operatic world was due not only to the glory of her ringing voice, and the complete musicianship which distinguished her above all her contemporaries, but also to the naïve simplicity of her acting in her favourite parts, such as Amina, Alice, or Agathe. In these and others she had the precious quality of conviction, and identified herself with the characters she represented with a thoroughness rarer in her day than in ours. Unharmed by the perils of a stage career, and unspoilt by the extraordinary *furore* of the British public, she was a model of rectitude, generosity, and straightforwardness, carrying the last quality into a certain blunt directness of manner that was sometimes rather startling to those who only knew her in her later years. (J. A. F. M.)

Lindau, Paul (1839-——), German author, was born at Magdeburg in 1839. After studying at the Universities of Halle and Berlin, he resided for some time in Paris; on returning to Germany in 1863 he engaged at first in journalism, but gave his attention more specifically to Hellenistic literature. In 1869 he founded *Das Neue Blatt*, in 1871 *Die Gegenwart*, and in 1877 the well-known monthly *Nord und Süd*. His earliest independent productions were some prettily conceived books of travel, *Aus Venetien* (1864) and *Aus Paris* (1865); but it was his critical sketches, notably *Die harmlosen Briefe eines deutschen Kleinstädters* (1870) and *Litterarische Rücksichtlosigkeiten* (1871), written in a light satirical vein, that first brought his name into prominence. His versatile pen also attempted with success various stage plays, which appeared under the title *Theater* in 1873–81. They are distinguished by brightness of dialogue and action, but are not remarkable for originality. As a novelist he has published many charming stories, such as *Im Fieber* (1890), *Herr und Frau Buver* (ninth edition, 1899), *Helene Jung*, &c.

Linden. See Hanover.

Lindley, Nathaniel Lindley, Baron (1828-——), English judge, eldest son of John Lindley, M.D., F.R.S., (see *Ency. Brit.*, ninth edition, vol. xiv. p. 663), was born at Acton Green, Middlesex, in 1828. He was educated at University College School, and studied for a short time at University College, London, which, however, he left without taking a degree; he then went to France, where he spent nearly a year. In September 1847 he entered as a student at the Middle Temple, where he was called to the bar on the 22nd of November 1850. In 1851 he went to Germany in order to learn German; in 1854 he took chambers in Lincoln's Inn, and commenced practice in the Court of Chancery. In 1855 he published *An Introduction to the Study of Jurisprudence*, consisting of a translation of the general part of Thibaut's *System des Pandekten Rechts*, with copious notes and references to illustrative cases decided in English courts. In 1860 he published in two volumes his *Treatise on the Law of Partnership, including its Application to Joint Stock and other Companies*, and in 1862 a supplement including the Companies Act of 1862. This work has since been developed into two text-books well known to lawyers as *Lindley on Companies* and *Lindley on Partnership*, and has gone through several editions. Having practised for twenty-one years at the junior bar, Mr Lindley became a Queen's Counsel in January 1872, and took his seat in the court presided over by Vice-Chancellor Hall. In 1872 he was elected a bencher of the Middle Temple, of which he was treasurer in 1894. In 1875 Baron Pigott, a much-respected judge of the Court of Exchequer, died, and in order to fill his place Mr Justice Huddleston, better known by his later title of Baron Huddleston, was transferred to the Exchequer from the Court of Common Pleas. Mr Lindley, Q.C., was invited by the Lord Chancellor to fill the place thus vacant, and to become a justice of common pleas, the appointment of a chancery barrister to a common-law court being justified by the fusion of law and equity then shortly to be brought about, in theory at all events, by the Judicature Acts. In the course of the changes made by these statutes Mr Justice Lindley became in the same year (1875) a justice of the Common Pleas Division of the High Court of Justice, and in 1880 of the Queen's Bench Division, distinctions perhaps a little confusing to the lay mind, but marking an important period of transition in the constitution of English courts of justice. In 1881 he was raised to the Court of Appeal and made a privy councillor. In 1897, on the retirement of Lord Esher, Lord Justice Lindley was made Master of the Rolls, and in 1900 he was raised to the House of Lords as a Lord of Appeal in Ordinary with a life peerage and the title of Baron Lindley. Thus Lord Lindley as a puisne judge and Lord Justice of Appeal occupied a seat on the bench for twenty-five years, a slightly shorter period than did Lord Bramwell, whom he succeeded in the Court of Appeal. During this period he was distinguished as a judge gifted with great industry, learning, patience, and courtesy, and with a wide experience of law and equity acquired in a Chancery practice and as a common-law judge. He was the last sergeant-at-law to be appointed, and the last judge to wear the sergeant's coif, or rather the black patch representing it, on the judicial wig. Lord Lindley was made Hon. LL.D. of Edinburgh and Cambridge, and Fellow of the Royal Society. He married in 1858 Sarah Katherine, daughter of Edward John Teale.

Lindley, William (1808–1900), English engineer, was born in London on 7th September 1808, and became a pupil under Mr Francis Giles, whom he assisted in designing the Newcastle and Carlisle and the London and Southampton railways. Leaving England about 1837, he was engaged for a time in railway work in various parts of the Continent, and then returned, as engineer-in-chief to the Hamburg–Bergedorf railway, to Hamburg, near which city he had received his early education, and to which he was destined to stand in much the same relation as Haussmann to Paris. His first achievement was to drain the Hammerbrook marshes, and so add some 1400 acres to the available area of the city. His real opportunity, however, came with the great fire which broke out on 5th May 1842 and burned for three days. He was entrusted with the direction of the operations to check its spread, and the strong measures he adopted, including the blowing-up of the town hall, brought his life into danger with the mob, who professed to see in him an English agent charged with the destruction of the port of Hamburg. After the extinction of the fire he was appointed consulting engineer to the Senate and Town Council, to the Water Board, and to the Board of Works, and thus came to have an important share in the rebuilding of the city in its present form. He began with the construction of a complete sewerage system on principles which did not escape criticism at the time, but which experience showed to be good. Between 1844 and 1848 water-works were established from his designs, the intake from the Elbe being at Rothenburgsort. Subsidence tanks were used for clarification, but in 1853, when he designed large extensions, he urged the substitution of sand-filtration, which, however, was not adopted until the cholera epidemic of 1892–1893 had shown the folly of the opposition directed against it. In 1846 he erected the Hamburg gas-works; public baths and wash-houses were built, and large extensions to the port executed according to his plans in 1854, and he supervised the construction of the Altona gas and water works in 1855. Among other services he rendered to the city may be mentioned the trigonometrical survey executed between 1848 and 1860, and the conduct of the negotiations which in 1852 resulted in the sale of the "Steelyard" on the banks of the Thames belonging to it jointly with the two other Hanseatic towns, Bremen and Lübeck; the site of this wharf is now occupied by Cannon Street station. In 1860 he left Hamburg, and during the remaining nineteen years of his professional practice he was responsible for many engineering works in various Continental cities, among them being Frankfort-on-the-Main, Warsaw, Pesth, Düsseldorf, Galatz, and Basel. In the first-named of these he constructed sewerage works on the same principles as those he followed in Hamburg, and the system was widely imitated not only in Europe, but also in America. In the course of his life he was also consulted in regard to water-works at Berlin, Kiel, Stralsund, Stettin, and Leipzig; he advised the New River Company of London on the adoption of the constant supply system in 1851; and he was commissioned by the British Government to carry out various works in Heligoland, including the big retaining wall "Am Falm." He died at Blackheath, London, on 22nd May 1900. (H. M. R.)

Lindo, Mark Prager (1819–1879), Dutch prose writer, of English-Jewish descent, was born in London, 18th September 1819. He went to Holland when only nineteen years of age, and his whole literary career was passed there, although at first he had no intention of settling in the Low Countries. Yet, when once established there as a private teacher of the English language, he soon made up his mind to remain, and in 1842 passed his examination at Arnhem, qualifying him as a professor of English in Holland, subsequently becoming a teacher of the English language and literature at the gymnasium in that town. In 1853 he was appointed in a similar capacity at the Royal Military Academy in Breda. Meanwhile Lindo had obtained a thorough grasp of the Dutch language, partly during his student years at Utrecht University, where in 1854 he gained the degree of doctor of literature. His proficiency in the two languages led him to translate into Dutch several of the works of then popular English authors, like Dickens, Thackeray, and others, and afterwards also of Fielding, Sterne, and Walter Scott. Some of Lindo's translations bore the imprint of hasty and careless work, and all were very unequal in quality. His name is much more likely to endure as the writer of humorous original sketches and novelettes in Dutch, which he published under the pseudonym of De Oude Herr Smits ("Old Mr Smits"). Among the most popular are: *Brieven en Ontboezemingen* ("Letters and Confessions," 1853, with three "Continuations"); *Familie van Ons* ("Family of Ours," 1855); *Bekentenissen eener Jonge Dame* ("Confessions of a Young Lady," 1858); *Uittreksels uit het Dagboek van Wijlen den Heer Janus Snor* ("Extracts from the Diary of the late Mr Janus Snor," 1865); *Typen* ("Types," 1871); and, particularly, *Afdrukken van Indrukken* ("Impressions from Impressions," 1854, reprinted many times). The last-named was written in collaboration with Lodewyk Mulder, who contributed some of its drollest whimsicalities of Dutch life and character, which, for that reason, are almost untranslatable. Lodewyk Mulder and Lindo also founded together, and carried on, for a considerable time alone, the *Nederlandsche Spectator* ("The Dutch Spectator"), a literary weekly, still published at The Hague, which bears little resemblance to its English prototype, and which perhaps reached its greatest popularity and influence when Vosmaer contributed to it a brilliant weekly letter under the fanciful title of Vlugmaren ("Swifts"). Lindo's serious original Dutch writings he published under his own name, the principal one being *De Opkomst en Ontwikkeling van het Engelsche Volk* ("The Rise and Development of the British People," 2 vols. 1868–1874)—a valuable history. His friend Lodewyk Mulder published in the years 1877–1879 a collected edition of Lindo's writings in five volumes, and there has since been a popular reissue. Lindo was appointed an inspector of primary schools in the province of South Holland in 1865, a post he held until his death at The Hague on 9th March 1879. (H. TI.)

Lindsay, a town and port of entry of Ontario, Canada, and capital of Victoria county, situated on the Scugog river, 57 miles north-east of Toronto by rail, at the junction of the Port Hope and Haliburton branches and the Midland division of the Grand Trunk railway. It has steamboat communication, by way of the Trent canal, with Lake Scugog, and ports on the Trent system between Coboconk and Lakefield. It contains saw and grist mills, agricultural implement and carriage works, and tanneries. Population (1881), 5080; (1891), 6081; (1901), 7003.

Linea, or LA LINEA DE LA CONCEPCION, a town of Spain, in the province and diocese of Cadiz, lying between Gibraltar and San Roque. It is a town of comparatively modern date, and was formerly looked upon as a suburb of San Roque. It is now, however, a distinct frontier post, and headquarters of the Spanish commandant of the lines of Gibraltar. All the buildings are modern and offer nothing artistic. There are barracks, casinos, a theatre, and a bull-ring, much frequented by the inhabitants and garrison of Gibraltar. It has some trade in cereals, fruit and vegetables. Population (1887), 13,862; (1897), 20,294.

Lingah. See Bander Lingah.

Lingayen, a town in the southern extremity of the Gulf of Lingayen, on the west coast of Luzon, Philippine Islands, the capital of the province of Pangasinan. It is a favourite resort during the hot season, on account of its coolness and healthfulness. It has good Government buildings, and a fine church and plaza. The rich agricultural lands in its vicinity produce rice, indigo, Indian corn, sugar-cane, and cotton, and alcohol is made from the juice of the nipa palm, which grows abundantly in the neighbouring swamps. The principal language is Pangasinan; Ilocano is also spoken. Population, 19,000.

Lingen, a town of Prussia, province of Hanover, on the Ems Canal, 43 miles north-north-west of Münster by rail. It was from 1685 to 1819 the seat of a university, and has now iron foundries, machinery factories, railway workshops, and a (female) prison. Population (1900), 7048.

Linköping, a town of the province of Östergötland, Sweden, 142 miles south-west from Stockholm on the railway to Malmö, and 29 miles west-south-west from Norrköping. The cathedral was restored in 1871–82, and in 1885 the Östergötland Museum, with the Dahlgren collection of pictures was opened. At Stångåbro (Stångå Bridge), close by, an obelisk was put up in 1898 to commemorate the important battle of Stångåbro (1598). A circle of stones, in the Iron Market of Linköping, marks the spot where Sigismund's adherents were beheaded in 1600. The town has manufactures of tobacco, cloth, and hosiery. Population (1880), 8752; (1890), 12,649; (1900), 14,552.

Linlithgow, a royal and parliamentary burgh (Falkirk group) and the county town of Linlithgowshire, Scotland, 16 miles by rail west of Edinburgh. Shoemaking and currying and tanning are the staple industries. The ancient parish church has been restored. A Roman Catholic chapel and a jubilee commemoration town hall have been erected. Population (1881), 3913; (1891), 4155; (1901), 4279.

Linlithgowshire, or West Lothian, a midland county of Scotland, bounded on the N. by the Firth of Forth, on the S.E. by Midlothian, on the S.W. by Lanarkshire, and on the N.W. by Stirlingshire.

Area and Population.—In 1891 a small part of the parish of Dalmeny in Linlithgow was transferred to the parish of Cramond in Midlothian. The area of the county is 77,310 acres, or about 120 square miles. The population was in 1881, 43,510; in 1891, 52,808; in 1901, 65,699, of whom 35,212 were males and 30,487 females, the males outnumbering the females, as they have done at every census since 1831 in this county. Taking the land area only (76,807 acres or 120·0 square miles), the number of persons to the square mile in 1891 was 440, and the number of acres to the person 1·4. In the registration county the population increased between 1881 and 1891 by 21·4 per cent. Between 1881 and 1891 the excess of births over deaths was 10,417, and the increase of the resident population 9443. The following table gives particulars of births, deaths, and marriages in 1880, 1890, and 1899:—

Year.	Deaths.	Marriages.	Births.	Per cent. of Illegitimate.
1880	838	293	1741	7·5
1890	951	399	2058	6·95
1899	1022	399	2243	4·8

The following table gives the birth-rate, death-rate, and marriage-rate per 1000 of the population for a series of years:—

	1880.	1881–90.	1890.	1891–98.	1899.
Birth-rate . .	39·75	40·09	39·07	37·87	35·82
Death-rate . .	19·13	18·71	18·05	16·82	16·32
Marriage-rate .	6·69	6·85	7·57	6·63	6·37

In 1891 there were 486 Gaelic-speaking persons in the county, and 192 foreigners. Valuation in 1889–90 £292,108; 1899–1900, £355,123.

Administration.—The county returns a member to Parliament. Linlithgow, the county town, and Queensferry (881) are royal burghs, and belong respectively to Falkirk and Stirling groups of parliamentary burghs. Bo'ness (9100) and Bathgate (6786) are police burghs, and Broxburn (6270) is an important manufacturing centre. There are eleven civil parishes, and there is a combination poorhouse at Linlithgow. The number of paupers and dependants in September 1899 was 1267. Linlithgow is part of the sheriffdom of the Lothians and Peebles, and there is a resident sheriff-substitute, who sits at Linlithgow and Bathgate.

Education.—Thirteen school boards manage 33 schools, which had an average attendance of 8952 in 1898–99; and 8 voluntary schools (4 Roman Catholic) had 1879. There are academies at Linlithgow, Bathgate, and Bo'ness, and 14 other schools earned grants in 1898 for giving higher education. The County Secondary Education Committee receives the bulk of the "residue" grant from the local authorities, and subsidizes with it elementary technical classes (cookery, laundry, and dairy) and science and art and technological classes, furnishing equipment for such classes.

Agriculture.—In 1898, 76 per cent. of the area was under cultivation. The acreage under wood was 5206 in 1895. The farming is predominantly arable, and permanent pasture has for some years almost ceased to increase. Oats are the principal corn crop; the barley acreage is less than a third of the oat acreage, and the wheat acreage is half the barley. Of the 518 holdings in 1895 the average size was 114 acres. The percentage under 5 acres was 12·93; between 5 and 50 acres, 23·94; and over 50 acres, 63·13. The number of farms between 50 and 100 acres was 87; between 100 and 300, 210; between 300 and 500, 25; and there were 5 over 500. The following table gives the principal acreages at intervals of five years from 1880:—

Year.	Area under Crops.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	59,253	18,032	6857	12,850	21,163	333
1885	59,253	16,107	6216	16,664	20,051	215
1890	59,264	14,342	5838	20,086	18,678	299
1895	59,090	15,078	6248	13,792	23,824	116
1899	58,699	14,860	6152	15,054	22,456	150

The following table gives particulars of the live stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or Calf.	Sheep.	Pigs.
1880	2161	10,957	3687	19,585	1675
1885	2064	12,317	4370	19,647	1580
1890	2144	12,644	4540	30,395	1547
1895	2282	11,918	4572	25,173	2085
1899	2123	12,239	4936	26,476	1996

At the census of 1891, 1623 males and 353 females were returned as being engaged in agriculture.

Industries and Trade.—The working of coal, oil-shale, ironstone, fire-clay, limestone, and sandstone gives employment, directly or indirectly, to at least half the population. In 1891, 13,775 males and 1562 females were connected with industrial pursuits, and of these 7975 men and 269 women were engaged in industries connected with minerals. The following table shows the output of minerals for 1890 and 1899:—

Year.	Oil Shale.		Coal.		Ironstone.		Sandstone.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1890	1,218,506	...	782,645	£264,142	76,161	£34,272	...	...
1899	1,499,878	£374,844	948,748	£355,780	45,298	£16,987	90,685	£21,489

There were also obtained in 1899, 59,602 tons of fire-clay, valued at £5401 (as compared with 540 tons in 1885). There are oil works at Dalmeny, Broxburn, Philipstoun, Winchburgh, Uphall, Bathgate, and Armadale, blast furnaces near Bo'ness, iron foundries, and steel rolling mills. Fishing is prosecuted on a small scale at Queensferry. The exports are noticed under Bo'ness, the principal port. The total addition to the railway mileage during the last quarter of the 19th century was 15¼ miles, three branches of that combined length on the North British system having been opened in 1890.

See Sir R. Sibbald. *History of the Sheriffdoms of Linlithgow and Stirlingshire.* Edinburgh, 1710.—John P. Wood. *Parish of Cramond.* Edinburgh, 1794.—J. Penny. *Historical Account* *of Linlithgow.* Edinburgh, 1832.—G. Waldie. *Walks along the Northern Roman Wall.* Linlithgow, 1883.—J. Collie. *The Palace of Linlithgow.* Edinburgh (*n.d.*).—A. M. Bisset. *Poets and Poetry of Linlithgow.* Paisley, 1896.—R. J. H. Cunningham. *Geology of the Lothians.* Edinburgh, 1838.—J. Small. *Castles and Mansions of the Lothians.* Edinburgh, 1883.—J. M. Bell. *The Castles of the Lothians.* Edinburgh, 1893.—*The Scottish Mineral Oil Trade.* Glasgow, 1893. (w. wa.)

Linosa, an island of Italy. See Lampedusa.

Linotype. See Type-setting.

Linton, Eliza Lynn (1822–1898), English novelist, daughter of the Rev. J. Lynn, vicar of Crosthwaite, in Cumberland, was born at Keswick, 10th February 1822. She early manifested independence of character, and in great measure educated herself from the stores of her father's library. Coming up to London about 1845 with a large stock of miscellaneous erudition, she turned this to account in her first novels, *Azeth the Egyptian* and *Amymone*, a romance of the days of Pericles. Her next story, *Realities*, a tale of modern life (1850), was not successful, and for several years she seemed to have abandoned fiction. When, in 1865, she reappeared with *Grasp your Nettle*, it was as an expert in a new style of novel-writing—stirring, fluent, ably-constructed stories, retaining the attention throughout, but affording little to reflect upon or to remember. Measured by their immediate success, they gave her an honourable position among the writers of her day, and secure of an audience, she continued to write with vigour nearly until her death. *Lizzie Lorton of Greyrigg* (1866), *Patricia Kemball* (1874), *The Atonement of Leam Dundas* (1877) are among the best examples of this more mechanical side of her talent, to which there were notable exceptions in *Joshua Davidson* (1872), a bold but not irreverent adaptation of the story of the Carpenter of Nazareth to that of the French Commune; and *Christopher Kirkland*, a veiled autobiography (1885). Mrs. Linton was even more thoroughly at home in journalism than in fiction; her articles on the "Girl of the Period" in the *Saturday Review* produced a great sensation, and she was long an influential contributor to the *St James's Gazette*, the *Daily News*, and other leading newspapers. Many of her detached essays have been collected. In 1858 she married W. J. Linton, the engraver, but the union was soon terminated by mutual consent; she nevertheless brought up one of Mr Linton's daughters by a former marriage. A few years before her death she retired to Malvern, where she died on 14th July 1898. Her life has been written by Mr G. S. Layard. (r. g.)

Linton, William James (1812–1897), English wood-engraver, republican, and author, was born in London in 1812. He was educated at Stratford, and in his sixteenth year was apprenticed to the wood-engraver G. W. Bonner. His earliest known work is to be found in Martin and Westall's *Pictorial Illustrations of the Bible* (1833). Henceforth his talent received ample recognition, and he rapidly rose to a place amongst the foremost wood-engravers of the time. After working as a journeyman engraver with two or three firms, losing his money over a cheap political library called the "National," and writing a life of Thomas Paine, he went into partnership (1842) with John Orrin Smith. The firm was immediately employed on the *Illustrated London News*, just then projected. The following year Orrin Smith died, and Linton, who had married a sister of Thomas Wade, editor of *Bell's Weekly Messenger*, found himself in sole charge of a business upon which two families were dependent. For years past he had concerned himself with the social and political problems of the time, and was now actively engaged in the republican propaganda. In 1844 he took a prominent part in exposing the violation by the English post-office of Mazzini's correspondence. This led to a friendship with the Italian revolutionist, and he threw himself with ardour into European politics. He carried the first congratulatory address of English workmen to the French Provisional Government in 1848. He edited a twopenny weekly paper, *The Cause of the People*, published in the Isle of Man, and he wrote political verses for the Dublin *Nation*, signed "Spartacus." He helped to found the "International League" of patriots, and in 1850, with G. H. Lewes and Thornton Hunt, started *The Leader*, an organ which, however, did not satisfy his advanced republicanism, and from which he soon withdrew. The same year he wrote a series of articles propounding the views of Mazzini in *The Red Republican*. In 1852 he took up his residence at Brantwood, which he afterwards sold to John Ruskin, and from there issued *The English Republic*, first in the form of weekly tracts and afterwards as a monthly magazine—"a useful exponent of republican principles, a faithful record of republican progress throughout the world; an organ of propagandism and a medium of communication for the active republicans in England." Most of the paper, which never paid its way and was abandoned in 1855, was written by himself. In 1852 he also printed for private circulation an anonymous volume of poems entitled *The Plaint of Freedom.* After the failure of his paper he returned to his proper work of wood-engraving, which had been largely abandoned for political agitation. In 1857 his wife died, and in the following year he married Eliza Lynn (afterwards known as Mrs Lynn Linton) and returned to London. In 1864 he retired to Brantwood, his wife remaining in London. In 1867, pressed by financial difficulties, he determined to try his fortune in America, and finally separated from his wife, with whom, however, he always corresponded affectionately. With his children he settled at Appledore, New Haven, Connecticut, where he set up a printing-press. Here he wrote *Practical Hints on Wood-Engraving*, 1879; *James Watson, a Memoir of Chartist Times*, 1879; *A History of Wood-Engraving in America*, 1882; *Wood-Engraving, a Manual of Instruction*, 1884; *The Masters of Wood-Engraving*, for which he made two journeys to England, 1890; *The Life of Whittier*, 1893; and *Memories*, an autobiography, 1895. He died at New Haven on 29th December 1897, aged eighty-five. Linton was a singularly gifted man, who, in the words of his wife, if he had not bitten the Dead Sea apple of impracticable politics, would have risen higher in the world of both art and letters. As an engraver on wood he reached the highest point of execution in his own line. He carried on the tradition of Bewick, fought for intelligent as against merely manipulative excellence in the use of the graver, and championed the use of the "white line" as well as of the black, believing with Ruskin that the former was the truer and more telling basis of æsthetic expression in the wood-block printed upon paper.

See also W. J. Linton, *Memories;* F. G. Kitton, article on "Linton" in *English Illustrated Magazine* (April 1891); G. S. Layard, *Life of Mrs Lynn Linton* (1901). (g. s. l.)

Linz, the capital of Upper Austria, on the right bank of the Danube, 20 miles north-north-west of Steyr. The population in 1890 was 47,685; in 1900, including Urfahr on the left bank of the Danube, 58,788, almost exclusively Catholic and German (estimated to have 1 per cent. Czech, 3 per cent. Protestant, and 1 per cent. Jewish). It has a garrison of 3502 men, composed of four battalions of infantry and an artillery regiment. Linz is now fairly provided with educational institutions, while its transit trade and industry have grown with the development of navigation on the river and its extended railway communications. In addition to brewing, boat-building, &c., it has a number of large printing establishments, machine factories, foundries, and other metal works, and cloth factories, and manufactures matches, leather, vinegar, liqueurs, and mineral waters.

Lipa, a town in the extreme south-eastern portion of the province of Batangas, Luzon, Philippine Islands, known for its cool and healthful climate. It is the centre of an extremely fertile agricultural region, which produces sugar, Indian corn, cacao, tobacco, and indigo. There were formerly extensive coffee plantations in its vicinity, but they were completely destroyed in 1889–90 by an insect pest. The language is Tagalog. Population, 40,000.

Lippa, a market town in the Hungarian county of Temes, on the Maros, 22 miles east-south-east of Arad. Its trade, once very considerable, especially in salt and wood, has decayed, but its cattle fairs and its manufacture of pottery are still famous. It has several important educational institutions. Opposite lies the village of Maria-Radna, with a double-towered monastery of the Franciscans, dating from 1761, which is visited thrice a year by a great number of pilgrims from all parts of the country. Population (1901), 7427.

Lippe, a principality of Germany, lying mainly between Westphalia and Hanover. Out of a total of 25,059 farms in 1895, no less than 16,109 were under 2½ acres each, 7327 between 2½ and 25 acres, 1586 between 25 and 250 acres, and only 37 exceeded 250 acres. Potatoes, beetroot (for sugar), hay, rye, oats, wheat, and barley are the principal crops. In 1900 the live stock consisted of 38,362 cattle, 86,513 pigs, 16,085 sheep, and 9477 horses. In 1900 the population was 139,238, giving on an area of 469 square miles a density of 296 persons to the square mile; of this total, 67,113 were males and 72,125 were females. Except for 4332 Roman Catholics and 989 Jews, the people were in 1895 all Protestants. In 1885 the population was 123,212. For the year 1900–01 the state revenue was estimated at £69,760 and the expenditure at £70,400. The public debt amounted in 1900 to £58,400, and the contribution to the imperial exchequer to £67,915.

Lippstadt, a town of Prussia, province of Westphalia, on the river Lippe, and 20 miles by rail west by south of Paderborn. St Mary's church is a large building in the Transitional style, built in 1189 and 1290. Lippstadt itself dates from 1168. It carries on distilling, and manufacture of cigars, gingerbread, sausages, &c. Population (1885), 10,504; (1900), 12,534.

LIQUID GASES.

THIS article will be mainly confined to the discussion of the properties of liquid atmospheric air and the so-called "permanent" gases—oxygen, nitrogen, and hydrogen—which are contained in it, the last, however, being present in very minute quantities. In the earlier volumes of this Encyclopædia it was stated (9th ed., vol. xii. p. 433) that all these permanent gases had been reduced to the liquid state by Cailletet and Pictet, working independently, and that the latter even succeeded in solidifying hydrogen, the least condensible of all the substances then isolated by the chemist. These statements, at the time they were made, embodied what was generally accepted as a correct account of the facts. But in the course of the next decade widened knowledge rendered it evident that the achievements of those investigators were not of so absolute and definite a character as had at first been supposed, and it became clear that if they were to be accepted at all it must be with certain important qualifications. In the first place, it was noted that what these experimenters obtained was at the best a "dynamic," not a "static" liquid; that is, the gas was reduced to a form which bore the same relation to a true liquid that the partially condensed steam seen issuing from the funnel of a locomotive does to water standing in a tumbler. Thus Cailletet in 1877 compressed about 100 cc. of oxygen to about 200 atmospheres, at the same time cooling it to −29° C., and on suddenly taking off the pressure he saw momentarily in the interior of the tube into which the gas was expanded a mist ("brouillard"), from which he inferred the "presence of a vapour very near its point of liquefaction." A few days later he repeated the experiment with hydrogen, using a pressure of nearly 300 atmospheres, and observed in his tube a fine mist which vanished almost instantaneously. We know now this mist could not be liquid hydrogen drops, because the cooling produced by the adiabatic expansions would only give a theoretical temperature of 44° absolute, which is certainly above the true critical point of hydrogen. But neither of these gases, any more than nitrogen (of which, however, he claimed to obtain "droplets of appreciable size"), was he able to get in the form of a true stable liquid. Pictet, again, on opening the tap of a vessel in which hydrogen was contained at a pressure of 650 atmospheres and a temperature of −140° C., saw issuing from the orifice an opaque jet, which he assumed to consist of hydrogen in the liquid form, or in the liquid and solid forms mixed, but he was not more successful than Cailletet in collecting any of the liquid. In the second place, some critics deny Cailletet and Pictet the credit of even this approximate liquefaction, and hold the opinion that the mist of the one and the liquid of the other, whatever else they may have been—whether ordinary air or impurities associated with the hydrogen used—were not composed of liquid hydrogen, since the means employed by these experimenters were quite inadequate to reduce the gas to what has more recently been ascertained to be its critical point, above which of course liquefaction is impossible. It need scarcely be added that if the liquefaction of hydrogen be rejected, *a fortiori* Pictet's claim to have effected its solidification falls to the ground.

After Cailletet and Pictet, the next important names in the history of the liquefaction of gases are those of Wroblewski and Olszewski, who for some years worked together at Cracow. In April 1883 the former announced to the French Academy that he had obtained oxygen in a completely liquid state, and (a few days later) that nitrogen at a temperature of −136° C., reduced suddenly from a pressure of 150 atmospheres to one of 50, had been seen as a liquid which showed a true meniscus, but disappeared in a few seconds. But with hydrogen treated in the same way he failed to obtain even the mist reported by Cailletet. At the beginning of 1884 he performed a more satisfactory experiment. Cooling hydrogen in a capillary glass tube to the temperature of liquid oxygen, he expanded it quickly from 100 atmospheres to one, and obtained the appearance of an instantaneous ebullition. Olszewski confirmed this result by expanding from a pressure of 190 atmospheres the gas cooled by liquid oxygen and nitrogen boiling under reduced pressure, and even announced that he saw it running down the walls of the tube as a colourless liquid.

Wroblewski, however, was unable to observe this phenomenon, and Olszewski himself, when seven years later he repeated the experiment in the more favourable conditions afforded by a larger apparatus, was unable to produce again the colourless drops he had previously reported: the phenomenon of the appearance of sudden ebullition indeed lasted longer, but he failed to perceive any meniscus such as would have been a certain indication of the presence of a true liquid. Still, though neither of these investigators succeeded in reaching the goal at which they aimed, their work was of great value in elucidating the conditions of the problem and in perfecting the details of the apparatus employed. Wroblewski in particular devoted the closing years of his life to a most valuable investigation of the isothermals of hydrogen at low temperatures. From the data thus obtained he constructed a van der Waals equation which enabled him to calculate the critical temperature, pressure, and density of hydrogen with very much greater certainty than had previously been possible. Liquid oxygen, liquid nitrogen, and liquid air—the last was first made by Wroblewski in 1885—became something more than mere curiosities of the laboratory, and by the year 1891 were produced in such quantities as to be available for the purposes of scientific research. Still, nothing was added to the general principles upon which the work of Cailletet and Pictet was based, and the "cascade" method, together with adiabatic expansion from high compression (see Condensation of Gases), remained the only means of procedure at the disposal of experimenters in this branch of physics.

In some quarters a certain amount of doubt appears to have arisen as to the sufficiency of these methods for the liquefaction of hydrogen. Olszewski, for example, in 1895 pointed out that the succession of less and less condensible gases necessary for the cascade method breaks down between nitrogen and hydrogen, and he gave as a reason for hydrogen not having been reduced to the condition of a static liquid the non-existence of a gas intermediate in volatility between those two. By 1894 attempts had been made in the Royal Institution laboratories to manufacture an artificial gas of this nature by adding a small proportion of air to the hydrogen, so as to get a mixture with a critical point of about – 200° C. When such a mixture was cooled to that temperature and expanded from a high degree of compression into a vacuum vessel, the result was a white mass of solid air together with a clear liquid of very low density. This was in all probability hydrogen in the true liquid state, but it was not found possible to collect it owing to its extreme volatility. Whether or not this artificial gas would ultimately have enabled liquid hydrogen to be collected in open vessels it is impossible to say, for experiments with it were abandoned in favour of other measures, the employment of which led finally to a more assured success.

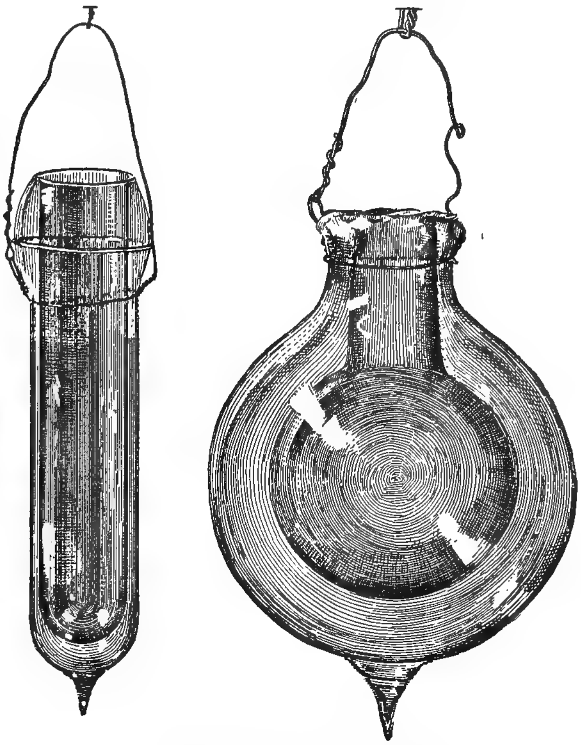

Fig. 1.—Vacuum or "Dewar" Vessels.

Vacuum Vessels.—The problem involved in the liquefaction of hydrogen was in reality a double one. In the first place, the gas had to be cooled to such a temperature that the change to the liquid state was rendered possible. In the second, means had to be discovered for protecting it, when so cooled, from the influx of external heat, and since the rate at which heat is transferred from one body to another increases very rapidly with the difference between their temperatures, the question of efficient heat insulation became at once more difficult and more urgent in proportion to the degree of cold attained. The second part of the problem was in fact solved first. Of course packing with non-conducting materials was an obvious expedient when it was not necessary that the contents of the apparatus should be visible to the eye, but in the numerous instances when this was not the case such measures were out of the question. Attempts were made to secure the desired end by surrounding the vessel that contained the cooled or liquid gas with a succession of other vessels, through which was conducted the vapour given off from the interior one. Such devices involved awkward complications in the arrangement of the apparatus, and besides were not as a rule very efficient, although some workers, *e.g.*, Dr Kamerlingh Onnes, of Leyden, reported some success with their use. In 1892 it occurred to Dewar that the principle of an arrangement he had used nearly twenty years before for some calorimetric experiments on the physical constants of hydrogenium, which was a natural deduction from the work of Dulong and Petit on radiation, might be employed with advantage as well to protect cold substances from heat as hot ones from cold. He therefore tried the effect of surrounding his liquefied gas with a highly exhausted space. The result was entirely successful. Experiment showed that liquid air contained in a glass vessel with two walls, the space between which was a high vacuum, evaporated at only one-fifth the rate it did when in an ordinary vessel surrounded with air at atmospheric pressure, the convective transference of heat by means of the gas particles being enormously reduced owing to the vacuum. Fig. 1 shows two of these vessels; other forms may be seen in the Plate illustrating the lecture-table at the Royal Institution. But in addition these vessels lent themselves to an arrangement by which radiant heat could also be cut off, and it was found that when the inner wall was coated with a bright deposit of silver, the influx of heat was diminished to one-sixth of the amount existing without the metallic coating. The total effect, therefore, of the high vacuum and silvering is to reduce the in-going heat to one-thirtieth part. In making such vessels a mercurial vacuum has been found very satisfactory. The vessel in which the vacuum is to be produced is provided with a small subsidiary vessel joined by a narrow tube with the main vessel, and connected with a powerful air-pump. A quantity of mercury having been placed in it, it is heated in an oil- or air-bath to about 200° C., so as to volatilize the mercury, the vapour of which is removed by the pump. After the process has gone on for some time, the pipe leading to the pump is sealed off, the vessel immediately removed from the bath, and the small subsidiary part immersed in some cooling agent such as solid carbonic acid or liquid air, whereby the mercury vapour is condensed in the small vessel and a vacuum of enormous tenuity left in the large one. The final step is to seal off the tube connecting the two. In this way a vacuum may be produced having a vapour pressure of about the hundred-millionth of an atmosphere at 0° C. If, however, some liquid mercury be left in the space in which the vacuum is produced, and the containing part of the vessel be filled with liquid air, the bright mirror of mercury which is deposited on the inside wall of the bulb is still more effective than silver in protecting the chamber from the influx of heat, owing to the high refractive index, which involves great reflecting power, and the bad heat-conducting powers of mercury.

Thermal Transparency at Low Temperatures.—The proposition, once enunciated by Pictet, that at low temperatures all substances have practically the same thermal transparency, and are equally ineffective as non-conductors of heat, is based on erroneous observations. It is true that if the space between the two walls of a double-walled vessel is packed with substances like carbon, magnesia, or silica, liquid air placed in the interior will boil off even more quickly than it will when the space merely contains air at atmospheric pressure; but in such cases it is not so much the carbon, &c., that bring about the transference of heat, as the air contained in their interstices. If this air be pumped out such substances are seen to exert a very considerable influence in stopping the influx of heat, and a vacuum vessel which has the space between its two walls filled with a non-conducting material of this kind preserves a liquid gas even better than one in which that space is simply exhausted of air. In experiments on this point double-walled glass tubes, as nearly identical in shape and size as possible, were mounted in sets of three on a common stem which communicated with an air-pump, so that the degree of exhaustion in each was equal. In two of each three the space between the double walls was filled with the powdered material it was desired to test, the third being left empty and used as the standard. The time required for a certain quantity of liquid air to evaporate from the interior of this empty bulb being called 1, in each of the eight sets of triple tubes, the times required for the same quantity to boil off from the other pairs of tubes were as follows:—

Charcoal . . .	5	Lampblack . .	5
Magnesia . . .	2	Silica . . .	4
Graphite . . .	1·3	Lampblack . .	4
Alumina . . .	3·3	Lycopodium . .	2·5
Calcium carbonate .	2·5	Barium carbonate .	1·3
Calcium fluoride .	1·25	Calcium phosphate .	2·7
Phosphorus (amorphous)	1	Lead oxide . .	2
Mercuric iodide .	1·5	Bismuth oxide . .	6

Other experiments of the same kind made—(*a*) with similar vacuum vessels, but with the powders replaced by metallic and other septa; and (*b*) with vacuum vessels having their walls silvered, yielded the following results:—

(*a*) Vacuum space empty	1	Vacuum space empty .	1
Three turns silver paper, bright surface inside . .	4	Three turns black paper, black outside . .	3
Three turns silver paper, bright surface outside .	4	Three turns black paper, black inside . .	3
Vacuum space empty	1	Vacuum space empty .	1
Three turns gold paper, gold outside	4	Three turns, not touching, of sheet lead .	4
Some pieces of gold-leaf put in so as to make contact between walls of vacuum-tube . .	0·3	Three turns, not touching, of sheet aluminium	4
(*b*) Vacuum space empty, silvered on inside surfaces . . .	1	Empty silvered vacuum	1
Silica in silvered vacuum space .	1·1	Charcoal in silvered vacuum . . .	1·25

It appears from these experiments that silica, charcoal, lampblack, and oxide of bismuth all increase the heat insulations to four, five, and six times that of the empty vacuum space. As the chief communication of heat through an exhausted space is by molecular bombardment, the fine powders must shorten the free path of the gaseous molecules, and the slow conduction of heat through the porous mass must make the conveyance of heat-energy more difficult than when the gas molecules can impinge upon the relatively hot outer glass surface, and then directly on the cold one without interruption. (See *Proc. Roy. Inst.*, vol. xv. pp. 821–826.)

Density of Solids and Coefficients of Expansion at Low Temperatures.—The facility with which liquid gases, like oxygen or nitrogen, can be guarded from evaporation by the proper use of vacuum vessels (now called Dewar vessels), naturally suggests that the specific gravities of solid bodies can be got by direct weighing when immersed in such fluids. If the density of the liquid gas is accurately known, then the loss of weight by fluid displacement gives the specific gravity compared to water. The metals and alloys, or substances that can be got in large crystals, are the easiest to manipulate. If the body is only to be had in small crystals, then it must be compressed under strong hydraulic pressure into coherent blocks weighing about 40 to 50 grammes. Such an amount of material gives a very accurate density of the body about the boiling point of air, and a similar density taken in a suitable liquid at the ordinary temperature enables the mean coefficient of expansion between +15° C. and −185° C. to be determined. One of the most interesting results is that the density of ice at the boiling point of air is not more than 0·93, the mean coefficient of expansion being therefore 0·000081. As the value of the same coefficient between 0° C. and −27° C. is 0·000155, it is clear the rate of contraction is diminished to about one-half of what it was above the melting point of the ice. This suggests that by no possible cooling at our command is it likely we could ever make ice as dense as water at 0° C., far less 4° C. In other words, the volume of ice at the zero of temperature would not be the minimum volume of the water molecule, though we have every reason to believe it would be so in the case of the majority of known substances. Another substance of special interest is solid carbonic acid. This body has a density of 1·53 at −78° C. and 1·633 at −185° C., thus giving a mean coefficient of expansion between these temperatures of 0·00057. This value is only about ⅙ of the coefficient of expansion of the liquid carbonic acid gas just above its melting point, but it is still much greater at the low temperature than that of highly expansive solids like sulphur, which at 40° C. has a value of 0.00019. The following table gives the densities at the temperature of boiling liquid air (−185° C.) and at ordinary temperatures (17° C.), together with the mean coefficient of expansion between those temperatures, in the case of a number of hydrated salts and other substances:—

TABLE I.

	Density at −185° C.	Density at −17° C.	Mean coefficient of expansion between −185° C. and +17° C.
Sulphate of aluminium (18)[1] .	1·7194	1·6913	0·0000811
Biborate of soda (10) . .	1·7284	1·6937	0·0001000
Chloride of calcium (6) . .	1·7187	1·6775	0·0001191
Chloride of magnesium (6) .	1·6039	1·5693	0·0001072
Potash alum (24) . . .	1·6414	1·6144	0·0000813
Chrome alum (24) . . .	1·7842	1·7669	0·0000478
Carbonate of soda (10) . .	1·4926	1·4460	0·0001563
Phosphate of soda (12) . .	1·5446	1·5200	0·0000787
Hyposulphite of soda (5) . .	1·7635	1·7290	0·0000969
Ferrocyanide of potassium (3) .	1·8988	1·8533	0·0001195
Ferricyanide of potassium . .	1·8944	1·8109	0·0002244
Nitro-prusside of sodium (4) .	1·7196	1·6803	0·0001138
Chloride of ammonium .	1·5757	1·5188	0·0001820
Oxalic acid (2)	1·7024	1·6145	0·0002643
Oxalate of methyl . . .	1·5278	1·4260	0·0003482
Paraffin	0·9770	0·9103	0·0003567
Naphthalene	1·2355	1·1589	0·0003200
Chloral hydrate	1·9744	1·9151	0·0001482
Urea	1·3617	1·3190	0·0001579
Iodoform	4·4459	4·1955	0·0002930
Iodine	4·8943	4·6631	0·0002510
Sulphur . . .	2·0989	2·0522	0·0001152
Mercury	14·382	...	0·0000881[2]
Sodium	1·0056	0·972	0·0001810
Graphite (Cumberland) . .	2·1302	2·0990	0·0000733

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[1] The figures within parentheses refer to the number of molecules of water of crystallization.

[2] −189° to −38°·85 C.

It will be seen from this table that, with the exception of carbonate of soda and chrome alum, the hydrated salts have a coefficient of expansion that does not differ greatly from that of ice at low temperatures. Iodoform is a highly expansive body like iodine, and oxalate of methyl has nearly as great a coefficient as paraffin, which is a very expansive solid, as are naphthalene and oxalic acid. The coefficient of solid mercury is about half that of the liquid metal, while that of sodium is about the value of mercury at ordinary temperatures. Further details on the subject can be found in the *Proc. Roy. Inst.*, 1895, and *Proc. Roy. Soc.*, 1902.

Density of Gases at Low Temperatures.—The ordinary mode of determining the density of gases may be followed, provided that the glass flask, with its carefully ground stop-cock sealed on, can stand an internal pressure of about five atmospheres, and that all the necessary corrections for change of volume are made. All that is necessary is to immerse the exhausted flask in boiling oxygen, and then to allow the second gas to enter from a gasometer by opening the stop-cock until the pressure is equalized. The stop-cock being closed, the flask is now taken out of the liquid oxygen and left in the balance-room until its temperature is equalized. It is then weighed against a similar flask used as a counterpoise. Following such a method, it has been found that the weight of 1 litre of oxygen vapour at its boiling point of 90°·5 absolute is 4·420 grammes, and therefore the specific volume is 226·25 cc. According to the ordinary gaseous laws, the litre ought to weigh 4·313 grammes, and the specific volume should be 231·82 cc. In other words, the product of pressure and volume at the boiling point is diminished by 2·46 per cent. In a similar way the weight of a litre of nitrogen vapour at the boiling point of oxygen was found to be 3·90, and the inferred value for 78° absolute, or its own boiling point, would be 4·51, giving a specific volume of 221·3.

Regenerative Cooling.—One part of the problem being thus solved and a satisfactory device discovered for warding off heat in such vacuum vessels, it remained to arrange some practically efficient method for reducing hydrogen to a temperature sufficiently low for liquefaction. To gain that end, the idea naturally occurred of using adiabatic expansion, not intermittently, as when gas is allowed to expand suddenly from a high compression, but in a continuous process, and an obvious way of attempting to carry out this condition was to enclose the orifice at which expansion takes place in a tube, so as to obtain a constant stream of cooled gas passing over it. But further consideration of this plan showed that although the gas jet would be cooled near the point of expansion owing to the conversion of a portion of its sensible heat into dynamical energy of the moving gas, yet the heat it thus lost would be restored to it almost immediately by the destruction of this mechanical energy through friction and its consequent reconversion into heat. Thus the net result would be *nil* so far as change of temperature through the performance of external work was concerned. But the conditions in such an arrangement resemble that in the experiments of Thomson and Joule on the thermal changes which occur in a gas when it is forced under pressure through a porous plug or narrow orifice, and those experimenters found, as the former of them had predicted, that a change of temperature does take place, owing to internal work being done by the attraction of the gas molecules. Hence the effective result obtainable in practice by such an attempt at continuous adiabatic expansion as that suggested above is to be measured by the amount of the "Thomson-Joule effect," which depends entirely on the internal, not the external, work done by the gas. To Linde belongs the credit of having first seen the essential importance of this effect in connexion with the liquefaction of gases by adiabatic expansion, and he was, further, the first to construct an industrial plant for the production of liquid air based on the application of this principle.

The change of temperature due to the Thomson-Joule effect varies in amount with different gases, or rather with the temperature at which the operation is conducted. At ordinary temperatures oxygen and carbonic acid are cooled, while hydrogen is slightly heated. But hydrogen also is cooled if before being passed through the nozzle or plug it is brought into a thermal condition comparable to that of other gases at ordinary temperatures—that is to say, when it is initially cooled to a temperature having the same ratio to its critical point as their temperatures have to their critical points—and similarly the more condensible gases would be heated, and not cooled, by passing through a nozzle or plug if they were employed at a temperature sufficiently above their critical points. Each gas has therefore a point of inversion of the Thomson-Joule effect, and this temperature is, according to the theory of van der Waals, about 6·75 times the critical temperature of the body. Olszewski has determined the inversion-point in the case of hydrogen, and finds it to be 192°·5 absolute, the theoretical critical point being thus about 28°·5 absolute. The cooling effect obtained is small, being for air about ¼° C. per atmosphere difference of pressure at ordinary temperatures. But the decrement of temperature is proportional to the difference of pressure and inversely as the absolute temperature, so that the Thomson-Joule effect increases rapidly by the combined use of a lower temperature and greater difference of gas pressure. By means of the "regenerative" method of working, which was described by Siemens in 1857, developed and extended by Solvay in 1885, and subsequently utilized by numerous experimenters in the construction of low temperature apparatus, a practicable liquid air plant was constructed by Linde. The gas which has passed the orifice and is therefore cooled is made to flow backwards round the tube that leads to the nozzle; hence that portion of the gas that is just about to pass through the nozzle has some of its heat abstracted, and in consequence on expansion is cooled to a lower temperature than the first portion. In its turn it cools a third portion in the same way, and so the reduction of temperature goes on progressively until ultimately a portion of the gas is liquefied. Apparatus based on this principle has been employed not only by Linde in Germany, but also by Tripler in America and by Hampson and Dewar in England. The last-named experimenter exhibited in December 1895 a laboratory machine of this kind (Fig. 2), which when supplied with oxygen initially cooled to -79° C., and at a pressure of 100–150 atmospheres, began to yield liquid in about a quarter of an hour after starting. The initial cooling is not necessary, but it has the advantage of reducing the time required for the operation. The efficiency of the Linde process is

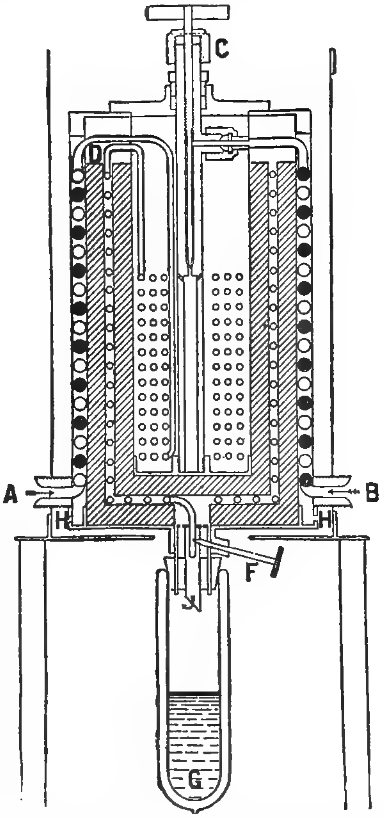


Fig. 2.—Laboratory Liquid Air Machine. A, air or oxygen inlet; B, carbon dioxide inlet; C, carbon dioxide valve; D, regenerator coils; F, air or oxygen expansion valve; G, vacuum vessel with liquid air or oxygen; H, carbon dioxide and air outlet; ○, air coil; ●, carbon dioxide coil.

small, but it is easily conducted and only requires plenty of cheap power. When we can work turbines or other engines at low temperatures, so as to effect cooling through the performance of external work, then the economy in the production of liquid air and hydrogen will be greatly increased.

This treatment was next extended to hydrogen. For the reason already explained, it would have been futile to experiment with this substance at ordinary temperatures, and therefore as a preliminary it was cooled to the temperature of boiling liquid air, about −190° C. At this temperature it is still $2\frac{1}{2}$ times above its critical temperature, and therefore its liquefaction in these circumstances would be comparable to that of air, taken at +60° C., in an apparatus like that just described. Dewar showed in 1896 that hydrogen cooled in this way and expanded in a regenerative coil from a pressure of 200 atmospheres was rapidly reduced in temperature to such an extent that after the apparatus had been working a few minutes the issuing jet was seen to contain liquid, which was sufficiently proved to be liquid hydrogen by the fact that it was so cold as to freeze liquid air and oxygen into hard white solids. Though with this apparatus, a diagrammatic representation of which is shown in Fig. 3, it was not found possible at the time to collect the liquid in an open vessel, owing to its low specific gravity and the rapidity of the gas-current, still the general type of the arrangement seemed so promising that in the next two years there was laid down in the laboratories of the Royal Institution a large plant—it weighs 2 tons and contains 3000 feet of pipe—which is designed on precisely the same principles, although its construction is far more elaborate. The one important novelty, without which it is practically impossible to succeed, is the provision of a device to surmount the difficulty of withdrawing the liquefied hydrogen after it has been made. The desideratum is really a means of forming an aperture in the bottom of a vacuum vessel by which the contained liquid may be run out. For this purpose the lower part of the vacuum vessel (D in Fig. 3) containing the jet is modified as shown in Fig. 4; the inner vessel is prolonged in a fine tube, coiled spirally, which passes through the outer wall of the vacuum vessel, and thus sufficient elasticity is obtained to enable the tube to withstand without fracture the great contraction consequent on the extreme cold to which it is subjected. Such peculiarly shaped vacuum vessels were made by Dewar's directions in Germany, and have subsequently been supplied to and employed by other experimenters.

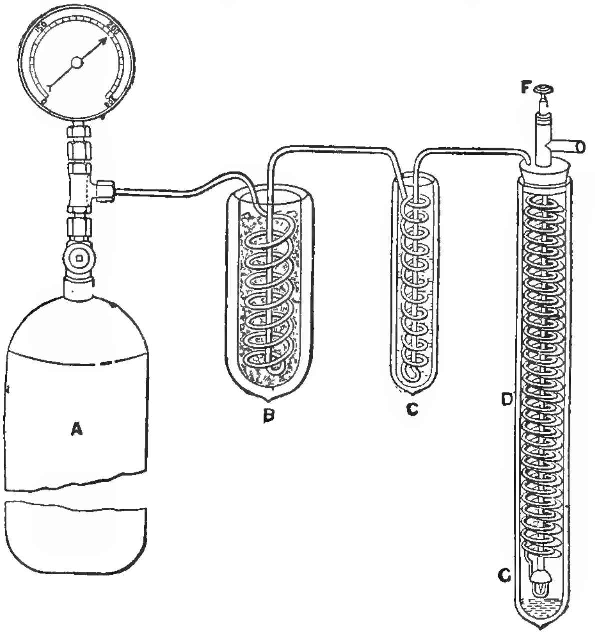


FIG. 3.—Hydrogen Jet Apparatus. A, cylinder containing compressed hydrogen; B and C, vacuum vessels containing carbonic acid under exhaustion and liquid air respectively; D, regenerating coil in vacuum vessel; F, valve; G, pin-hole nozzle.

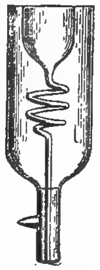


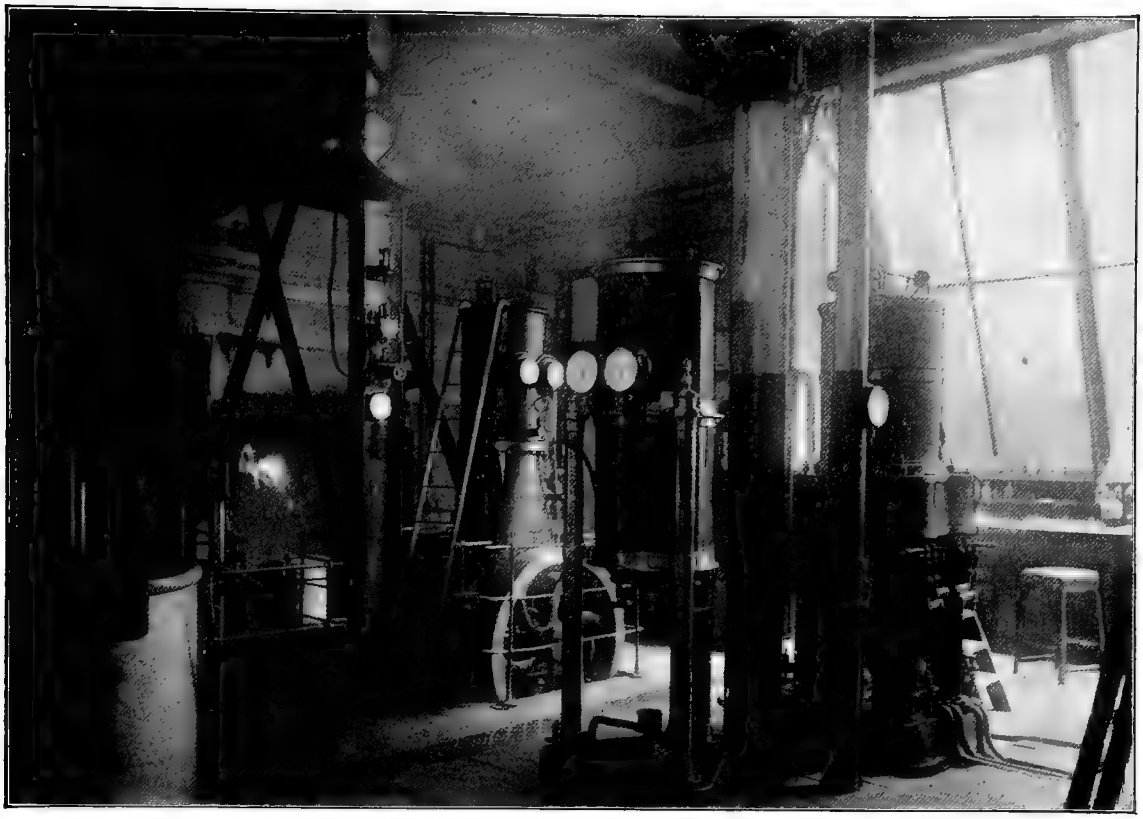
FIG. 4.—Bottom of Vacuum Vessel.

The external appearance of the liquid hydrogen machine is shown in Fig. 5, while on the Plate may be seen a general view of the liquid hydrogen plant in the Royal Institution. With this apparatus liquid hydrogen was for the first time collected in an open vessel on 10th May 1898. The gas at a pressure of 180 atmospheres was cooled to −205° C. by means of liquid air boiling *in vacuo*, and then passed through the nozzle of the regenerative coil, which was enclosed in vacuum vessels in such a way as to exclude external heat as perfectly as possible. In this way some 20 cc. of the liquid had been collected when the experiment came to a premature end, owing to the nozzle of the apparatus becoming blocked by a dense solid—air-ice resulting from the congelation of the air which was present to a minute extent as an impurity in the hydrogen. This accident exemplifies what is a serious trouble encountered in the production of liquid hydrogen, the extreme difficulty of obtaining the gas in a state of sufficient purity, for the presence of 1 per cent. of foreign matters, such as air or oxygen, which are more condensible than hydrogen, is sufficient to cause complete stoppage, unless the nozzle valve and jet arrangement is of special construction. In subsequent experiments the liquid was obtained in larger quantities—on 13th June 1901 five litres of it were successfully conveyed through the streets of London from the laboratory of the Royal Institution to the rooms of the Royal Society—and it may be said that it is now possible to produce it in any desired amount, subject only to the limitations entailed by expense. Finally, the reduction of hydrogen to a solid state was successfully undertaken in 1899. A portion of the liquid carefully isolated in vacuum-jacketed vessels was suddenly transformed into a white mass resembling frozen foam, when evaporated under an air-pump at a pressure of 30 or 40 mm., and subsequently hydrogen was obtained as a clear transparent ice by immersing a tube containing the liquid in this solid foam.

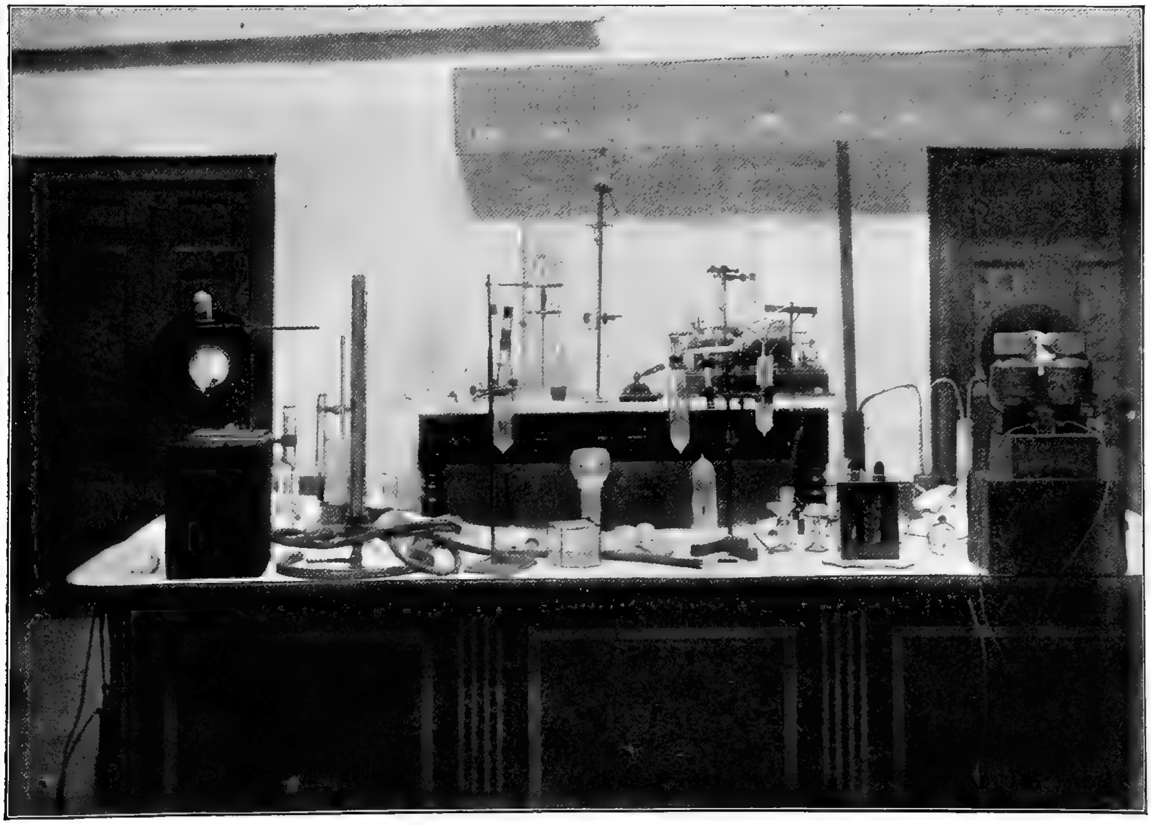
The following are brief details respecting the more important liquefied gases that have become available for study within recent years. (For argon, neon, krypton, &c., see ARGON.)

Oxygen.—Liquid oxygen is a mobile transparent liquid, possessing a faint blue colour. At atmospheric pressure it boils at −181°·5 C.; under a reduced pressure of 1 cm. of mercury its temperature falls to −210° C. At the boiling point it has a density of 1·124 according to Olszewski, or of 1·168 according to Wroblewski; Dewar obtained the value 1·1375 as the mean of twenty observations by weighing a number of solid substances in liquid oxygen, noting the apparent relative density of the liquid, and thence calculating its real density, Fizeau's values for the coefficients of expansion of the solids being employed. The capillarity of liquid oxygen is about one-sixth that of water; it is a non-conductor of electricity, and is strongly magnetic. By its own evaporation it cannot be reduced to the solid state, but exposed to the temperature of liquid hydrogen it is frozen into a solid mass, having a pale bluish tint, showing by reflection all the absorption bands of the liquid. It is remarkable that the same absorption bands occur in the compressed gas. Dewar gives the melting-point as 38° absolute. The refractive index of the liquid for the D sodium ray is 1·2236.

Ozone.—This gas is easily liquefied by the use of liquid air. The



Plant for Liquefaction of Gases in Laboratories of Royal Institution, London.



Lecture Table at Royal Institution, London, arranged for Lecture on Liquid Gases.

liquid obtained is intensely blue, and on allowing the temperature to rise, boils and explodes about −120° C. About this temperature it may be dissolved in bisulphide of carbon to a faint blue solution. The liquid ozone seems to be more magnetic than liquid oxygen.

Nitrogen forms a transparent colourless liquid, having a density of 0·800 at its boiling point, which is −195° C. The refractive index for the D line is 1·2053. Evaporated under diminished pressure the liquid becomes solid at a temperature of −215° C., under a pressure of 64 mm.

Air.—Seeing that the boiling points of nitrogen and oxygen are different, it might be expected that on the liquefaction of atmospheric air the two elements would appear as two separate liquids. Such, however, is not the case; they come down simultaneously as one homogeneous liquid. Prepared on a large scale, liquid air may contain as much as 50 per cent. of oxygen when collected in open vacuum-vessels, but since nitrogen is the more volatile it boils off first, and as the liquid gradually becomes richer in oxygen the temperature at which it boils rises from about −192° C. to about −182° C. At the former temperature it has a density of about 0·910. It is a non-conductor of electricity. Properly protected from external heat, and subjected to high exhaustion, liquid air becomes a stiff transparent jelly-like mass, a magma of solid nitrogen containing liquid oxygen, which may indeed be extracted from it by means of a magnet, or by rapid rotation of the vacuum vessel in imitation of a centrifugal machine. The temperature of this solid under a vacuum of about 14 mm. is −216° At the still lower temperatures attainable by the aid of liquid hydrogen it becomes a white solid having, like solid oxygen, a faint blue tint. The refractive index of liquid air is 1·2068.

Fluorine, prepared in the free state by Moissan's method of electrolysing a solution of potassium fluoride in anhydrous hydrofluoric acid, was liquefied in the laboratories of the Royal Institution, London, in 1897. Exposed to the temperature of quietly-boiling liquid oxygen, the gas did not change its state, though it lost much of its chemical activity, and ceased to attack glass. But a very small vacuum formed over the oxygen was sufficient to determine liquefaction, a result which was also obtained by cooling the gas to the temperature of freshly-made liquid air boiling at atmospheric pressure. Hence the boiling point is fixed at about −187° C. The liquid is of a clear yellow colour, possessing great mobility. Its density is 1·14, and its capillarity rather less than that of liquid oxygen. The liquid, when examined in a thickness of 1 cm., does not show any absorption bands, and it is not attracted by a magnet. Even when cooled to −210° C., it shows no sign of becoming solidified.

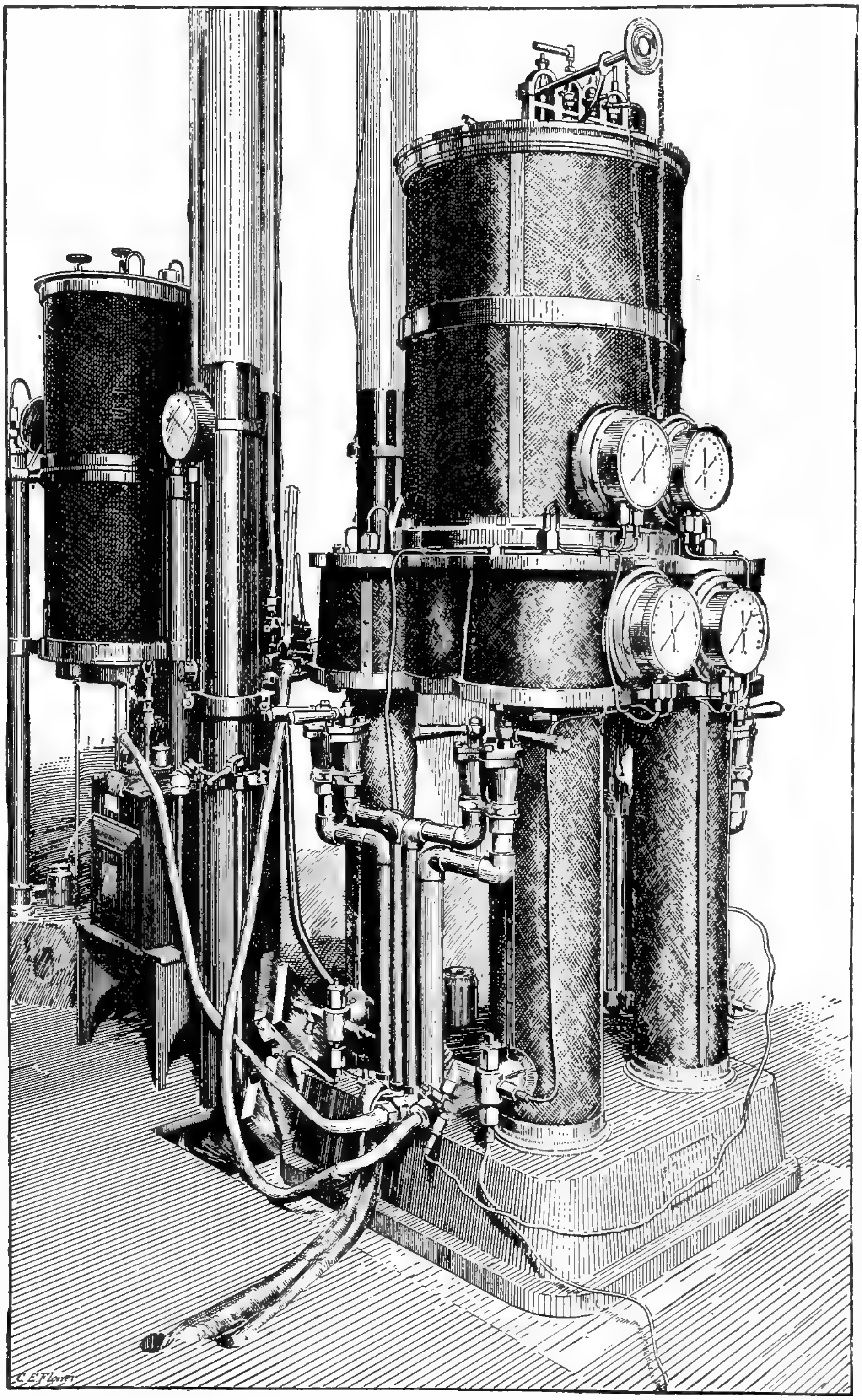


Fig. 5.—Liquid Hydrogen Machine.

Hydrogen.—Liquid hydrogen is the lightest liquid known to the chemist, having a density slightly less than 0·07 as compared with water, and being six times lighter than liquid marsh-gas, which is next in order of lightness. One litre weighs only 70 grammes, and 1 gramme occupies a volume of 14–15 cc. In spite of its extreme lightness, however, it is easily seen, has a well-defined meniscus, and drops well. At its boiling point the liquid is only 55 times denser than the vapour it is giving off, whereas liquid oxygen in similar condition is 258 times denser than its vapour, and nitrogen 177 times. Its atomic volume is about 14·3, that of liquid oxygen being 13·7, and that of liquid nitrogen 16·6, at their respective boiling points. Its latent heat of vaporization about the boiling point, as deduced from the vapour pressures and helium thermometer temperatures, is about 200 units, and the latent heat of fluidity cannot exceed 16 units, but may be less. Liquid hydrogen has the greatest specific heat of any known body near its melting point, the average being about 6 between the boiling and freezing points. Its surface tension is exceedingly low, about one-fifth that of liquid air at its boiling point, or one-thirty-fifth that of water at ordinary temperatures, and this is the reason that bubbles formed in the liquid are so small as to give it an opalescent appearance during ebullition. The liquid is without colour, and gives no absorption spectrum. Electric sparks taken in the liquid between platinum poles give a spectrum showing the hydrogen lines C. and F. bright on a background of continuous spectrum. Its refractive index at the boiling point has theoretically the value 1·11. It was measured by determining the relative difference of focus for a parallel beam of light sent through a spherical vacuum vessel filled successively with water, liquid oxygen, and liquid hydrogen; the result obtained was 1·12. Liquid hydrogen is a non-conductor of electricity. The precise determination of its boiling point is a matter of some difficulty. The first results obtained from the use of a platinum resistance thermometer gave −238° C., while a similar thermometer made with an alloy of rhodium-platinum indicated a value 8 degrees lower. Later, a gold thermometer indicated about −249° C., while with an iron one the result was only −210° C. It was thus evident that electrical resistance thermometers are not to be trusted at these low temperatures, since the laws correlating resistance and temperature are not known for temperatures at and below the boiling point of hydrogen, though they are certainly not the same as those which hold good higher up the thermometric scale. The same remarks apply to the use of thermo-electric junctions at such exceptional temperatures. Recourse was therefore had to a constant-volume hydrogen thermometer, working under reduced pressure, experiments having shown that such a thermometer, filled with either a simple or a compound gas (*e.g.*, oxygen or carbonic acid) at an initial pressure somewhat less than one atmosphere, may be relied upon to determine temperatures down to the respective boiling points of the gases with which they are filled. The result obtained was −252° C. Subsequently various other determinations were carried out in thermometers filled with hydrogen derived from different sources, and also with helium, the average value given by the experiments being −252·5° C. (See "The Boiling Point of Liquid Hydrogen determined by Hydrogen and Helium Gas Thermometers," *Proc. Roy. Soc.*, 7th February 1901.) The critical temperature is about 30° absolute (−243° C.), and the critical pressure about 15 atmospheres. Hydrogen has not only the lowest critical temperature of all the old permanent gases, but it has the lowest critical pressure. Given a sufficiently low temperature, therefore, it is the easiest gas to liquefy so far as pressure is concerned. Solid hydrogen has a temperature about 4 degrees less. By exhaustion under reduced pressure a still lower depth of cold may be attained, and a steady temperature reached less than 16 degrees above the zero of absolute temperature. By the use of high exhaustion, and the most stringent precautions to prevent the influx of heat, a temperature of 13° absolute (−260° C.) may be reached. This is the lowest steady temperature which can be maintained by the evaporation of solid hydrogen. The solid has a density of about 0·09. Solid hydrogen presents no metallic characteristics, such as were predicted for it by Faraday, Dumas, Graham, and other chemists, and neither it nor the liquid is magnetic.

Low Temperature Research.

The subjection of hydrogen completes the experimental proof that all substances can exist in the three states of solid, liquid, and gas, at least so far as concerns those in the hands of the chemist at the beginning of the last decade of the 19th century. But a year or so before hydrogen was obtained in the liquid form, a substance known spectroscopically to exist in the sun from researches carried out by Frankland and Lockyer so far back as 1868, was found by Professor W. Ramsay to exist on this earth, though in excessively small quantities, and experiment has shown helium, as the gas is named, to be much less condensible than hydrogen. It has been expanded from a pressure of 80 to 100 atmospheres at the temperature of solid hydrogen without the least indication of liquefaction being perceived, although in this connexion it must be remembered that its exceedingly low refractivity would render small drops of the liquid forming in the gas near its critical point very difficult to see. It may, however, be said without much doubt that helium has been cooled to 9° or 10° absolute (264° or 263° below zero centigrade) without sign of liquefaction, and the inference is that its critical point is below 9° absolute. This means that its boiling point is about 5° absolute, or one-fourth that of liquid hydrogen. The hope of liquefying the gas must depend on subjecting it to the same process that has succeeded with hydrogen, but instead of liquid air under exhaustion being used as the primary cooling agent, liquid hydrogen under exhaustion must be employed, and the resulting liquid collected in vacuum vessels immersed in liquid hydrogen. The practical difficulties and cost of the operation will be very great, but, on the other hand, success would mean the command of a liquid probably boiling within 5 degrees of the absolute zero. If a gas of the same series, still unisolated, may exist (as is not impossible), which has an atomic weight half that of helium, this gas, liquefied in turn by the aid of liquid helium, would bring the experimenter still closer to that zero. The following table embodies the results of experiments and of theory based on them. The third column shows the critical temperature of the gas which can be liquefied by continuous expansion through a regenerative cooling apparatus, the operation being started from the initial temperature shown in the second column, while the fourth column gives the temperature of the resulting liquid. It will be seen that by the use of liquid or solid hydrogen as a cooling agent, it should be possible to liquefy a body having a critical temperature of about 6° to 8° on the absolute scale, and a boiling point of about 4° or 5°, while with the aid of liquid helium at an initial temperature of 5° we could liquefy a body having a critical temperature of 2° and a boiling point of 1°.

Table II.

Substance.	Initial Temperature. Abs. Degrees.	Critical Temperature. Abs. Degrees.	Boiling Points. Abs. Degrees.
(Low red heat) .	760	304	195 (CO_2)
(52° C.) . .	325	130	86 (Air)
Liquid air under exhaustion	75	30	20 (H)
Liquid hydrogen .	20	8	5 (He ?)
Solid hydrogen .	15	6	4
Liquid helium .	5 ?	2 ?	1 ?

It is to be remarked, however, that even so the physicist would not have attained the absolute zero, and probably he can scarcely ever hope to do so. It is true he would only be a very short distance from it, but it must be remembered that in a thermodynamic sense one degree low down the scale, say at 10° absolute, is equivalent to 30° at the ordinary temperature, and as the experimenter gets to lower and lower temperatures, the difficulties of further advance increase, not in arithmetical but in geometrical progression. Thus the step between the liquefaction of air and that of hydrogen is, thermodynamically and practically, greater than that between the liquefaction of chlorine and that of air, but the number of degrees of temperature that separates the boiling points of the first pair of substances is less than half what it is in the case of the second pair. But the ratio of the absolute boiling points in the first pair of substances is as 1 to 4, whereas in the second pair it is only 1 to 3, and it is this value that expresses the difficulty of the transition.

But though Ultima Thule may continue to mock the physicist's efforts, he will long find ample scope for his energies in the investigation of the properties of matter at the temperatures placed at his command by liquid air and liquid and solid hydrogen. Indeed, great as is the sentimental interest attached to the liquefaction of these refractory gases, the importance of the achievement lies rather in the fact that it opens out new fields of research and enormously widens the horizon of physical science, enabling the natural philosopher to study the properties and behaviour of matter under entirely novel conditions. This department of inquiry is as yet only in its infancy, but speedy and extensive developments may be looked for, since within recent years several special cryogenic laboratories have been established for the prosecution of such researches, and a liquid air plant is becoming a common adjunct to the equipment of the ordinary chemical laboratory. We propose to indicate briefly the general directions in which these inquiries have so far been carried on, but before doing so will call attention to two important manipulative uses to which liquid gases may be turned.

Production of High Vacua.—The first use of liquid gases is in the production of exceedingly high vacua. If a vessel containing liquid hydrogen be freely exposed to the atmosphere, a rain of snow (solid air) at once sets in; similarly, if one end of a sealed tube containing ordinary air be immersed in the liquid, the same process takes place, but as now there is no new supply available to take the place of the portion that has solidified and fallen to the bottom of the tube, the pressure in the vessel is quickly reduced to something like one-millionth of an atmosphere, and a vacuum is readily formed of such tenuity that the electric discharge can only be made to pass with great difficulty. Liquid air may be used in the same manner if the tube before sealing is filled with some less volatile gas or vapour, such as sulphurous acid, benzol, or water vapour. The last is the most suitable substance to show this rapid production of high vacua by simple cooling. Provided a Geissler tube has platinum poles, and is filled with nothing but vapour of water, it is sufficient to cool a small area of its surface with a sponge containing liquid air to see it pass rapidly through all the phases of striation, and ultimately reach the phosphorescent glow.

Analytic Uses.—The second use of liquid gases is as analytic agents, and for this purpose liquid air is becoming an almost essential laboratory reagent. It is one of the most convenient agents for drying gases and for their purification. If a mixture of gases be subjected to the temperature of liquid oxygen it is obvious that all the constituents that are more condensible than oxygen will be reduced to liquid, while those that are less condensible will either remain as a gaseous residue or be dissolved in the liquid obtained. The bodies present in the latter may be separated by fractional distillation, while the contents of the gaseous residue may be further differentiated by the aid of still lower temperatures, such as are obtainable by liquid hydrogen. An apparatus such as the following can be used to separate both the less and the more volatile gases of the atmosphere, the former being obtained from their solution in liquid air by fractional distillation at low pressure, and separation of the condensible part of the distillate by cooling in liquid hydrogen, while the latter are extracted from the residue of liquid air, after the distillation of the first fraction, by allowing it to evaporate gradually at a temperature rising only very slowly.

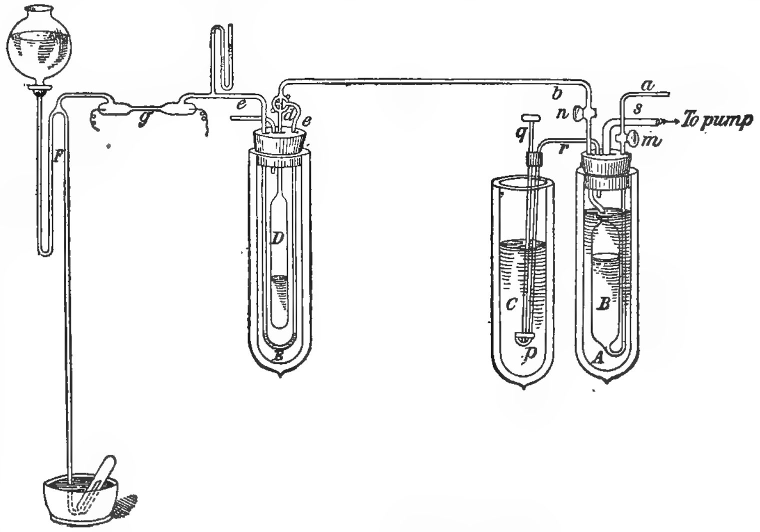


FIG. 6.—Apparatus for Fractional Distillation.

In Fig. 6, A represents a vacuum-jacketed vessel, containing liquid air; this can be made to boil at reduced pressure and therefore be lowered in temperature by means of an air-pump, which is in communication with the vessel through the pipe s. The liquid boiled away is replenished when necessary from the reservoir C, p being a valve, worked by handle q, by which the flow along r is regulated. The vessel B, immersed in the liquid air of A, communicates with the atmosphere by a; hence when the temperature of A falls under exhaustion below that of liquid air, the contents of B condense, and if the stop-cock m is kept open, and n shut, air from the outside is continuously sucked in until B is full of liquid, which contains in solution the whole of the most volatile gases of the atmosphere which have passed in through a. At this stage of the operation m is closed and n opened, a passage thus being opened along b from A to the remainder of the apparatus seen on the left side of the figure. Here E is a vacuum vessel containing liquid hydrogen, and d a three-way cock by which communication can be established either between b and D, between b and e, the tube leading to the sparking-tube g, or between D and e. If now d is arranged so that there is a free passage from b to D, and the stop-cock n also opened, the gas dissolved in the liquid in B, together with some of the most volatile part of that liquid, quickly distils over into D, which is at a much lower temperature than B, and some of it condenses there in the solid state. When a small fraction of the contents of B has thus distilled over, d is turned so as to close the passage between D and b and open that between D and e, with the result that the gas in D is pumped out by the mercury-pump, shown diagrammatically at F, along the tube e (which is immersed in the liquid hydrogen in order that any more condensible gas carried along by the current may be frozen out) to the sparking-tube or tubes g, where it can be examined spectroscopically. When the apparatus is used to separate the least volatile part of the gases in the atmosphere, the vessel E and its contents are omitted, and the tube b made to communicate with the pump through a number of sparking-tubes which can be sealed off successively. The nitrogen and oxygen which make up the bulk of the liquid in B are allowed to evaporate gradually, the temperature being kept low so as to check the evaporation of gases less volatile than oxygen. When most of the oxygen and nitrogen have thus been removed, the stopcock n is closed, and the tubes partially exhausted by the pump; spectroscopic examination is made of the gases they contain, and repeated from time to time as more gas is allowed to evaporate from B. The general sequence of spectra, apart from those of nitrogen, oxygen, and carbon compounds, which are never eliminated by the process of distillation alone, is as follows:—The spectrum of argon first appears, followed by the brightest (green and yellow) rays of krypton. Then the intensity of the argon spectrum wanes and it gives way to that of krypton, until, as Runge observed, when a Leyden jar is in the circuit, the capillary part of the sparking-tube has a magnificent blue colour, while the wide ends are bright pale yellow. Without a jar the tube is nearly white in the middle and yellow about the poles. As distillation proceeds, the temperature of the vessel containing the residue of liquid air being allowed to rise slowly, the brightest (green) rays of xenon begin to appear, and the krypton rays soon die out, being superseded by those of xenon. At this stage the capillary part of the sparking-tube is, with a jar in circuit, a brilliant green, and it remains green, though less brilliant, if the jar is removed.

An improved form of apparatus for the fractionation is represented in Fig. 7. The gases to be separated, that is, the least volatile part of atmospheric air, enter the bulb B from a gasholder by the tube a with stop-cock c. B, which is maintained at a low temperature by being immersed in liquid hydrogen, A, boiling under reduced pressure, in turn communicates through the tube b and stop-cock d with a sparking-tube or tubes f, and so on through *e* with a mercurial pump. To use the apparatus, stopcock *d* is closed and *c* opened, and gas allowed to pass from the gasholder into *B*, where it is condensed in the solid form. Stopcock *c* then being closed and *d* opened, gas passes into the exhausted tube *f*, where it is examined with the spectroscope. The vessel *D* contains liquid air, in which the tube *e* is immersed in order to condense vapour of mercury which would otherwise pass from the pump into the sparking-tube. The success of the operation of separating all the gases which occur in air and which boil at different temperatures, depends on keeping the temperature of *B* as low as possible, as will be understood from the following consideration :—

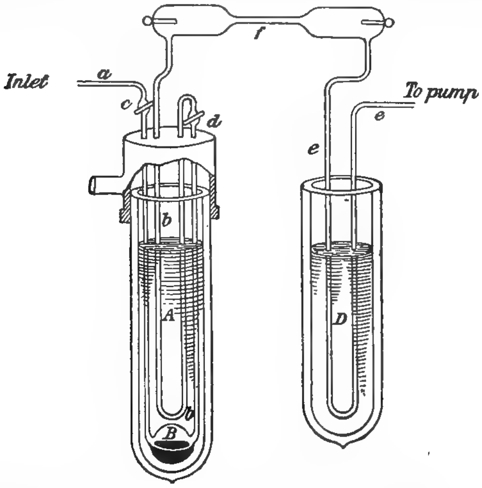


Fig. 7.—Apparatus for continuous Spectroscopic Examination.

The pressure p, of a gas G, above the same material in the liquid state, at temperature T, is given approximately by the formula

$$\log p = A - \frac{B}{T},$$

where A and B are constants for the same material. For some other gas G' the formula will be

$$\log p_1 = A_1 - \frac{B_1}{T},$$

and

$$\log \frac{p}{p_1} = A - A_1 + \frac{B_1 - B}{T}.$$

Now for argon, krypton, and xenon respectively the values of A are 6·782, 6·972, and 6·963, and those of B are 339, 496·3, and 669·2; so that for these substances and many others $A - A_1$ is always a small quantity, while $\frac{B_1 - B}{T}$ is considerable and increases as T diminishes. Hence the ratio of p to p_1 increases rapidly as T diminishes, and by evaporating all the gases from the solid state, and keeping the solid at as low a temperature as possible, the gas that is taken off by the mercurial pump first consists mainly of the substance which has the lowest boiling point, in this case nitrogen, and is succeeded with comparative abruptness by the gas which has the next higher boiling point. Examination of the spectrum in the sparking-tube easily reveals the change from one gas to another, and when that is observed the reservoirs into which the gases are pumped can be changed and the fractions stored separately. Or several sparking-tubes may be arranged so as to form parallel communications between *b* and *e*, and can be successively sealed off at the desired stages of fractionation.

Chemical Action.—By extreme cold chemical action is enormously reduced, though it may not in all cases be entirely abolished even at the lowest temperatures yet attained; one reason for this diminution of activity may doubtless be sought in the fact that in such conditions most substances are solid, that is, in the state least favourable to chemical combination. Thus an electric pile of sodium and carbon ceases to yield a current when immersed in liquid oxygen. Sulphur, iron, and other substances can be made to burn under the surface of liquid oxygen if the combustion is properly established before the sample is immersed, and the same is true of a fragment of diamond. Nitric oxide in the gaseous condition combines instantly with free oxygen, producing the highly-coloured gas, nitric peroxide, but in the solid condition it may be placed in contact with liquid oxygen without showing any signs of chemical action. If the combination of a portion of the mixture is started by elevation of temperature, then detonation may take place throughout the cooled mass. The stability of endothermic bodies like nitric oxide and ozone at low temperatures requires further investigation. The behaviour of fluorine, which may be regarded as the most active of the elements, is instructive in this respect. As a gas, cooled to −180° C. it loses the power of attacking glass; similarly silicon, borax, carbon, sulphur, and phosphorus at the same temperature do not become incandescent in an atmosphere of the gas. Passed into liquid oxygen, the gas dissolves and imparts a yellowish tint to the liquid; if the oxygen has been exposed to the air for some hours, the fluorine produces a white flocculent precipitate, which if separated by filtering deflagrates with violence as the temperature rises. It appears to be a hydrate of fluorine. As a liquid at −210° fluorine attacks turpentine also cooled to that temperature with explosive force and the evolution of light, while the direction of a jet of hydrogen upon its surface is immediately followed by combination and a flash of flame. A far more severe test of chemical action would be effected by mixing liquid or solid fluorine and liquid hydrogen, but this experiment has yet to be made.

Photographic Action.—The action of light on photographic plates, though greatly diminished at −180°, is far from being in abeyance; an Eastman film, for instance, remains fairly sensitive at −210°. At the still lower temperature of liquid hydrogen the photographic activity is reduced to about half what it is at that of liquid air; in other words, about 10 per cent. of the original sensitivity remains. Experiments carried out with an incandescent lamp, a Röntgen bulb, and the ultra-violet spark from magnesium and cadmium, to discover at what distances from the source of light the plates must be placed in order to receive an equal photographic impression, yielded the following results :—

Source of Light.	Cooled Plate.	Uncooled Plate.	Ratio of Intensities at Balance.
16 C.P. lamp . .	20 in.	50 in.	1 to 6
Röntgen bulb . .	10 in.	24¾ in.	1 to 6
Ultra-violet spark .	22½ in.	90 in.	1 to 16

It appears that the photographic action of both the incandescent lamp and the Röntgen rays is reduced by the temperature of liquid air to 17 per cent. of that exerted at ordinary temperatures, while ultra-violet radiation retains only 6 per cent. It is possible that the greater dissipation of the latter by the photographic film at low temperatures than at ordinary ones is due to its absorption and subsequent emission as a phosphorescent glow, and that if the plate could be developed at a low temperature it would show no effect, the photographic action taking place subsequently through an internal phosphorescence in the film during the time it is heating up. With regard to the transparency of bodies to the Röntgen radiation at low temperatures, small tubes of the same bore, filled with liquid argon and chlorine, potassium, phosphorus, aluminium, silicon, and sulphur, were exposed at the temperature of liquid air (in order to keep the argon and chlorine solid), in front of a photographic plate shielded with a sheet of aluminium, to an X-ray bulb. The sequence of the elements as mentioned represents the order of increasing opacity observed in the shadows. Sodium and liquid oxygen and air, nitrous and nitric oxides, proved much more transparent than chlorine. Tubes of potassium, argon, and liquid chlorine showed no very marked difference of density on the photographic plates. It appears that argon is relatively more opaque to the Röntgen radiation than either oxygen, nitrogen, or sodium, and is on a level with potassium, chlorine, phosphorus, aluminium, and sulphur. This fact may be regarded as supporting the view that the atomic weight of argon is twice its density relative to hydrogen, since in general the opacity of elements in the solid state increases with the atomic weight.

Phosphorescence.—Phosphorescing sulphides of calcium, which are luminous at ordinary temperatures, and whose emission of light is increased by heating, cease to be luminous if cooled to − 80° C. But their light energy is merely rendered latent, not destroyed, by such cold, and they still retain the capacity of taking in light energy at the low temperature, to be evolved again when they are warmed. At the temperature of liquid air many bodies become phosphorescent which do not exhibit the phenomenon at all, or only to a very slight extent, at ordinary temperatures, *e.g.*, ivory, indiarubber, egg-shells, feathers, cotton-wool, paper, milk, gelatine, white of egg, &c. Of definite chemical compounds, the platinocyanides among the inorganic bodies seem to yield the most brilliant effects. Crystals of ammonium platinocyanide, if stimulated by exposure to the ultra-violet radiation of the electric arc, while kept moistened with liquid air, may be seen in the dark to glow faintly so long as they are kept cold, but become exceedingly brilliant when the liquid air evaporates and the temperature rises. Among organic bodies the phenomenon is particularly well marked with the ketonic compounds and others of the same type. The chloro-, bromo-, iodo-, sulpho-, and nitro-compounds show very little effect as a rule. The activity of the alcohols, which is usually considerable, is destroyed by the addition of a little iodine. Coloured salts, &c., are mostly inferior in activity to white ones. When the lower temperature of liquid hydrogen is employed there is a great increase in phosphorescence under light stimulation as compared with that observed with liquid air. The radioactive bodies, like radium, which exhibit self-luminosity in the dark, maintain that luminosity unimpaired when cooled in liquid hydrogen.

Some crystals become for a time self-luminous when placed in liquid hydrogen, because the high electric stimulation due to the cooling causes actual electric discharges between the crystal molecules. This phenomenon is very pronounced with nitrate of uranium and some platinocyanides, and cooling such crystals even to the temperature of liquid air is sufficient to develop marked electrical and luminous effects, which are again observed, when the crystal is taken out of the liquid, during its return to normal temperature. Since both liquid hydrogen and liquid air are good electrical insulators, the fact that electric discharges take place in them proves that the electric potential generated by the cooling must be very high. A crystal of nitrate of uranium indeed gets so highly charged electrically that it refuses to sink in liquid air, although its density is 2·8 times greater, but sticks to the side of the vacuum vessel, and requires for its displacement a distinct pull on the silk thread to which it is attached. Such a crystal quickly removes cloudiness from liquid air by attracting all the suspended particles to its surface, just as a fog is cleared out of air by electrification. It is interesting to observe that neither fused nitrate of uranium nor its solution in absolute alcohol shows any of the remarkable effects of the crystalline state on cooling.

Cohesion.—The physical force known as cohesion is greatly increased by low temperatures. This fact is of much interest in connexion with two conflicting theories of matter. Lord Kelvin's view is that the forces that hold together the ultimate particles of bodies may be accounted for without assuming any other forces than that of gravitation, or any other law than the Newtonian. An opposite view is that the phenomena of cohesion, chemical union, &c., or the general phenomena of the aggregation of molecules, depend on the molecular vibrations as a physical cause (Tolver Preston, *Physics of the Ether*, p. 64). Hence at the zero of absolute temperature, this vibrating energy being in complete abeyance, the phenomena of cohesion should cease to exist and matter generally be reduced to an incoherent heap of "cosmic dust." This second view receives no support from experiment. Atmospheric air, for instance, frozen at the temperature of liquid hydrogen, is a hard solid, the strength of which gives no hint that with a further cooling of some 20 degrees it would crumble into powder. On the contrary, the lower the scale of temperature is descended, the more powerful become the forces which hold together the particles of matter. A spiral of fusible metal, which at ordinary temperatures cannot support the weight of an ounce without being straightened out, will, when cooled to the temperature of liquid oxygen, and so long as it remains in that cooled condition, support several pounds and vibrate like a steel spring. Similarly a bell of fusible metal at − 182° C. gives a distinct metallic ring when struck. Balls of iron, lead, tin, ivory, &c., thus cooled, exhibit an increased rebound when dropped from a height; an indiarubber ball, on the other hand, becomes brittle, and is smashed to atoms by a very moderate fall. The following tables, which give the mean results of a large number of experiments, show the increased breaking stress gained by metals while they are cooled to the temperature of liquid oxygen.

TABLE III.

Breaking stress in pounds of metallic wires 0·098 inch in diameter :—

	+ 15° C.	− 182° C.
Steel (soft)	420	700
Iron	320	670
Copper	200	300
Brass	310	440
German silver	470	600
Gold	255	340
Silver	330	420

TABLE IV.

Breaking stress in pounds of cast metallic test-pieces ; diameter of rod —0·2 inch.

	+ 15° C.	− 182° C.
Tin	200	390
Lead	77	170
Zinc	35	26
Mercury	0	31
Bismuth	60	30
Antimony	61	30
Solder	300	645
Fusible metal (Wood)	140	450

In the second series of experiments the test-pieces were 2 inches long and were all cast in the same mould. It will be noticed that in the cases of zinc, bismuth, and antimony the results appear to be abnormal, but it may be pointed out that it is difficult to get uniform castings of crystalline bodies, and it is probable that by cooling such stresses are set up in some set of cleavage planes as to render rupture comparatively easy. In the case of strong steel springs the rigidity modulus does not appear to be greatly affected by cold, for although a number were examined, no measurable differences could be detected in their elongation under repeated additions of the same load. No quantitative experiments have been made on the cohesive properties of the metals at the temperature of boiling hydrogen (− 252°), owing to the serious cost that would be involved. A lead wire cooled in liquid hydrogen did not become brittle, as it could be bent backwards and forwards in the liquid.

Electrical Resistivity.—The first experiments on the conductivity of metals at low temperatures appear to have been made by Wroblewski (*Comptes Rendus*, vol. ci. p. 160), and by Cailletet and Bouty (*Journ. de Phys.* 1885, p. 297). The former's experiments were undertaken to test the suggestion made by Clausius that the resistivity of pure metals is sensibly proportional to the absolute temperature; he worked with copper having a conductibility of 98 per cent., and carried out measurements at various temperatures, the lowest of which was that given by liquid nitrogen boiling under reduced pressure. His general conclusion was that the resistivity decreases much more quickly than the absolute temperature, so as to approach zero at a point not far below the temperature of nitrogen evaporating *in vacuo.* Cailletet and Bouty, using ethylene as the refrigerant, and experimenting at temperatures ranging from 0° C. to −100° C. and −123° C., constructed formulæ intended to give the coefficients of variation in electrical resistance for mercury, tin, silver, magnesium, aluminium, copper, iron, and platinum. Between 1892 and 1896 Dewar and Fleming carried out a large number of experiments to ascertain the changes of conductivity that occur in metals and alloys cooled in liquid air or oxygen to −200° C. The method employed was to obtain the material under investigation in the form of a fine regular wire and to wind it in a small coil; this was then plunged in the liquid and its resistance determined. The accompanying chart (Fig. 8) gives the results in a compendious form, the temperatures being expressed not in degrees of the ordinary air-thermometer scale, but in platinum degrees as given by one particular platinum resistance thermometer which was used throughout the investigation. A table showing the value of these degrees in degrees centigrade according to Dickson will be found in the *Phil. Mag.* for June 1898, p. 527; to give some idea of the relationship, it may be stated here that −100° of the platinum thermometer = −94°·2 C., −150° plat. = −140°·78 C., and −200° plat. = −185°·53 C. In general, the resistance of perfectly pure metals was greatly decreased by cold—so much so that, to judge by the course of the curves on the chart, it appeared probable that at the zero of absolute temperature resistance would vanish altogether and all pure metals become perfect conductors of electricity. This conclusion, however, has been rendered very doubtful by subsequent observations by Dewar, who found that with the still lower temperatures attainable with liquid hydrogen the increases of conductivity became less for each decrease of temperature, until a point was reached where the curves bent sharply round and any further diminution of resistance became very small; that is, the conductivity remained finite. The reduction in resistance of some of the metals at the boiling point of hydrogen is very remarkable. Thus copper has only $\frac{1}{105}$th, gold $\frac{1}{30}$th, platinum $\frac{1}{35}$th to $\frac{1}{17}$th, silver $\frac{1}{24}$th the resistance at melting ice, but iron is only reduced to $\frac{1}{8}$th part of the same initial resistance. Table V. shows the progressive decrease of resistance for certain metals and one alloy as the temperature is lowered from that of boiling water down to that of liquid hydrogen boiling under reduced pressure; it also gives the "vanishing temperature," at which the conductivity would become perfect if the resistance continued to decrease in the same ratio with still lower temperatures, the values being derived from the extrapolation curves of the relation between resistance and temperature, according to Callendar and Dickson. It will be seen that many of the substances have actually been cooled to a lower temperature than that at which their resistance ought to vanish.

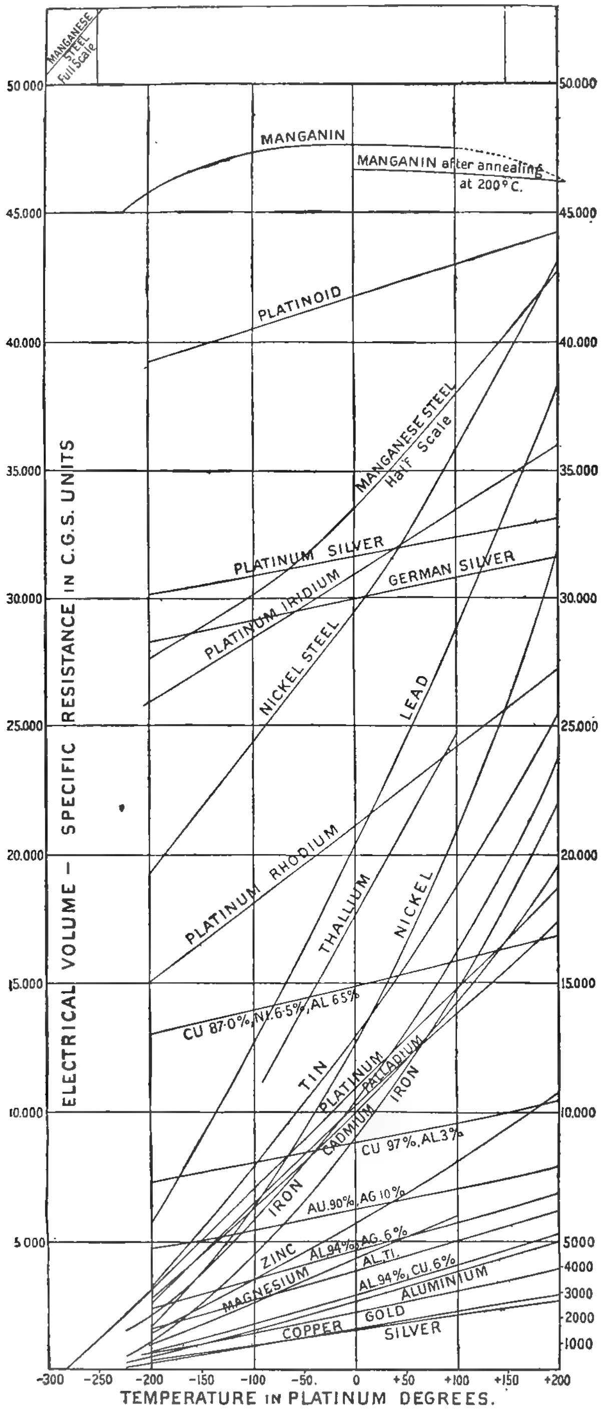


Fig. 8.—Chart of the Variation of Electrical Resistance of Pure Metals and Alloys with Temperature. (Dewar and Fleming.)

In the case of alloys and impure metals, cold brings about a much smaller decrease in resistivity, and the continuations of the curves at no time show any sign of passing through the zero point. The influence of the presence of impurities in minute quantities is strikingly shown in the case of bismuth. Various specimens of this metal, prepared with great care by purely chemical methods, gave in the hands of Dewar and Fleming some very anomalous results, appearing to reach at −80° C. a maximum of conductivity, and thereafter to increase in resistivity with decrease of temperature. But when the determinations were carried out on a sample of really pure bismuth prepared electrolytically, a normal curve was obtained corresponding to that given by other pure metals. As to alloys, there is usually some definite mixture of two pure metals which has a maximum resistivity, often greater than that of either of the constituents. It appears too that high, if not the highest, resistivity corresponds to possible chemical compounds of the two metals employed, *e.g.*, platinum 33 parts with silver 66 parts = $PtAg_4$; iron 80 with nickel 20 = Fe_4Ni; platinum 80 with iridium 20 = $IrPt_4$; and copper 70 with manganese 30 = Cu_2Mn. The product obtained by adding a small quantity of one metal to another has a higher specific resistance than the predominant constituent, but the curve is parallel to, and therefore the same in shape as, that of the latter (cf. the curves for various mixtures of Al and Cu on the chart). The behaviour of carbon and of insulators like guttapercha, glass, ebonite, &c., is in complete contrast to the metals, for their resistivity steadily increases with cold. The thermoelectric properties of metals at low temperatures are discussed in the article THERMOELECTRICITY.

TABLE V.

Metals.	Platinum.	Platinum-rhodium Alloy.	Gold.	Silver.	Copper.	Iron.
Resistance at 100° C.	39·655	36·87	16·10	8·336	11·572	4·290
,, 0° C.	28·851	31·93	11·58	5·990	8·117	2·765
,, carbonic acid	19·620					
,, liquid oxygen	7·662	22·17	3·380	1·669	1·589	0·633
,, ,, nitrogen	...	...	...	...	1·149	
,, ,, oxygen under exhaustion	4·634	20·73				
,, ,, hydrogen	0·826	18·96	0·381	0·244	0·077	0·356
,, ,, hydrogen under exhaustion	0·705	18·90	0·298	0·226	0·071	
Resistance coefficients	0·003745	0·003607	0·003903	0·003917	0·004257	0·005515
Vanishing temperatures (centigrade)	– 244°·50 – 244°·15	– 543°·39 – 530°·32	– 257°·90 – 257°·8	– 252°·26 – 252°·25	– 225°·62 – 226°·04	– 258°·40 C. – 246°·80 D.

Magnetic Phenomena.—Low temperatures have very marked effects upon the magnetic properties of various substances. Oxygen, long known to be slightly magnetic in the gaseous state, is powerfully attracted in the liquid condition by a magnet, and the same is true, though to a less extent, of liquid air, owing to the proportion of liquid oxygen it contains. A magnet of ordinary carbon steel has its magnetic moment temporarily increased by cooling, that is, after it has been brought to a permanent magnetic condition ("aged"). The effect of the first immersion of such a magnet in liquid air is a large diminution in its magnetic moment, which decreases still further when it is allowed to warm up to ordinary temperatures. A second cooling, however, increases the magnetic moment, which is again decreased by warming, and after a few repetitions of this cycle of cooling and heating the steel is brought into a condition such that its magnetic moment at the temperature of liquid air is greater by a constant percentage than it is at the ordinary temperature of the air. The increase of magnetic moment seems then to have reached a limit, because on further cooling to the temperature of liquid hydrogen hardly any further increase is observed. The percentage differs with the composition of the steel and with its physical condition. It is greater, for example, with a specimen tempered very soft than it is with another specimen of the same steel tempered glass hard. Aluminium steels show the same kind of phenomena as carbon ones, and the same may be said of chrome steels in the permanent condition, though the effect of the first cooling with them is a slight increase of magnetic moment. Nickel steels present some curious phenomena. When containing small percentages of nickel (*e.g.*, 0·84 or 3·82), they behave under changes of temperature much like carbon steel. With a sample containing 7·65 per cent., the phenomena after the permanent state had been reached were similar, but the first cooling produced a slight increase in magnetic moment. But steels containing 18·64 and 29 per cent. of nickel behaved very differently. The result of the first cooling was a reduction of the magnetic moment, to the extent of nearly 50 per cent. in the case of the former. Warming again brought about an increase, and the final condition was that at the temperature of liquid air the magnetic moment was always less than at ordinary temperatures. This anomaly is all the more remarkable in that the behaviour of pure nickel is normal, as also appears to be generally the case with soft and hard iron. Silicon, tungsten, and manganese steels are also substantially normal in their behaviour, although there are considerable differences in the magnitudes of the variations they display (*Proc. Roy. Soc.* vol. lx. pp. 57 *et seq.*).

Low temperatures also affect the permeability of iron, *i.e.*, the degree of magnetization it is capable of acquiring under the influence of a certain magnetic force. With fine Swedish iron, carefully annealed, the permeability is slightly reduced by cooling to – 185° C. Hard iron, however, in the same circumstances suffers a large increase of permeability. Unhardened steel pianoforte wire, again, behaves like soft annealed iron. As to hysteresis, low temperatures appear to produce no appreciable effect in soft iron; for hard iron the observations are undecisive.

Biological Research.—The effect of cold upon the life of living organisms is a matter of great intrinsic interest as well as of wide theoretical importance. Experiment indicates that moderately high temperatures are much more fatal, at least to the lower forms of life, than are exceedingly low ones. Professor M'Kendrick froze for an hour at a temperature of – 182° C. samples of meat, milk, &c., in sealed tubes; when these were opened, after being kept at blood-heat for a few days, their contents were found to be quite putrid. More recently some more elaborate tests were carried out at the Jenner Institute of Preventive Medicine on a series of typical bacteria. These were exposed to the temperature of liquid air for twenty hours, but their vitality was not affected, their functional activities remained unimpaired, and the cultures which they yielded were normal in every respect. The same result was obtained when liquid hydrogen was substituted for air. A similar persistence of life has been demonstrated in seeds, even at the lowest temperatures; they were frozen for over 100 hours in liquid air at the instance of Messrs Brown and Escombe, with no other effect than to afflict their protoplasm with a certain inertness, from which it recovered with warmth. Subsequently commercial samples of barley, peas, and vegetable-marrow and mustard seeds were literally steeped for six hours in liquid hydrogen at the Royal Institution, yet when they were sown by Sir W. T. Thiselton Dyer at Kew in the ordinary way, the proportion in which germination occurred was no smaller than with other batches of the same seeds which had suffered no abnormal treatment. Mr. Harold Swithinbank has found that exposure to liquid air has little or no effect on the vitality of the tubercle bacillus, although by very prolonged exposures its virulence is modified to some extent; but alternate exposures to normal and very cold temperatures do have a decided effect both upon its vitality and its virulence. The suggestion once put forward by Lord Kelvin, that life may in the first instance have been conveyed to this planet on a meteorite, has been objected to on the ground that any living organism would have been killed before reaching the earth by its passage through the intense cold of interstellar space; the above experiments on the resistance to cold offered by seeds and bacteria show that this objection at least is not fatal to Lord Kelvin's idea.

At the Jenner Institute of Preventive Medicine liquid air has been brought into use as an agent in biological research. An inquiry into the intracellular constituents of the typhoid bacillus, initiated under the direction of Dr Allan Macfadyen, necessitated the separation of the cell-plasma of the organism. The method at first adopted for the disintegration of the bacteria was to mix them with silver-sand and churn the whole up in a closed vessel in which a series of horizontal vanes revolved at a high speed. But certain disadvantages attached to this procedure, and accordingly some means were sought to do away with the sand and triturate the bacilli *per se*. This was found in liquid air, which, as had long before been shown at the Royal Institution, has the power of reducing materials like grass or the leaves of plants to such a state of brittleness that they can easily be powdered in a mortar. By its aid a complete trituration of the typhoid bacilli has been accomplished at the Jenner Institute, and the same process, already applied with success also to yeast cells and animal cells, is being extended in other directions.

Industrial Applications.—While liquid air and liquid hydrogen are being used in scientific research to an extent which increases every day, but few applications to industrial purposes can as yet be reported. The temperatures they give used as simple refrigerants are much lower than are generally required industrially, and such cooling as is needed can be obtained quite satisfactorily, and far more cheaply, by refrigerating machinery employing more easily condensible gases. Their use as a source of motive power, again, is impracticable for any ordinary purposes, on the score of inconvenience and expense. Cases may be conceived of in which for special reasons it might prove advantageous to use liquid air, vaporized by heat derived from the surrounding atmosphere, to drive compressed-air engines, but any advantage so gained would certainly not be one of cheapness. No doubt the power of a waterfall running to waste might be temporarily conserved in the shape of liquid air, and thereby turned to useful effect. But the reduction of air to the liquid state is a process which involves the expenditure of a very large amount of energy, and it is not possible even to recover all that expended energy during the transition of the material back to the gaseous state. Hence to suggest that by using liquid air in a motor more power can be developed than was expended in producing the liquid air by which the motor is worked, is to propound a fallacy worse than perpetual motion, since such a process would have an efficiency of more than 100 per cent. Still, in conditions where economy is of no account, liquid air might perhaps, with effectively isolated storage, be utilized as a motive power, *e.g.*, to drive the engines of submarine boats and at the same time provide a supply of oxygen for the crew; even without being used in the engines, liquid air or oxygen might be found a convenient form in which to store the air necessary for respiration in such vessels. A use to which liquid air machines have already been put to a limited extent is for obtaining oxygen from the atmosphere. Although when air is liquefied the oxygen and nitrogen are condensed simultaneously, yet owing to its greater volatility the latter boils off the more quickly of the two, so that the remaining liquid becomes gradually richer and richer in oxygen. The production of such highly oxygenated air was the object Linde had in view in constructing his liquid air machines, and it would find important applications in metallurgical and other operations, if only it could be produced at a sufficiently low cost. Pictet also has patented an apparatus designed to attain the same end, but no account of the practical results has appeared. Mention may be made of one interesting though minor application of this denitrogenized air, which is substantially liquid oxygen. If it be mixed with powdered charcoal, or finely divided organic bodies, it forms a liquid oxygen sponge which can be made by the aid of a detonator to explode with a violence comparable to that of dynamite. This explosive, which might properly be called an emergency one, has the disadvantage that it must be prepared on the spot where it is to be used and must be fired without delay, since the liquid evaporates in a short time and the explosive power is lost; but, on the other hand, if a charge fails to go off it has only to be left a few minutes, when it can be withdrawn without any danger of accidental explosion. Satisfactory results are claimed for experiments carried out with this substance in a coal mine at Pensberg, near Munich, and it has been used in the Simplon Tunnel works between Brigue and Domo d'Ossola.

For further information the reader may consult Hardin, *Rise and Development of the Liquefaction of Gases* (New York, 1899), and Lefèvre, *La liquefaction des gaz et ses applications;* also the article Condensation of Gases in these volumes. But the literature of liquid gases is mostly contained in scientific periodicals and the proceedings of learned societies. Papers by Wroblewski and Olszewski on the liquefaction of oxygen and nitrogen may be found in the *Comptes Rendus*, vols. xcvi.–cii., and there are important memoirs by the former on the relations between the gaseous and liquid states and on the compressibility of hydrogen in *Wien. Akad. Sitzber.* vols. xciv. and xcvii.; his pamphlet *Comme l'air a été liquefié* (Paris, 1885) should also be referred to. For Dewar's work, see *Proc. Roy. Inst.* from 1878 onwards, including "Solid Hydrogen," 1900; also "The Nadir of Temperature and Allied Problems" (Bakerian Lecture), *Proc. Roy. Soc.*, 1901. The researches of Fleming and Dewar on the electrical and magnetic properties of substances at low temperatures are described in *Proc. Roy. Soc.* vol. lx., and *Proc. Roy. Inst.*, 1896; see also "Electrical Resistance of Pure Metals, Alloys, and Non-Metals at the Boiling-Point of Oxygen," *Phil. Mag.* vol. xxxiv. (1892); "Electrical Resistance of Metals and Alloys at Temperatures approaching the Absolute Zero," *ib.* vol. xxxvi. (1893); "Thermo-electric Powers of Metals and Alloys between the Temperatures of the Boiling-Point of Water and the Boiling-Point of Liquid Air," *ib.* vol. xl., 1895; and papers on the dielectric constants of various substances at low temperatures in *Proc. Roy. Soc.* vols. lxi. and lxii. Optical and spectroscopic work by Liveing and Dewar on liquid gases is described in *Phil. Mag.* vols. xxxiv. (1892), xxxvi. (1893), xxxviii. (1894), and xl. (1895); for papers by the same authors on the separation and spectroscopic examination of the most volatile and least volatile constituents of atmospheric air, see *Proc. Roy. Soc.* vols. lxiv., lxvii., and lxviii. An account of the influence of very low temperatures on the germinative power of seeds is given by Brown and Escombe in *Proc. Roy. Soc.* vol. lxii., and by Thiselton Dyer, *ib.* vol. lxv., and their effect on bacteria is discussed by Macfadyen, *ib.* vol. lxvi.

(J. Dr.)

Liquor Laws.—No period in history has been so fruitful in progressive liquor legislation as the decades since about 1880. The laws enacted, as well as the proposed legislation agitated before nearly every civilized government, reflect both a growing public consciousness of the evils of the drink traffic and determined efforts to overcome them. The modern tendency is to combat these evils by restrictive measures rather than by attempting a general suppression of the sale of intoxicants, and to give the local community the right to choose between licence and the prohibition of the traffic, instead of applying prohibitory laws to entire states or countries. The liquor laws meriting special attention may be referred to three categories: I. the group of wholly new departures in the form of private or state monopolies; II. local option laws; and III. the various groups of licence laws.

Private and state monopolies.

I. The Scandinavian experiments, commonly designated as *the Gothenburg System*, the most widely known of modern liquor laws, afford a remarkable illustration of the power of wise national legislation combined with national temperance efforts to reduce the consumption of liquor. Although the original Gothenburg plan dates from 1865, it was not generally introduced throughout Sweden until 1880; the Norwegian adoption of it followed some time later. In both countries the central principle of the system is the elimination of private profit from the drink traffic by granting a monopoly of the retail sale of spirits to local corporations, under restrictions which prevent it from becoming a source of private enrichment, and which generally safeguard public interests both from the temperance and pecuniary point of view. In Norway especially the law of 1894, which expresses the advanced temperance opinion of the country, has enhanced the usefulness of the liquor corporations (*samlag*) and minimized the danger of abuses in administration. The non-inclusion of malt beverages and wine under the monopoly is perhaps the most serious obstacle to the success of the system as a means of combating intemperance. Nevertheless it is mainly due to the monopoly that the annual consumption of spirits in Sweden has been reduced to a third of what it was in 1850, and in Norway to a third of what it was in 1876. The Gothenburg plan has been followed in Finland, and has been experimented with by private associations in Great Britain.

The Government spirit monopoly in Russia owes its inception to Emperor Alexander III. It was, however, not introduced until January 1895, and then experimentally in four of the eastern provinces. The law became applicable to the entire empire in 1896, and is operative in about forty provinces with a total population of about seventy-five millions. The introduction of the monopoly, which was hastened by the famine of 1891 and the lamentable conditions it revealed, was not, it has been officially declared, for the purpose of increasing the drink revenue, but in order (1) "to save the peasantry from ruin" by protecting it from exploitation by persons licensed to sell spirits, and (2) to diminish drunkenness. Under the monopoly, which controls only the sale of spirituous liquors, spirits are retailed at the shops and depôts of the Government and at *traktirs* (establishments supplying both food and drink), restaurants and private resorts which sell on a Government commission. Except at a few restaurants of the highest class in cities and at railway stations, spirits are sold only in sealed bottles for consumption off the premises. In 1898 the Government licensed 357 wholesale and 17,240 retail shops. A sweeping reduction of places where liquor may be sold has everywhere followed the introduction of the monopoly. In several provinces the Government has endeavoured to establish tea-houses as counter-attractions to the grog-shops, by granting small subsidies to be expended by local temperance committees. In an address to the Emperor, under date of January 1899, the Russian minister of finance, having referred to the fact that as the people become accustomed to the new régime the consumption of spirits, which at first diminished, is reverting to the former figures, nevertheless continues: "The reports addressed to your majesty by the governors of the provinces where the new system is in force, and the accounts communicated to the minister of finance by the highest ecclesiastical authorities, by the officials of the nobility, by the zemstvos, and by the municipalities, are almost unanimous in bearing evidence to the salutary effects of the reform. . . . Drunkenness has perceptibly diminished." The revenue from the system is much larger than was anticipated, the net profit in 1898 being about £3,000,000.

The *Dispensary System*, which is peculiar to the United States, takes either the form of a State monopoly of the retail traffic in alcoholic liquors, as in South Carolina, or the form of a local monopoly, as in North Carolina, Georgia, and Alabama, where the local communities can adopt the system or not, as they may determine. Under both forms the retail rate of alcoholic drink is taken out of private hands and carried on in dispensaries. In South Carolina, under an Act of 1892, variously amended from time to time, the state monopoly is managed by a state board of control of five members elected by the General Assembly: it appoints the county boards of control as well as a state commissioner, from whom all liquors sold by the local dispensers must be purchased. Liquors may only be sold for cash, between sunrise and sundown, in sealed packages containing not less than one half-pint or more than five gallons. Similar restrictions apply to the sale of malt beverages. The state virtually controls the distillation of spirits within its borders. The monopoly has a twofold aim: (1) to reduce the evil of the drink traffic by taking it out of private hands, and (2) to retain the entire profit for state and municipal purposes. Determined hostility to the system, mismanagement of its affairs, and adverse court decisions with regard to its constitutionality, have at different times come perilously near wrecking the monopoly. Now that the Dispensary Act has been upheld by the United States Supreme Court, the permanency of the system seems fairly well assured. Whatever the difference of opinion may be concerning the effect of the system on the consumption of spirits and public intoxication, it undoubtedly possesses some advantages of great merit which are more or less incident to any system that eliminates from the traffic the element of private profits. It has effected numerous administrative reforms of far-reaching consequence; it has abolished the saloon with its many dangerous accessories, and with it the domination of whisky rings in politics has become a thing of the past. A wise adjustment of the relation of the state to the local community is difficult under the South Carolina system, as under any state monopoly. As a revenue producer the system has not fulfilled expectations.

The Swiss *Alcohol Monopoly* of 1897 controls the importation, manufacture, and wholesale distribution of spirits in quantities of not less than 40 litres. The sale of liquor in smaller quantities is not regulated by the monopoly, but is subject to taxes imposed by the various cantons. In general the taxes are about three times higher than before 1887. The monopoly has suppressed the evil of the many small stills in agricultural districts, whose product, owing to primitive methods of manufacture and lack of rectification, found no market, but was consumed where produced, and caused much drunkenness. By abolishing cantonal and communal duties on beer and wine, as well as by removing other restrictions on their sale in quantities of more than two litres, the Government has carried out its policy of supplanting the use of spirits by that of fermented beverages. In consequence, a notable increase has taken place in the consumption of beer, while the consumption of spirits has decreased about 25 per cent. The law requires that one-tenth of the revenue from the monopoly shall be applied to counteract alcoholism.

Local option laws.

II. The principal of local option, or the right of the local community to forbid the sale of liquor within its own borders, has gained wide recognition and sanction, particularly in the United States, where it may be said to have become the alternative system to state prohibition and is supplanting the latter in popular favour. The right of choice between licence and local prohibition does not, however, imply an exercise of this right. All states with local option have some form of licence, the right to prohibit the traffic being exercised only in certain localities, even if applicable to all. In seventeen states local option is by direct popular vote applicable to all localities, both urban and rural; in six states by direct popular vote applicable to certain localities, or rural districts only; nine states have indirect local option, *i.e.*, through discretionary powers vested in city councils and other elective bodies; and in five states the right to vote is by "remonstrance," and by requiring the consent of qualified electors, property-holders, &c. Within the particular areas to which it has been applied, local option has, on the whole, been a success. It has banished the liquor traffic from immense areas. Moreover, the enforcement of the popular will as expressed in the vote has generally been free from the demoralizing effects attending attempts to suppress the traffic in cities under state prohibition. The value of local prohibition in populous centres, except where they have a safety valve through adjoining towns under licence, remains to be demonstrated.

In the Dominion of Canada, under the so-called Scott Act of 1878, which is a Federal law, counties and cities can by a majority vote prohibit the retail sale of liquor within their boundaries. Several provincial laws also recognize the principle of local option, but can only be taken advantage of by localities that have refused to adopt the prohibitory clauses of the Scott Act. Under provincial legislation, local option is usually exercised through discretionary powers vested in the licensing authorities. Local prohibition is successfully enforced throughout wide rural districts of the Dominion.

In Norway local vote on the retail traffic in spirits has been exercised in rural districts since 1845. By the law of 1894, however, which requires all retail trade in spirits to be placed under the monopolies (*samlag*), the establishment of a new *samlag*, or even the continuance of an old one, is made dependent upon a general vote of all residents in the district, both men and women, over twenty-five years of age; and the decision is binding for five years. All rural districts and about one-half of the towns are now under local prohibition. Practically the whole of rural Sweden is under local prohibition by virtue of a law of 1855.

New Zealand and Queensland are the two Australasian colonies granting full powers of local option, but little advantage has been taken of the privilege. Limited option prevails in the other colonies, with the exception of Tasmania. There are, of course, numerous examples in other parts of the world of the more or less successful adoption of local prohibition, but not as the result of expressed popular will.

Licensing laws.

III. Outside the United States and Canada, there have been few innovations in licensing methods or elaborations of licence systems deserving mention. In the United States the scheme known as the high-licence has claimed great attention; it was first introduced in Nebraska in 1881. In general, high-licence systems may be said to have two objects: (1) to reduce the volume of the traffic and place it under better control by charging high fees, (2) to divorce the trade as much as possible from politics by selecting the proper licensing authorities. Massachusetts (law of 1888), Pennsylvania (law of 1888), and New York (Liquor Tax Law of 1896) furnish the most conspicuous examples of the working of high-licence. The Massachusetts law combines a very high fee (not less than $1000 for a licence to sell for consumption on the premises) with statutory limitation of the number of licensed places according to population (1 to 1000 inhabitants in all places outside Boston, where the ratio is 1 to 500 inhabitants). Licences are usually issued by special commissioners. In Pennsylvania all licences are granted by the Court of Quarter Sessions in such number as it may deem necessary, with full powers to revoke any or all at the end of twelve months. The New York law centralizes the control of the excise business in a "State Commissioner of Excise," who issues tax receipts in place of the old-time licences, which are practically obtainable by all who can pay for them and are willing to conform to certain regulations. Under high-licence the restrictive measures and regulations are usually numerous and elaborate, with severe penalties for infraction. In the Canadian provinces it is sought to hold the liquor traffic in check not so much by the high-licence fees as by statutory limitations, and by requiring the applicant to obtain the consent of a majority, or even two-thirds, of the qualified voters of the electoral district in which he wishes to sell liquor. Especially drastic are the laws of Ontario and Nova Scotia, in respect both of the requirements before a licence can be issued and the regulations governing sales. Under any form of licence it has been found impossible to divorce drink-selling from politics. High-licence systems particularly give the communities too large a pecuniary interest in the traffic; and since he is obliged to pay a very high fee, the interest of the ordinary dealer in pushing sales is intensified. (See also under Social Progress.)

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Liria, a town of Spain, in the province of Valencia, on the left bank of the river Guadalaviar, 15 miles north-west of Valencia. It is situated in a fertile plain which produces much wheat, wine, olives, and esparto grass.

There are several fine squares, and some ruins of an older city. The town hall and hospital are handsome structures. The parish church contains the family tombs of the dukes of Berwick and Liria. Population (1897), 8617.

Lisbon, the capital of the kingdom of Portugal, on the right bank of the Tagus, 10 miles above its mouth. Owing to the extreme irregularity of its surface, funicular railways and lifts are much used for communicating between the upper and lower parts of the city. Amongst the improvements of the last twenty years of the 19th century is the fine promenade, the Avenue of Liberty, with a monument of the deliverance from the yoke of Spain in 1640. Modern buildings include the central penitentiary, the new water-works, the central railway station, the medical school, and the "Figueira" market. The most notable of the museums are the colonial museum and the artillery museum. The city also possesses zoological gardens and an aquarium. One of the chief charms of Lisbon is the number of its public gardens, planted with tropical plants; and the Polytechnic School has a good botanical garden. The leading learned and scientific societies are the Society of Medical Sciences, the Geographical Society, the Academy of Sciences, the Association of Civil Engineers, the Academy of Fine Arts, the Artists' Union, the Royal Society of the Lovers of Music, the Royal Conservatory of Music, and the Commercial Athenæum. The educational institutions include the medico-surgical school, polytechnic school, military and naval schools, commercial, agricultural, and industrial institutes, trades' schools, school of the fine arts, a central lyceum, normal school, &c. There are hospitals for women, for contagious diseases, and a quarantine establishment. Lisbon is the seat of a commercial tribunal, and of the cardinal-patriarch of Lisbon. The port, which includes the out-ports of Nazareth and Setubal, was in 1897 entered and cleared by an aggregate of 5926 vessels of 7,087,815 tons. In 1899 the total aggregate of vessels was 5233 of 6,861,142 tons in Lisbon itself. In 1898 it had a fishing fleet of 593 vessels, manned by 2405 men, who took fish to the value of £115,780. The chief branches of industry carried on are the manufacture of pottery (21 factories), woollens, linens, cottons, and silks (36 factories), soap (13), chemicals (7), paper (5), alimentary pastes (12), glass (2), and factories for preserved foods, fruit, and fish, tobacco, phosphorus, &c. The growth of the population is shown in the following table:—

	Extent in acres.	Population, 1878.	Population, 1890.	Population, 1900.
Former area .	2,938	187,404	240,712	...
Present ,,	11,152	242,297	301,206	357,000

The district of Lisbon has an area of 16,900 square miles, and population 611,160 (1890), and 708,750 (1900), showing 42 inhabitants to the square mile. Wine is the most important product, the vintages including the wines of Collares, Torres, Bucellas, Lavradio, Carcavellos, and Setubal. In 1892 the vineyards covered 55,100 acres, and yielded 8,621,000 gallons of wine, valued at £449,350. In 1898 the wine production reached 31,751,799 gallons. Wheat and millet, olive oil, fruits, vegetables, and cattle are the other chief products. Mineral waters are plentiful (see Estremadura). In addition to the industries of the city, there are in the district factories for biscuits, sardines, porcelain, dyeing, cottons, woollens, linen, and jute, cement, and corks. (E. de V.)

Lisburn, a town, and urban sanitary district, in the province of Ulster, Ireland, on the river Lagan, 8 miles south-south-west of Belfast by rail. It ceased to be a parliamentary borough in 1885, and in 1898 the portion situated in Down was added to Antrim. Sir Richard Wallace presented a people's park to the town. Population (1881), 10,834; (1901), 11,459.

Liskeard, a municipal borough, market town, and railway station, in the Bodmin parliamentary division (since 1885) of Cornwall, England, 18 miles west-north-west of Plymouth. St Martin's church has been restored. A cottage hospital and public buildings (containing a literary institute and a school of art) and a public library have been erected. The Caradon copper mines are no longer worked. There are a woollen mill and a foundry. Area, 2704 acres. Population (1881), 4536; (1901), 4011.

Lissa, an Austrian island in the Adriatic, belonging to the province of Dalmatia. Population (1890), 8674; (1900), 9918. The chief town, of the same name, has a population of 5261. Its harbour is strongly fortified. Comisa, on the west side, in a deep bay, is also a steamship station. Population, 4657.

Lister, Joseph Lister, 1st Baron (1827- ——), English surgeon, was born at Upton, in Essex, on the 5th of April 1827. His father, Joseph Jackson Lister, F.R.S., was eminent in science, especially in optical science, his chief claim to remembrance being that by certain improvements in lenses he raised the compound microscope from the position of a scientific toy, "distorting as much as it magnified," to its present place as a powerful engine of research. Other members of Lord Lister's family were eminent in natural science. In his boyhood Joseph Lister was educated at Quaker schools; first at Hitchin in Hertfordshire, and afterwards at Tottenham, near London. In the year 1844 he entered University College, London, as a student in arts, and took his B.A. degree at the University of London in 1847. He continued at University College as a medical student, and became M.B. and F.R.C.S. in 1852. Lister had a natural bent to science, which brought him into intimate association with some of the ablest men of the staff of his teachers, among whom, at this period of his life, Graham, Sharpey, and Wharton Jones may be specially mentioned. The keen young student was not long in bringing his faculties to bear upon pathology and the practice of medicine. While house-surgeon at University College Hospital, he had charge of certain cases during an outbreak of hospital gangrene, and carefully observed the phenomena of the disease and the effects of treatment upon it. He was thus early led to suspect the parasitic nature of the disorder, and searched with the microscope the material of the spreading sore, in the hope of discovering in it some invading fungus; he soon convinced himself of the cardinal truth that its causes were purely local. He also minutely investigated cases of pyæmia, another terrible scourge of hospitals at that time, and made *camera lucida* sketches of the appearances revealed by the microscope.

To realize Lister's work it is necessary to remember the condition of surgical practice at that date. About the middle of the 19th century the introduction of anæsthetics had relieved the patient of much of the horror of the knife, and the surgeon of the duty of speed in his work. The agony of the sufferer had naturally and rightly compelled the public to demand rapid if not slapdash surgery, and the surgeon to pride himself on it. Within decent limits of precision, the quickest craftsman was the best. This rivalry was as unfortunate as it was unavoidable. The operation once begun was hurried through with the utmost rapidity, while there was little time to deliberate upon the conditions revealed, or for niceties of adaptation. With anæsthetics this state of things at any rate was changed. The pain of the operation itself no longer counted, and the surgeon was enabled not only to be as cautious and sedulous as dexterous, but also to venture upon long, profound, and intricate operations which before had been out of the question. Yet unhappily this new enfranchisement seemed to be but an ironical liberty of Nature, who with the other hand took away what she had given. Direct healing of surgical wounds ("by first intention"), far from being the rule, was a piece of luck too rare to enter into the calculations of the operator; while of the graver surgical undertakings, however successful mechanically, the mortality by sepsis was ghastly. At all times suppuration, phagedæna, and septic poisonings of the system carried away even the most promising patients and followed even trifling operations. Often, too, these diseases rose to the height of epidemic pestilences, so that patients, however extreme their need, dreaded the very name of hospital, and the most skilful surgeons distrusted their own craft. New hospitals or new wards were built, yet after a very short time the new became as pestiferous as the old; and even scrupulous care in ventilation and housemaids' cleanliness failed to prevent the devastation. Surgery had enlarged its freedom, but only to find the weight of its new responsibilities more than it could bear.

Lord Lister.
(*From a photograph by Elliott and Fry, London.*)

When Lister was appointed to the chair of surgery in Glasgow the infirmary of that city was a hotbed of septic disease; so much so that his hospital visits evidently distressed him greatly. Windows were widely opened, piles of clean towels were supplied, but still the pestilence stalked through the wards. The building stands to-day as it stood then, with no substantial alteration; but by the genius of Lister its surgical wards are now as free from septic accidents as the most modern hospital in the land. James Simpson, early in the 'sixties, pathetically denounced the awful mortality of operations in hospitals, and indeed uttered desperate protests against the hospital system itself; yet, not long afterwards, Lister came to prove that it was not in the hospital that the causes of that mortality lay hidden, but in the operator himself, his tools, and his assistants. Happily this beneficent discovery was made in time to preserve the inestimable boon of the hospital system from the counsels of despair. When Lister took up the task speculation was on the wrong tack; the oxygen of the air was then supposed to be the chief cause of the dissolution of the tissues, and to prevent access of air was impossible. For instance, a simple fracture, as of a bone of the leg, would do perfectly well, while in the very next bed a compound fracture—one, that is, where the skin is lacerated, and access to the seat of injury opened out—would go disastrously wrong. If the limb were amputated, a large proportion of such cases of amputation succumbed to septic poisoning—the fell and occult foe.

On graduation as bachelor of medicine, Lister went to Edinburgh, where he soon afterwards became house-surgeon to Mr Syme; and he was much impressed by the skill and judgment of this great surgeon, and also by the superiority of his method of dressing recent wounds with dry lint, as compared with the "water dressing" in use at University College. Yet under these more favourable conditions the amelioration was only one of degree; in most wounds indeed "union by first intention" was rendered impossible by the presence of the silk ligatures employed for arresting bleeding, for these could come away only by a process of suppuration. On the expiry of his house-surgeoncy in Edinburgh, Lister started in that city an extra-academical course of lectures on surgery; and in preparation for these he entered on a series of investigations into inflammation and allied subjects. These researches, which were detailed fully in three papers in *Phil. Trans.*, 1859, and in his Croonian lecture to the Royal Society in 1863, testified to an earnestness of purpose, a persevering accuracy of observation and experiment, and an insight of scientific conception which show that if Lister had never developed the aseptic method of surgery, he would have taken a very high place in pathology. In any case his earlier work was an indispensable preliminary to his later labours. In his speech in Paris at the Thirteenth International Congress of Medicine in 1900, Lord Lister said that he had done no more than seize upon Pasteur's discoveries and apply them to surgery. But though Lister saw the vast importance of the discoveries of Pasteur, he saw it because he was watching on the heights; and he was watching there alone. From Pasteur Lister derived no doubt two fruitful ideas: first, that decomposition in organic substances is due to living "germs"; and, secondly, that these lowly and minute forms of vegetable life spring always, like higher organisms, from parents like themselves, and cannot arise *de novo* in the animal body. After his appointment to the Glasgow chair in 1860, Lister had continued his researches on inflammation; and he had long been led to suspect that decomposition of the blood in the wound was the main cause of suppuration. The two great theories established by Pasteur seemed to Lister to open out the possibility of what had before appeared hopeless—namely, the prevention of putrefaction in the wound, and consequently the forestalling of suppuration. To exclude the oxygen of the air from wounds was impossible, but it might be practicable to protect them from microbes.

The first attempt to realize this idea was made upon compound fractures; and the means first employed was carbolic acid, the remarkable efficacy of which in deodorizing sewage made Lister regard it as a very powerful germicide. It was applied to the wound undiluted, so as to form with the blood a dense crust, the surface of which was painted daily with the acid till all danger had passed. The results, after a first failure, were in the highest degree satisfactory, so that, as Lister said in his presidential address to the British Association in Liverpool, he "had the joy of seeing these formidable injuries follow the same safe and tranquil course as simple fractures." The caustic property of undiluted carbolic acid, though insignificant in comparison with the far greater evils to be avoided in compound fracture, made it quite unsuited for general surgery. In order to make it applicable to the treatment of abscesses and incised wounds, it was necessary to mitigate its action by blending it with some inert body; and the endeavour to find the best medium for this purpose, such as to combine perfect antiseptic efficiency with the least possible irritation of the tissues, formed the subject of experiments continued for many years in the laboratory and in the ward. At one stage in these inquiries an attempt was made to provide an atmosphere free from living organisms by means of a fine spray of a watery solution of carbolic acid; for it was then supposed by Lister to be necessary not only to purify the surgeon's hands and instruments and the skin of the patient about the seat of operation, but also to wage war with the microbes which, as Pasteur had shown, people every cubic inch of the air of an inhabited room. Under the use of the spray better results were obtained than ever before, and this success encouraged its use. But researches carried on for several years into the relations of the blood to micro-organisms led Lister to doubt the harmfulness of the atmospheric dust. At the London Congress in 1881 he narrated experiments which proved that the serum of the blood is a very unfavourable soil for the development of the bacteria diffused through the air, and others which showed that the cells of an organizing blood-clot have a very remarkable power of disposing of microbes and of limiting their advance. Hence he considered it probable that in surgical operations the atmosphere might be disregarded altogether.[1] As long, however, as this was only a matter of probability, he did not dare to discard the spray. But at length, at the Berlin Congress in 1890, he was able to announce that the certainty he had so long desired had been arrived at. A careful consideration of the physical constitution of the spray had shown him that the microbes of the dust involved in its vortex could not possibly have their vitality destroyed or even impaired by it. Such being the case, the uniform success obtained when he had trusted the spray implicitly as an aseptic atmosphere, abandoning completely certain other precautions which he had before deemed essential, proved conclusively to his mind that the air might safely be left entirely out of consideration in operating.[2] Thus he learnt that not the spray only, but all antiseptic irrigations or washings of the wound also, with their attendant irritation of the cut surfaces, might be dispensed with—a great simplification, indirectly due to experiments with the spray. The spray had also served a very useful purpose by maintaining a pure condition of the *entourage* of the operation; not indeed in the way for which it was devised, but as a very mild form of irrigation. And Lister took care to emphasize the necessity for redoubled vigilance on the part of the surgeon and his assistants when this "unconscious caretaker," as he called it, had been discarded.

The announcement that he had given up the spray was absurdly interpreted in some quarters to mean that he had virtually abandoned his theory and his antiseptic methods. The truth is that the spray was only one of many devices tried for a while in the course of the long-continued endeavour to apply the antiseptic principle to the best advantage, and abandoned in favour of something better. Two main objects were always kept steadily in view by him—during the operation to guard the wound against septic microbes by such means as existing knowledge indicated, and afterwards to protect it against their introduction, avoiding at the same time all needless irritation of the tissues by the antiseptic. Upon the technical methods of attaining these ends this is not the place to enlarge; suffice it to say that the endowments and the industry of the discoverer, as seen in the rapidity and flexibility of mind with which he seized upon and selected the best means, were little less remarkable than the activity of the same faculties in his original ideas.

To illustrate this opinion, his work on the ligature may be taken. It had long been the universal practice of surgeons to employ threads of silk or flax for tying arteries, long ends being left to provide escape of the pus (invariably formed during the tedious process of the separation of the ligature) together with the portion of the arterial coats included in the knot. Lister hoped that if, by antiseptic means, the thread were deprived of living microbes, it would no longer cause suppuration, but might be left with short cut ends to become embedded permanently among the tissues of the wound, which thus would be allowed to heal by primary union throughout. A trial of this method upon the carotid artery of a horse having proved perfectly successful, he applied it in a case of aneurysm in the human subject; and here again the immediate results were all that could be desired. But a year later, the patient having died from other causes, the necropsy showed remnants of the silk thread incompletely absorbed, with appearances around them which seemed to indicate that they had been acting as causes of disturbance. Thus was suggested to him the idea of employing for the ligature some material susceptible of more speedy absorption; and the antiseptic treatment of contused wounds having shown that dead tissue, if protected from putrefaction, is removed by the surrounding structures without the intervention of suppuration, he resolved to try a thread of some such nature. Catgut, which is prepared from one of the constituents of the small intestine of the sheep, after steeping in a solution of carbolic acid, was used in a preliminary trial upon the carotid artery of a calf. The animal was killed a month later, when, on dissection, a very beautiful result was disclosed. The catgut, though removed, had not been simply absorbed; *pari passu* with its gradual removal, fibrous tissue of new formation had been laid down, so that in place of the dead catgut was seen a living ligature embracing the artery and incorporated with it. The wound meanwhile had healed without a trace of suppuration. This success appeared to justify the use of the catgut ligature in the human subject, and for a while the results were entirely satisfactory. But though this was the case with the old samples of catgut first employed, which, as Lister was afterwards led to believe, had been "seasoned" by long keeping, it was found that when catgut was used fresh as it comes from the makers, it was unsuited in various ways for surgical purposes. The attempt by special preparation to obtain an article in all respects trustworthy engaged his attention from time to time for years afterwards. To quote the words of Sir Hector Cameron, who was for several years assistant to Lord Lister, it required "labour and toilsome investigation and experiment of which few can have any adequate idea."

In 1869 Lister succeeded his father-in-law, Syme, in the chair of clinical surgery of Edinburgh. In 1877 he accepted an invitation to the chair of surgery at King's College, London, in the anticipation that here he would be more centrally placed for communication with the surgical world at home and abroad, and might thus exercise his beneficent mission to more immediate advantage. In 1896 Lister retired from practice, but not from scientific study. From 1895 to 1900 he was President of the Royal Society. In 1883 he was created a baronet, and in 1897 he was raised to the peerage as Baron Lister of Lyme Regis. Among the Coronation honours in 1902, he was nominated an original member of the new Order of Merit.

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[1] See *Trans. of the International Medical Congress*, 1881, vol. ii. p. 373.

[2] See *Verhandlungen des X internationalen Congresses*, Bd. i. p. 33.

In England Lister's teaching was slow in making its way. The leading surgeons of Germany were among the first to seize upon the new idea with avidity and practical success; so early as 1875, in the course of a tour he made on the Continent, great festivals were held in his honour in Munich and Leipzig. The countrymen of Pasteur did not lag far behind; and it is no exaggeration to speak of Lister's appearances in foreign countries at this time as triumphal, not in respect of formal honours only, but also of an enthusiasm almost stupendous.

The relation of Semmelweiss to Lister is of historical importance. Lister's work on the antiseptic system began in 1864; his first publication on the subject was in March 1867. At this date, and for long afterwards, the very name of Semmelweiss was unknown, or ignored, not only by French and Germans, but also by his own Hungarian people; and this neglect broke his heart. The French Academy pronounced against his opinions, and so did the highest pathological authority in Germany. In England, till long after his death, probably his name was not so much as mentioned. In the early 'seventies Lister's method was in full operation in Hungary as elsewhere, yet none of the surgeons of Budapest ever mentioned Semmelweiss; not even when, in 1883, they gave a great banquet to Lister, followed by a torchlight procession of the students. It was after this occasion that Dr Duka, a Hungarian physician practising in London, wrote a biography of Semmelweiss, which he sent to Lister, and thus brought the name of Semmelweiss before him for the first time. Thenceforth Lister generously regarded Semmelweiss as in some measure his forerunner; though we may point out that Semmelweiss was not aware of the microbic origin of septic poisons, nor were his methods, magnificent as was their success in lying-in hospitals, suitable for surgical work.

In public Lord Lister's speeches were simple, clear, and graceful, avoiding rhetorical display, earnest for the truth, jealous for his science and art, forgetful of himself. His writings, in like manner plain, lucid, and forcible, scarcely betray the labour and thought of their production. With the courtesy and serenity of his carriage he combined a passionate humanity, so often characteristic of those who come of the Society of Friends, and a simple love of truth which showed itself in his generous encouragement of younger workers.

Liszt, Franz (1811–1886), Hungarian pianist and composer, was born on 22nd October 1811, at Raiding, in Hungary. His appeal to musicians was made in a threefold capacity, and we have, therefore, to deal with Liszt the unrivalled pianoforte virtuoso (1830–48); Liszt the conductor of the "music of the future" at Weimar, the teacher of Tausig, Bülow, and a host of lesser pianists, the eloquent writer on music and musicians, the champion of Berlioz and Wagner (1848–61); and Liszt the prolific composer, who for some five-and-thirty years continued to put forth pianoforte pieces, songs, symphonic orchestral pieces, cantatas, masses, psalms, and oratorios (1847–82). As virtuoso he held his own for the entire period during which he chose to appear in public; but the militant conductor and prophet of Wagner had a hard time of it, and the composer's place is still in dispute. Liszt's father, a clerk to the agent of the Esterhazy estates and an amateur musician of some attainment, was Hungarian by birth and ancestry, his mother an Austrian-German. The boy's gifts attracted the attention of certain Hungarian magnates, who furnished a sum of 600 gulden annually for some years to enable him to study music at Vienna and Paris. At Vienna he had lessons in pianoforte playing from Carl Czerny of "Velocity" fame, and from Salieri in harmony and analysis of scores. In his eleventh year he began to play in public there, and Beethoven came to his second concert in April 1823. During the three years following he played in Paris, the French provinces, and Switzerland, and paid three visits to England. In Paris he had composition lessons from Paër, and a six months' course of lessons in counterpoint from Reicha. In the autumn of 1825 the handsome and fascinating *enfant gâté* of the salons and ateliers—"La neuvième merveille du monde"—had the luck to get an operetta (*Don Sancho*) performed three times at the Académie Royale. The score was accidentally destroyed by fire, but a set of studies *à la* Czerny and Cramer, belonging to 1826 and published at Marseilles as 12 Études, op. i., is extant, and shows remarkable precocity. After the death of his father in 1828 young Liszt led the life of a teacher of the pianoforte in Paris, got through a good deal of miscellaneous reading, and felt the influence of the religious, literary, and political aspirations of the time. He attended the meetings of the Saint-Simonists, lent an ear to the romantic mysticism of Père Enfantin, and later to the teaching of Abbé Lamennais. He also played Beethoven and Weber in public—a very courageous thing in those days. The appearance of the violinist Paganini in Paris, 1831, marks the starting-point of the supreme eminence Liszt ultimately attained as a virtuoso. Paganini's marvellous technique inspired him to practise as no pianist had ever practised before. He tried to find equivalents for Paganini's effects, transcribed his violin caprices for the piano, and perfected his own technique to an extraordinary degree. After Paganini he received a fresh impulse from the playing and the compositions of Chopin, who arrived in 1831, and yet another impulse of equal force from a performance of Berlioz's "Symphonie Fantastique, épisode de la vie d'un artiste," in 1832. Liszt transcribed this work, and its influence ultimately led him to the composition of his "Poèmes symphoniques" and other examples of orchestral programme-music. From 1833 to 1848—when he gave up playing in public—he was greeted with frantic applause as the prince of pianists. Five years (1835–40) spent in semi-retirement in the company of Madame la Comtesse D'Agoult (George Sand's friend and would-be rival, known in literary circles as Daniel Stern) in Switzerland and Italy, were devoted to further study in playing and composition, and were interrupted only by occasional appearances at Geneva, Milan, Florence, and Rome, and by annual visits to Paris. During one of these visits the famous contest with Thalberg took place (1837). The enthusiasm aroused by Liszt's playing and his personality—the two are inseparable—reached a climax at Vienna and Budapest in 1839–40, when he received a patent of nobility from the emperor of Austria, and a sword of honour from the magnates of Hungary in the name of the nation. During the eight years following he was heard at all the principal centres—including London, Leipzig, Berlin, Copenhagen, St Petersburg, Moscow, Warsaw, Constantinople, Lisbon, and Madrid. He gained much money, and gave large sums in charity. His munificence with regard to the Beethoven statue at Bonn made a great stir. The subscriptions having come in but sparsely, Liszt took the matter in hand, and the monument was completed at his expense, and unveiled at a musical festival conducted by Spohr and himself in 1845. In 1848 he settled at Weimar with Madame la Princesse Sayn-Wittgenstein, and remained there till 1861. During this period he acted as conductor at court concerts and on special occasions at the theatre, gave lessons to a number of pianists, wrote articles of permanent value on certain works of Berlioz and the early operas of Wagner, and produced those orchestral and choral pieces upon which his reputation as a composer mainly depends. His ambition to found a school of composers as well as a school of pianists met with complete success on the one hand and partial failure on the other. His efforts on behalf of Wagner, who was then an exile in Switzerland, culminated in the first performance of *Lohengrin* on 28th August 1850, before a special audience assembled from far and near. Among the works produced for the first time or rehearsed with a view to the furtherance of musical art were Wagner's *Tannhäuser*, *Der fliegende Holländer*, *Das Liebesmahl der Apostel*, and *Eine Faust Ouvertüre*, Berlioz's *Benvenuto Cellini*, the *Symphonie Fantastique*, *Harold en Italie*, *Roméo et Juliette*, *La Damnation de Faust*, and *L'Enfance du Christ*—the last two conducted by the composer—Schumann's *Genoveva*, *Paradise and the Peri*, the music to *Manfred* and to *Faust*, Weber's *Euryanthe*, Schubert's *Alfonso und Estrella*, Raff's *König Alfred*, Cornelius's *Der Barbier von Baghdad*, and many more. It was Liszt's habit to recommend novelties to the public by explanatory articles or essays, which were written in French (some for the *Journal des Débats* and the *Gazette Musicale* of Paris) and translated for the journals of Weimar and Leipzig,—thus his two masterpieces of sympathetic criticism, the essays *Lohengrin et Tannhäuser à Weimar*, and *Harold en Italie*, found many readers and proved very effective. They are now included, together with articles on Schumann and Schubert, and the elaborate and rather high-flown essays on Chopin and *Des Bohémiens et de leur musique en Hongrie* (the latter certainly, and the former probably, written in collaboration with Madame de Wittgenstein), in his *Gesammelte Schriften* (6 volumes, Leipzig). The compositions belonging to the period of his residence at Weimar comprise two pianoforte concertos, in E flat and in A, the "Todtentanz," the "Concerto pathétique" for two pianos, the solo sonata "An Robert Schumann," sundry "Études," fifteen "Rhapsodies Hongroises," twelve orchestral "Poèmes symphoniques," "Eine Faust Symphonie," and "Eine Symphonie zu Dante's 'Divina Commedia,'" the "13th Psalm" for tenor solo, chorus, and orchestra, the choruses to Herder's dramatic scenes "Prometheus," and the "Missa solennis" known as the "Graner Fest Messe." Liszt retired to Rome in 1861, and joined the Franciscan order in 1865. From 1869 onwards Abbé Liszt divided his time between Rome and Weimar, where during the summer months he received pupils—gratis as formerly—and, from 1876 up to his death at Bayreuth on the 31st July 1886, he also taught for several months every year at the Hungarian Conservatoire of Budapest.

Franz Liszt.
(*From a photograph by Elliott and Fry, London.*)

About Liszt's pianoforte technique in general it may be said that it derives its efficiency from the teaching of Czerny, who brought up his pupil on Mozart, a little Bach and Beethoven, a good deal of Clementi and Hummel, and a good deal of his (Czerny's) own work. Classicism in the shape of solid, respectable Hummel on the one hand, and Carl Czerny, a trifle flippant, perhaps, and inclined to appeal to the gallery, on the other—these gave the musical parentage of young Liszt. Then appears the Parisian Incroyable and grand seigneur—"Monsieur Lits," as the Parisians called him. Later, we find him imitating Paganini and Chopin, and at the same time making a really passionate and deep study of Beethoven, Weber, Schubert, Berlioz. Thus gradually was formed the master of style—whose command of the instrument was supreme, and who played like an inspired poet. Liszt's strange musical nature was long in maturing its fruits. At the pianoforte his achievements culminate in the two books of studies, twice rewritten, and finally published in 1852 as *Études d'exécution transcendante*, the *Études de concert*, and the *Paganini Studies*; the two concertos and the *Todtentanz*, the *Sonata in B minor*, the *Hungarian Rhapsodies*, and the fine transcriptions of Beethoven's symphonies (the 9th for two pianofortes as well as solo), and of Berlioz's *Symphonie fantastique*, and the symphony, *Harold en Italie*. In his orchestral pieces Liszt appears—next to Berlioz—as the most conspicuous and most thorough-going representative of programme music, *i.e.*, instrumental music expressly contrived to illustrate in detail some poem or some succession of ideas or pictures. It was Liszt's aim to bring about a direct alliance or amalgamation of instrumental music with poetry. To effect this he made use of the means of musical expression for purposes of illustration, and relied on points of support outside the pale of music proper. There is always danger of failure when an attempt is thus made to connect instrumental music with conceptions not in themselves musical, for the order of the ideas that serve as a programme is apt to interfere with the order which the musical exposition naturally assumes—and the result in most cases is but an amalgam of irreconcilable materials. In pieces such as Liszt's "Poèmes symphoniques," *Ce qu'on entend sur la montagne* (1848–1856)—after a poem by Victor Hugo—and *Die Ideale* (1853–57)—after a poem by Schiller—the hearer is bewildered by a series of startling orchestral effects which succeed one another apparently without rhyme or reason. The music does not conform to any sufficiently definite musical plan—it is, in fact, hardly intelligible as music without reference to the programme. Liszt's masterpiece in orchestral music is the *Dante Symphony* (1847–55), the subject of which was particularly well suited to his temperament, and offered good chances for the display of his peculiar powers as a master of instrumental effect. By the side of it ranks the *Faust Symphony* (1854–57), in which the moods of Goethe's characters—Faust, Gretchen, and Mephistopheles—are depicted in three instrumental movements, with a chorus of male voices, supplying a kind of comment, by way of close. The method of presentation in both symphonies is by means of representative themes (*Leitmotif*), and their combination and interaction. Incidents of the poem or the play are illustrated or alluded to as may be convenient, and the exigencies of musical form are not unfrequently disregarded for the sake of special effects. Of the twelve Poèmes Symphoniques, *Orphée* is the most consistent from a musical point of view, and is exquisitely scored. Melodious, effective, readily intelligible, with a dash of the commonplace, *Les Préludes*, *Tasso*, *Mazeppa*, and *Fest-Klänge* bid for popularity. In these pieces, as in almost every production of his, in lieu of melody Liszt offers fragments of melody—touching and beautiful, it may be, or passionate, or tinged with triviality; in lieu of a rational distribution of centres of harmony in accordance with some definite plan, he presents clever combinations of chords and ingenious modulations from point to point; in lieu of musical logic and consistency of design, he is content with rhapsodical improvisation. The power of persistence seems wanting. The musical growth is spoilt, the development of the themes is stopped, or prevented, by some reference to extraneous ideas. Everywhere the programme stands in the way. In much of Liszt's vocal music, particularly in the songs and choral pieces written to German words, an annoying discrepancy is felt to exist between the true sound of the words and the musical accents. The music is generally emotional, the expression direct and passionate; there is no lack of melodic charm and originality, yet the total effect is frequently disappointing. In the choral numbers of the five masses, and in the oratorios *Die Heilige Elisabeth* and *Christus*, the rarity of fugal polyphony acts as a drawback. Its almost complete absence in some of these works makes for monotony and produces a sense of dulness, which may not be inherent in all the details of the music, but is none the less distinctly present.

A thematic catalogue of Liszt's works was published during his lifetime. The rather indiscriminate and verbose biography by Lina Ramann (3 vols., Leipzig) is trustworthy as to facts and dates.

Omitting trifles and all publications that have been cancelled, the following list of compositions may be taken as fairly comprehensive :—

Pianoforte Pieces.—Études d'exécution transcendante; Études de concert; Zwei Etuden, Waldesrauschen, Gnomentanz; Ab Irato; Paganini Studies; Années de Pélerinage, 3 sets; Harmonies poétiques et religieuses, 1–10; Consolations, 1–6; Ave Maria in E; Sonata in B minor; Konzert-Solo in E minor; Scherzo und Marsch; Ballades, I., II.; Polonaises, I., II.; Apparitions, 1–3; Berceuse; Valse impromptu; Mazurka brillant; 3 Caprices Valses; Galop chromatique; Mephisto-Walzer, I., II., III., and Polka; Zwei Legenden, "Die Vogelpredigt," "Der heilige Franciscus auf den Wogen schreitend"; "Der Weihnachtsbaum," 1–12; Sarabande und Chaconne ("Almira"); Elegies, I., II., and III.; La lugubre Gondola; Dem Andenken Petöfi's; Mosonyi's Grabgeleit; Romance oubliée; Valses oubliées, 1–3; Liebesträume, 1–3 (originally songs); Hexameron; Rhapsodies Hongroises, 1–18.

Pieces for Two Pianos.—Concerto pathétique (identical with the Konzert-Solo in E minor); Dante symphony; Faust symphony; Poèmes symphoniques, 1–12; Beethoven's 9th symphony.

Pianoforte with Orchestra.—Concertos I. in E flat, II. in A; Todtentanz; Fantasie ueber Motif aus Beethoven's "Ruinen von Athen"; Fantasie ueber Ungarische National Melodien; Schubert's Fantasia in C; Weber's Polacca in E.

Fantaisies de Concert for Piano Solo.—Don Juan; Norma; Sonnambula; I Puritani; Lucia, I., II.; Lucrezia, I., II.; La Juive; Robert le Diable; Les Huguenots; Le Prophète, 1–4. *Paraphrases*, Auber, Tarantella di bravura (Masaniello); Verdi, Rigoletto, Ernani, Il Trovatore; Mendelssohn, "Hochzeitsmarsch und Elfenreigen"; Gounod, Valse de Faust, Les Adieux de Roméo et Juliette; Tschaikowsky, Polonaise; Dargomiyski, Tarantelle; Cui, Tarantella; Saint-Saëns, Danse macabre; Schubert, Soirées de Vienne, Valses caprices, 1–9.

Transcriptions.—Beethoven's Nine Symphonies; Berlioz's "Symphonie fantastique," "Harold en Italie"; Bénédiction et Serment (Benvenuto Cellini); Danse des Sylphes (Damnation de Faust); Weber's overtures, Der Freischütz, Euryanthe, Oberon, Jubilee; Beethoven's and Hummel's Septets; Schubert's Divertissement à la Hongroise; Beethoven's Concertos in C minor, G and E flat (orchestra for a second piano); Wagner's Tannhäuser overture, march, romance, chorus of pilgrims; Lohengrin, Festzug und Brautlied, Elsa's Brautgang, Elsa's Traum, Lohengrin's Verweiss an Elsa; Fliegender Holländer, Spinnlied; Rienzi, Gebet; Rheingold, Walhall; Meistersinger, "Am stillen Herd"; Tristan, Isolde's Liebestod; Chopin's six Chants Polonais; Meyerbeer's Schillermarsch; Bach's six organ Preludes and Fugues; Prelude and Fugue in G minor; Beethoven, Adelaide; 6 miscellaneous and 6 Geistliche Lieder; Liederkreis; Rossini's Les Soirées musicales; Schubert, 59 songs; Schumann, 13 songs; Mendelssohn, 8 songs; Robert Franz, 13 songs.

Organ Pieces.—Missa pro organo; Fantasia and Fugue, "Ad nos, ad salutarem undam"; B-A-C-H Fugue; Variations on Bach's Basso continuo, "Weinen, Klagen"; Bach's Introduction and Fugue, "Ich hatte viel Bekümmerniss"; Bach's Choral Fugue, "Lob und Ehre"; Nicolai's Kirchliche Festouvertüre, "Ein feste Burg"; Allegri's Miserere; Mozart's Ave Verum; Arcadelt's Ave Maria; Lasso's Regina Cœli.

Orchestral Pieces.—Eine Symphonie zu Dante's "Divina Commedia"; Eine Faust Symphonie; Poèmes symphoniques: 1. "Ce qu'on entend sur la montagne"; 2. Tasso; 3. Les Préludes; 4. Orphée; 5. Prométhée; 6. Mazeppa; 7. Fest-Klänge; 8. Héroïde funèbre; 9. Hungaria; 10. Hamlet; 11. Hunnenschlacht; 12. Die Ideale; Zwei Episoden aus Lenau's Faust: I. Der nächtliche Zug, II. Der Tanz in der Dorfschenke; Marches, Rakoczy, Goethe, Huldigung, "Vom Fels zum Meer" (for a military band); Ungarischer, Heroischer, and Sturmmarsch; Le Triomphe funèbre du Tasse; "Von der Wiege bis zum Grab"; six Hungarian rhapsodies; four marches; four songs, and Die Allmacht, by Schubert.

Vocal Music.—Oratorios: "Die Legende von der Heiligen Elisabeth," "Christus," "Stanislaus" (unfinished). Masses: Missa solennis for the inauguration of the cathedral at Gran; Ungarische Krönungs-messe; Missa choralis (with organ); Missa and Requiem for male voices (with organ); Psalms, 13, 137, 23, and 18; 12 Kirchen-Chor-Gesänge (with organ). Cantatas: Prometheus-chöre; "Beethoven Cantata"; "An die Künstler"; Die Glocken des Strassburger Münsters; 12 Chöre für Männergesang; Songs, 8 books; Scena, Jeanne d'Arc au bücher.

Melodramatic Pieces for Declamation, with Pianoforte Accompaniment.—Leonore (Bürger); Der traurige Mönch (Lenau); Des todten Dichter's Liebe (Jokai); Der blinde Sänger (Tolstoy).

Editions, Text and Variants.—Beethoven's Sonatas; Weber's Concertstück and Sonatas; Schubert Fantasia, 4 Sonatas, Impromptus, Valses, and Moments musicaux. (E. DA.)

Litchfield, a city of Montgomery county, Illinois, U.S.A., at the intersection of six railways and at an altitude of 664 feet. Its site is on the level prairie, its plan is regular, and it has Holly water-works and other municipal improvements. It is in a region of coal, natural gas, and petroleum. Population (1880), 4326; (1890), 5811; (1900), 5918, of whom 521 were foreign-born and 156 were negroes.

Lithgow, town, Australia, New South Wales, in the county of Cork, 96 miles west of Sydney by rail. Coal is found in the district, which has also ironworks, brickworks, and a large pottery. Altitude, 3000 feet. Population (1881), 2112; (1891), 3865; (1901), 5269.

Lithography. See Engraving.

Litin, a district town of Russia, government of Podolia, on the Bug river, 67 miles south-south-west of Zhitomir, and 19 miles from Vinnitsa railway station. It is an old town, which existed under the name of Lytyn in the first half of the 15th century. It has brisk trade in grain, timber, and wooden goods. Population, 11,162.

Littleborough, a town in the Middleton parliamentary division of Lancashire, England, on the Rochdale canal, 3 miles north-east of Rochdale by rail. There are an endowed free school (founded 1727) and a technical institute. The industries are cotton and woollen manufactures and dyeing; in the neighbourhood there are collieries and quarries. Area of urban district, 7736 acres. Population (1881), 10,406; (1891), 10,878; (1901), 11,166.

Little Falls, a city of Minnesota, U.S.A., capital of Morrison county, on the east bank of the Mississippi river, on the Northern Pacific railroad, at an altitude of 1117 feet. It has excellent water-power, which has been made use of in lumber manufacture, the principal industry of the city. Population (1880), 508; (1890), 2354; (1900), 5774, of whom 1559 were foreign-born.

Little Falls, a city of Herkimer county, New York, U.S.A., on the Mohawk river, the Erie canal, the New York Central and Hudson River, the West Shore, and the Little Falls and Dolgeville railways, at an altitude of 376 feet. It is irregularly built on a steep slope. The fine water-power furnished by the falls in the Mohawk river has been turned to account in a variety of manufactures. Population (1890), 8783; (1900), 10,381, of whom 1915 were foreign-born.

Littlehampton, a parish, town, and seaport in the Eastbourne parliamentary division of Sussex, England, at the mouth of the Arun, 59 miles south-south-west of London, with a station on the London, Brighton, and South Coast railway. The town is an attractive seaside resort. The church of St Mary the Virgin was reconstructed in 1899, and a chapel of ease (a wooden structure) was erected in 1877. The Roman Catholic church, built in 1864, was enlarged in 1884. There are Congregational, Methodist, and other places of worship. The town is provided with a public hall, excellent golf-links, and a field of 11 acres for sports, presented by the duke of Norfolk in 1897. The harbour is easily accessible in all weathers, and in 1900 was entered and cleared by an aggregate of 802 vessels of 65,650 tons, the trade being valued at about £53,000. Area of urban district, 2325 acres. Population (1891), 5772; (1901), 7363.

Little Rock, a city of Arkansas, U.S.A., capital of Pulaski county and of the state, of which it is the largest city, on the south bank of the Arkansas river, at the east base of the Ozark Hills, at an altitude of 263 feet. It has a level site, a regular plan with broad streets, a good water-supply and sewerage system, and is divided into eight wards. It is on the St Louis, Iron Mountains and Southern, the St Louis South-Western, the Choctaw and Memphis, and the Little Rock and Hot Springs Western railways, which, with steamboats on the river, give it a large trade. In 1890 its manufacturing establishments numbered 124, with a total capital of $2,265,324. They employed 1534 hands, and their product was valued at $3,120,677. The leading products were cotton-seed oil and oil-cake, valued at $937,963, and lumber, valued at $324,000. Little Rock is the seat of Philander Smith University, a Methodist Episcopal institution, founded in 1877. The assessed valuation of real and personal property in 1900, on a basis of about 40 per cent. of the full value, was $14,845,458; the net debt of the city was only $217,719, and the rate of taxation was $22 per $1000. Population (1890), 25,874; (1900), 38,307, of whom 2099 were foreign-born and 14,694 were negroes.

Littlestone-on-Sea. See Romney, New.

Liverpool, a city, municipal, county, and parliamentary borough and seaport of Lancashire, England, 201 miles north-west of London by rail, on the right bank of the Mersey, about three miles from the open sea. The city extends about six miles along the east bank of the estuary, which here runs nearly north and south and is about one mile in breadth. On the north the city is bounded by the borough of Bootle, along which the line of docks is continued, and on the south by the township of Garston. In 1891 the population was 517,980; in 1901 it had reached 686,332. The birth-rate for 1901 was 32·2, and the death-rate 21·6 per thousand. An extension of the city boundaries took place on 9th November 1895, when an estimated population of 134,234 and an area of 8026 acres of land and 2016 acres of water space were added. At the same time the number of the wards was increased to 28, and the number of aldermen to 28 and councillors to 84. In 1899 a fresh ward with 1 alderman and 3 councillors was added, a similar increase also taking place in 1900. The total area now stands at 15,252 acres, comprising 30 wards, with 30 aldermen and 90 councillors. In 1893 the title of mayor was raised to that of Lord Mayor. The rateable value in 1890 was £3,221,771; in 1895, £3,168,315; in 1900, £3,711,986. The decrease in 1895 was due to the demolition of a large quantity of insanitary property, while the marked increase in 1900 was largely due to the extension of the boundaries. In 1885 the number of members of Parliament was increased to nine by the creation of six new wards.

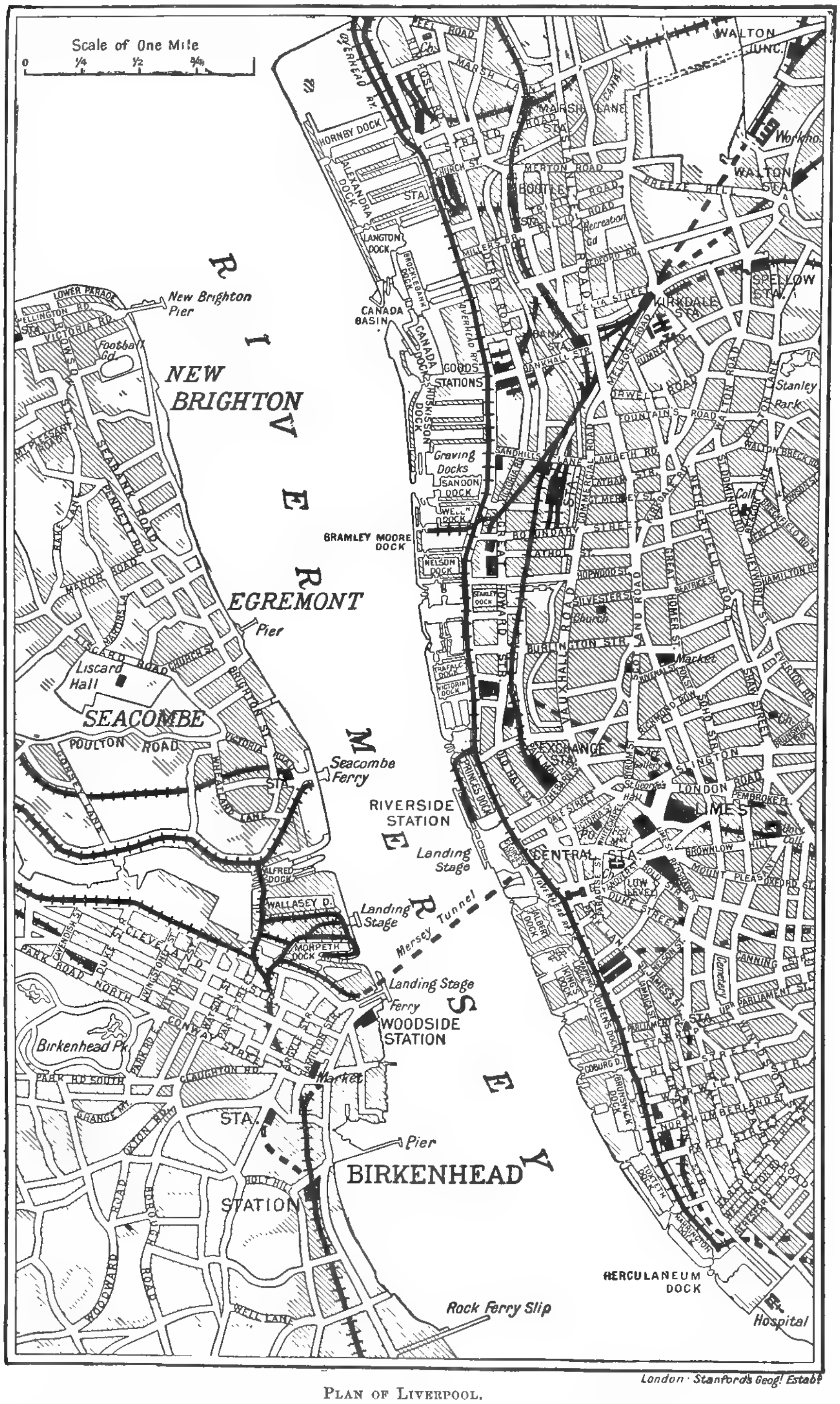
The following table gives particulars of the chief suburbs on the east side of the river:—

	Population, 1901.	Rateable Value.
Bootle (borough of)	58,556	£504,311
Allerton	1,100	24,296
Childwall	219	4,092
Garston	17,288	121,178
Great Crosby	7,555	45,000
Huyton-cum-Roby	4,661	31,456
Litherland	10,592	42,689
Little Crosby	563	5,358
Little Woolton	1,091	13,044
Much Woolton	4,731	24,352
Waterloo-cum-Seaforth	23,102	109,932

Since 1882 several of the city churchyards have been laid out in gardens. A playground containing 108 acres in Wavertree was presented in 1895 by an anonymous donor. The total area of the public parks and gardens now amounts to 772½ acres. In 1884 a new County Sessions House, adjoining the Walker Art Gallery opposite St George's Hall, was opened for public business. In 1889 a wholesale fish market in Great Charlotte Street was opened, and in 1896 the new Liverpool Cotton Exchange. In 1899 the new post office in Victoria Street was completed. Considerable alterations in the internal structure of the town hall have been made, and the council chamber is now extended so as to permit of the enlarged council meeting without discomfort, and provides seating accommodation for 124 members. The Shakespeare Theatre was opened in 1888. The Free Library has steadily increased in size and usefulness, and now contains upwards of 120,000 volumes in the reference department. There are nine lending libraries and reading-rooms under control of the central library, and in these the total number of volumes is nearly 92,000. The basement of the Brown Library (central reference) has been reconstructed to provide additional book space, to establish a special newspaper files and patent department, and to provide a central lending library.

The *Walker Art Gallery*, spacious though it was, as originally constructed, began to prove inadequate to meet the requirements of the recurring exhibitions and the housing of the steadily growing permanent collection very shortly after its opening in 1877, and a scheme was sanctioned by the council for the enlargement of the building to almost twice its original size by an addition on the north side. This improvement was completed and opened in 1884, the entire cost of the additions being borne by Sir Andrew Walker, Bart. The permanent collection now numbers upwards of 750 works, including sculpture. An important addition was made in 1894, when the examples of early Italian art, numbering altogether about 180 pictures, collected at the beginning of the 19th century by William Roscoe, were deposited in the gallery. They had formerly been housed at the Royal Institution, Colquit Street.

Museums.—Very extensive alterations in the structure and arrangement of the William Brown Museum have been undertaken. The ground on which the building stands falls somewhat sharply in a westerly direction, and the Corporation have extended the galleries previously in existence by building an addition at the west end equal in size to the whole of the previous museum and library building as presented by Sir William Brown. By excavating the slope from a face perpendicular to the west wall of the old museum down to the level of Byrom Street (a thoroughfare running north and south some fifty yards away at the foot of the slope), accommodation has been found for a large central technical school below the level of the museum, with an entrance from Byrom Street distinct from the museum entrance. The former levels in the museum are maintained, and the new galleries, which are extended in a westerly direction over the technical school, fit into the old, and together they form immense horse-shoe galleries, each about 500 feet long by 35 feet wide; and it is possible now to arrange the magnificent collection in the possession of the Corporation logically and comprehensively, so that a regular sequence of ideas may be obtained. In addition to this, a fine series of laboratories for biological investigation has been constructed and fitted with all the latest appliances, in which original research may be carried on, in addition to the usual dissection for museum exhibits and the ordinary mounting of specimens.



Plan of Liverpool.

London: Stanford's Geog! Estab!

Municipal Technical Schools.—The building for the Central Municipal Technical School in Byrom Street, the upper part of which, as stated above, is devoted to museum galleries, was opened in October 1901, the cost of the building, exclusive of the site and equipment, being over £112,000. The Nautical College established by the Corporation in 1892 is now carried on in this building, which comprises a small astronomical observatory in addition to the usual lecture rooms, laboratories, and workshops. The Corporation have also built two branch technical schools in the north and east districts of the city, and conduct classes also in other buildings which have been adapted for the purpose in the other districts.

Colleges and Schools.—University College received its charter of incorporation on the 18th October 1881, and on the 15th November 1884 was admitted as a college of the Victoria University. Since its foundation a sum of upwards of £500,000 has been raised by voluntary contribution, in addition to £33,708 contributed by public bodies. Twenty-seven chairs have been endowed, and the university buildings very largely extended. There are at present 24 professors and 24 lecturers. The average attendance of students in 1899–1900 amounted to 409 in the arts and science and 154 in the medical school. The number of students attending evening classes amounted to 717. Early in 1900 a supplemental charter extended the powers of self-government, and brought the college into close relations with the authorities of the city and with local institutions, by providing for their fuller representation on the court of governors. The authorities of the college are the president, the vice-presidents, the court of governors, the council, the treasurer, and the senate. The general management is conducted by the council, which is composed of the president, the vice-presidents, the treasurer, the principal and three professors of the college chosen by the senate, fifteen persons chosen by the court of governors, and three persons chosen by the municipal council. The School Board was introduced in 1870, and the first Board elected on the 25th November in that year. At that time the number of scholars under the Board (average attendance) amounted to 47,590, and the number of schools to 80. The figures for the month of June 1901 were as follows:—32 permanent and 18 temporary board schools, and 108 voluntary schools, with an average attendance at the former of 41,855 and at the latter of 64,440. During the year ending 30th June 1901 the municipal expenditure was £128,000, while the various Government grants amounted to £71,669.

Churches.—The various denominations have nearly all seen an increase in the number of churches attached to them. The numbers now stand approximately as follows:—Established Church, 103; Roman Catholic, 34; Welsh Nonconformists, 29; Wesleyan, 25; Presbyterian, 22; Methodists, 21; Baptist, 17; Congregational, 13; Unitarians, 5; others, 25. None of the new churches call for any special notice.

Railways.—A new railway route to Southport *viâ* the Cheshire lines was opened for traffic in 1884, and the Mersey Tunnel, connecting Birkenhead with Liverpool, in 1885. The Exchange Station in Tithebarn Street, which was formerly approached by a long flight of steps, was brought down to the level of the street and opened for passenger traffic in 1896. An extension of the Mersey railway, bringing Wallasey, Hoylake, and New Brighton into direct communication with Liverpool, was completed in 1888. The Electric Overhead railway, running along the line of docks from Seaforth to the Dingle, was formally opened in 1893. In 1895 the riverside station at the Princes Dock was completed, giving direct access from the landing-stage to the London and North-Western system.

Tramways.—The Corporation in 1896 purchased the property, rights, powers, and privileges of the Liverpool Electric Supply Company, and in the following year the undertaking of the Liverpool Tramway Company, which they formally took over in the autumn of the same year. Since that date a large and extended system of electric tramways has been laid down, which has led to a very remarkable increase in the receipts and the number of passengers carried. The following table shows how rapidly the tramways have spread during 1897–1901:—

Year.	Passengers.	Miles run.	Receipts.
1897	38,409,084	6,013,182	£290,743
1898	41,772,034	6,279,758	314,207
1899	63,771,450	7,600,546	359,929
1900	82,367,958	9,100,866	417,574
1901	101,108,780	10,970,063	468,383

The mileage under the electric system is 95 miles of single track.

Lighting.—A steady improvement in lighting has taken place, especially since the Corporation took it over in 1894. The following comparative table of the old city area will show this more clearly:—

Year.	No. of Lamps.	Mileage.	Courts.	Passage Lamps.	Candle-power.	Cost.
1890	11,330	272	1761	...	744½ millions	£39,000
1901	11,905	275	1084	1045	2261 ,,	31,187

The second table shows the improvement in the extended area added to the city in 1895:—

Year.	No. of Lamps.	Mileage.	Candle-power.	Cost.
1895	2789	128	137½ millions	£7194
1901	3493	144	623 ,,	7900

The increased candle-power and decreased cost have been mainly brought about by the introduction of a system of incandescent gas burners. Electric light is also used in many of the main thoroughfares, and has been installed in all the principal shops and many of the better-class dwelling-houses.

Water Supply.—The Rivington reservoirs in Lancashire (8 in number), with a total capacity of 4,105,000,000 gallons, continue to supply Liverpool with water, supplemented by several of the old wells bored in the pebble beds of the New Red Sandstone. The main supply, however, is drawn from Lake Vyrnwy in Montgomeryshire and Rivington. The scheme for utilizing the water from the Vyrnwy district was adopted by the City Council in 1879, and the necessary powers obtained in the following year. The works were begun in 1881, and completed eleven years later. The impounding of the water was commenced on the 28th of November 1888, and the overflow was not reached until the 25th of November 1889, the process of filling, therefore, occupying almost twelve months. A temporary supply was obtained from Lake Vyrnwy in July 1891, as it was urgently needed, and the permanent aqueduct was completed shortly afterwards. The total area of the gathering-grounds of Rivington and Vyrnwy from which the Corporation can impound water is 32,742 acres. (See WATER-SUPPLY and AQUEDUCTS.) The consumption of water per head of the population has gradually increased, the figures being—1846, 8·24 gallons per head; 1881, 24·84; 1891, 25·25; 1901, 30·62.

Trade and Shipping.—Though Liverpool is essentially a port, and the main industries are those dependent on shipping, several other forms of industrial enterprise have made rapid strides during the period. The confectionery trade is a case in point, several large works having been built, no doubt induced by the prospect of cheap sugar directly from the Liverpool quays. The cutting, blending, and preparing of crude tobacco have also led to the erection of several large factories employing several thousands of hands. Two large mills, fitted with the latest and most improved machinery for expressing oil from various oleaginous seeds and for the production of feeding cake for cattle, have also added to the general prosperity. One of these latter has grown from the employment of only a few hands to that of nearly a thousand, and the works now rank among the largest in the world for this class of business. As will be seen from the figures given below, the general trade of the port has steadily grown. The figures for the port of Manchester have been introduced as they are important for the sake of comparison, representing trade which has passed through Liverpool.

Exports of Produce and Manufacture of United Kingdom.

	1885.	1895.	1900.
Liverpool	£79,765,100	£78,126,746	£87,488,183
Manchester .	...	8,836,999	7,416,873

Exports of Foreign and Colonial Merchandise.

	1885.	1895.	1900.
Liverpool .	£10,189,272	£12,493,722	£15,084,707
Manchester	...	165,935	407,394

Imports of Foreign and Colonial Merchandise.

	1885.	1895.	1900.
Liverpool .	£94,912,069	£95,630,489	£124,713,436
Manchester .	...	4,220,792	16,159,954

The following table shows the increase in the shipping:—

	1885.		1895.		1900.			1885.		1895.		1900.	
	Vessels	Tonnage.	Vessels.	Tonnage.	Vessels.	Tonnage.		Vessels.	Tonnage.	Vessels.	Tonnage.	Vessels.	Tonnage.
Entered—							Cleared—						
Liverpool	14,018	7,070,245	19,457	8,675,049	20,300	9,315,674	Liverpool	12,965	6,624,272	19,261	8,525,185	19,620	9,158,332
Manchester	..	..	1,752	589,159	2,900	1,230,784	Manchester	..	..	1,809	636,305	2,926	1,249,463

It is the docks, however, that indicate the growth and extent of Liverpool's trade (see DOCKS). In September 1881 the opening of the newly-completed Langton and Alexandra Docks at the extreme north end of the river frontage indicated a substantial advance towards the completion of the great scheme of dock extension for which parliamentary powers had been obtained in 1873. That scheme may be said to have been fully completed in 1889, the Hornby Dock at the north end, and the Harrington, Toxteth, and Union Docks at the south end, bringing up the water area of the docks at Liverpool, which in 1882 was 343 acres, to 380 acres in 1889 (not including Birkenhead). Since the latter date the advances which the port has made in the matter of dock accommodation are not to be measured so much by the figures of water area and quayage, although these have both increased, but by the augmented depths of docks, entrances, water approaches, and the increased width of entrances, improvements in the alignment of the quays, in the class of sheds provided on them for the accommodation of goods, and in the facilities for handling ships and goods generally. Thus in 1889 an important scheme of improvement at the Canada and Huskisson Docks was commenced, which comprised the alteration of the Canada Dock and lock, the construction of a new branch dock of about 7½ acres area, with sheds of the newest type, and a large new graving dock capable of receiving the very largest steamer. This graving dock is 925½ feet long, 94 feet wide at entrance, and has 34 feet depth of water on its sill on spring tides. In addition to the works above mentioned, the scheme comprised deepening and other improvements at Huskisson Dock, and the provision of a large new half-tide dock on the site of Sandon Basin and Wellington half-tide dock. Within a few years of their deciding to improve the Canada-Huskisson system, so great and rapid was the development of shipping that the Mersey Docks and Harbour Board found that the alterations provided by the scheme of 1891 would be quite inadequate, and in 1898 they sought and obtained powers to supplement it by large additions at the north and south ends of their estate. Under these powers the Sandon graving docks are being obliterated and a new branch dock constructed, and the construction of another large graving dock is contemplated. The scheme of 1898 also provides for a reconstruction in a deepened and otherwise improved form of the whole of the Queen's-Wapping group of docks, and the provision of deep-water approaches thereto by means of new river entrances at Brunswick Dock, deepening of Brunswick Dock and the passage between it and the Queen's Dock. Four new branch docks and two graving docks were provided for. In 1895 a great improvement was made in the facilities for passenger traffic by the construction of a railway station on the river side of the Princes Dock, and the extension of railway lines from the London and North-Western Railway Company's trunk and other systems to that point, so that passengers disembarking from Atlantic liners at the landing-stage could enter trains at once and proceed to their destinations. The landing-stage was extended to 2460 feet in length. A very fine group of wool warehouses was constructed on the east side of Great Howard Street, and was opened in 1896. A block of warehouses, having fourteen floors in all and a total floor area of 36 acres, has been constructed for the storage of tobacco, the stock of which in the port is about 100,000 hogsheads, and such a stock can be accommodated in the group of warehouses at the Stanley Dock, consisting of the new warehouse above referred to and the old warehouses. A large part of the George's Dock has been sold to the Corporation; on the other hand, about twelve acres of land hitherto in the hands of the Manchester Ship Canal Company, owners of the Duke's Dock property, has been acquired by the Board. No account of the port would be complete without mention being made of the unique dredging operations (see DREDGING) which have taken place at the bar of the Queen's Channel, which have enabled the largest ocean liners to enter the river at all hours, except upon the rarest occasions. The dredging at the bar was commenced as an experiment in September 1890 by two of the Board's ordinary hopper barges of 500 tons capacity each. The result was favourable, and in 1892 the Board decided to order a new hopper dredger larger than any hitherto built. This vessel, which cost about £60,000, was set to work in July 1893. Then another vessel of like size was built, and in November 1895 put to work on the bar; and as the result of all these operations, up to the 17th November 1900 there had been removed over 25,773,000 tons of sand. Before dredging was commenced the depth of water at dead low water of spring tides was only 11 feet; now there is, under the same conditions, about 27 feet. The space over which dredging has been carried on at the bar measures about 7000 feet by 1250 feet wide, the latter being the average width of the buoyed cut or channel through the bar. Dredging has also taken place on shoals and projections of sand-banks in the main sea channels, and from these the sand pump dredgers have removed over 26,085,500 tons. The total expenditure in connexion with the dredging operations up to the 1st of July 1900, not including capital cost of plant, interest, or depreciation on capital, was about £192,283. The expenditure in like terms for the year ending the 1st July 1900 was £24,400. (W. F. I.)

Liversedge, a township, urban district, and railway station in the Spen Valley parliamentary division of Yorkshire, England, 3 miles north-west of Dewsbury. The industries are chiefly the manufacture of woollen goods, the making of machinery, chemical manufactures, and coal mining. Area, 2130 acres. Population (1881), 12,757; (1901), 13,978.

Livingstone (or KINGA) **Mountains,** a band of highlands in German East Africa, forming the eastern border of the rift valley of Lake Nyasa, at the northern end of the lake. In parts these highlands present rather the character of a plateau than of a true mountain range, but the latter name may be justified by the fact that they form a comparatively narrow belt of country, which falls considerably to the east as well as to the west. The northern end is well marked in 8° 50′ S. by an escarpment falling to the Ruaha valley, which is regarded as a north-eastern branch of the main rift valley. Southwards the Livingstone range may be considered to terminate in the deep valley of the Ruhuhu in 10° 30′ S., the first decided break in the highlands that is reached from the north, on the east coast of Nyasa. Geologically the range is formed on the side of the lake by a zone of gneiss running in a series of ridges and valleys generally parallel to its axis. The ridge nearest the lake (which in Mount Chamembe, 9° 41′ S., rises to an absolute height of 7870 feet, or 6200 feet above Nyasa) falls almost sheer to the water, the same steep slope being continued beneath the surface. Towards the south the range appears to have a width of some 20 miles only, but northwards it widens out to about 40 miles, though broken here by the depression, drained towards the Ruaha, of Buanyi, on the south side of which is the highest known summit of the range, reaching a height of 9600 feet. North and east of Buanyi, as in the eastern half of the range generally, table-topped mountains occur, composed above of horizontally bedded quartzites, sandstones, and conglomerates. The uplands are generally clothed in rich grass, forest occurring principally in the hollows, while the slopes towards the lake are covered with poor scrub. Native settlements are scattered over the whole range, and German mission stations have been established at Bulongwa and Mtandala, a little north of the north end of Nyasa, at the former of which European crops have been cultivated with success. The climate is here healthy, and night frosts occur in the cold season.

See BORNHARDT in *Verh. Gesells. Erdk.*, Berlin, 1899, No. 10. (E. HE.)

Livonia, or LIVLAND (*Liflandia* of the Russians), one of the three Baltic provinces of Russia. Its area, with the islands, but without Lake Peipus, covers 17,070 square miles. The population in 1897 was 1,300,640 (as against 1,121,000 in 1882), out of whom 670,038 were women, and 376,040 lived in towns. In 1895, out of a total population of 1,274,531, the peasants numbered 1,146,658; artisans, 98,366; noblemen, 8275; clergy, 3135; merchants, 5898; foreigners, 10,317; and various, 1882; to which 36,147 military had to be added. The bulk of the population consisted of Letts (552,860) and Esthonians (509,243), Germans, Russians, Jews, and Poles coming next in the order named.

Agriculture has reached a high degree of perfection, especially on the estates of the landlords. The fields are drained, and no fewer than 300 artesian wells are used for irrigation; 41 per cent. of the total surface is under artificial meadows and pastures, including dried-up marshes. Dairy-farming has been rapidly growing, and factories for the utilization of raw produce, derived from improved cattle-rearing, have been on the increase. The average crops of the years 1895–99 were: rye, 4,775,000 cwt.; wheat, 360,000; oats, 3,926,000; barley, 4,188,000; all cereals, 13,566,000 cwt. Gardening is on the increase. Fishing in Lake Peipus gives occupation to nearly 100,000 persons. The industries are rapidly developing, the aggregate yearly returns of the factories reaching £8,824,000 in 1897. Woollen, cloth, cotton, and flax mills, steam flour and saw mills, distilleries and breweries, machinery works, paper mills, furniture, tobacco, soap, candle, and hardware works are among the chief industrial establishments. Education stands on a much higher level than elsewhere in Russia, no less than 87 per cent. of the children receiving regular education. Of higher educational institutions there are Dorpat University, Riga polytechnicum, and a high school for the clergy. There are also 16 gymnasia for boys, and 11 high schools for girls, and a considerable number of general and professional schools. The government is divided into eleven districts, the chief towns of which, and their population in 1897, are:—Riga, capital of the government (256,197, as against 104,200 in 1881); Arensburg, in the island of Oesel (4621); Dorpat, now named officially Yuriev (42,421); Fellin (7659); Lämsall (2425); Pernau (12,856); Schlock (2011); Walk (10,139); Wenden (6327); Werro (4154); and Wolmar (5112). (P. A. K.)

Llandrindod Wells, a health resort of Wales, near the middle of Radnorshire, situated amid somewhat bare surroundings, 46 miles by rail west-north-west of Hereford. Its medicinal waters—chalybeate, sulphurous, and saline—attract some thousands of visitors annually, and the place is equipped with three pump-houses, a public hall, golf-course, park, and electric light. The waters have been long known, and were visited in the 18th century. Population (1901), 1827.

Llandudno, a parish and favourite seaside resort in the Arfon parliamentary division of Carnarvonshire, Wales, 227 miles north-west of London by rail. There are several public halls, two theatres, two hospitals, a library, and hydropathic establishments, and a new town hall and assembly rooms were opened in February 1902. The pier is 1250 feet long. Area of urban district, 3034 acres. Population (1881), 4807; (1891), 7348; (1901), 9307.

Llanelly, a seaport of Carmarthenshire, Wales, 10 miles west-north-west of Swansea by rail. It unites with Carmarthen to send one member to Parliament. Modern erections include a new town hall, a hospital, a higher-grade school, a theatre, and a parish hall. There is an intermediate and technical college. In 1888, 1228 vessels of 167,646 tons entered, and 1233 of 168,864 tons cleared; in 1898, 1068 vessels of 181,288 tons entered, and 1665 vessels of 181,211 tons cleared. Area of the urban district, 2107 acres. Population (1891), 21,360; (1901), 24,213.

Llanes, a picturesque coast town of northern Spain, in the province of Oviedo, on the river Carrocedo. The population in 1897 was 19,224. The streets are mostly narrow and irregular, and contain some curious and interesting old houses. The parish church is a fine Gothic structure. The old Augustine convent has been turned into a school, with gymnasium, meteorological station, adult and commercial classes, and a library. The district is much frequented in summer. Llanes is a second-class port for light-draught vessels; but the entrance is narrow, and rather difficult in rough weather. The trade is chiefly in agricultural products, timber, butter, and fish.

Llerena, a town and railway station of Spain, in the province of Badajoz, near the Seville frontier. The population was 6181 in 1897. Remains of the old walls and towers still survive. The local markets are important. The surrounding districts produce wheat, chick-peas, wine, oil; and live stock is extensively reared. The local industries are chiefly the manufactures of soap, linen, and coarse woollen stuffs.

Lloyd, Edward (1845– ——), English tenor, was born in London, 7th March 1845, his father, Richard Lloyd, being vicar choralist at Westminster Abbey. From 1852 to 1860 he sang in the Abbey choir, and was thoroughly trained in music, eventually becoming solo tenor at the Chapel Royal. He began singing at concerts in 1867, and in 1871 appeared at the Gloucester Musical Festival. His fine evenly-produced voice and pure style at once brought him into notice, and he gradually took the place of Sims Reeves as the leading English tenor of the day, his singing of classical music, and especially of Handel, being particularly admired. At the Handel Festivals after 1888 he was the principal tenor, and even in the vast auditorium at the Crystal Palace his silver-trumpet tones triumphed over acoustic difficulties. In 1888, 1890, and 1892 he paid successful visits to the United States; but by degrees he appeared less frequently in public, and in 1900 he formally retired from the platform.

Lloyd's. See INSURANCE.

Loanda, or SÃO PAULO DE LOANDA, a city and episcopal see of Portuguese West Africa, capital of the province of Angola, situated on a bay between the rivers Bengo and Quanza. It is a good port, with a floating dock, and possesses a meteorological observatory, hospital, public garden, tramways, gas-works, statues to Salvador Correia de Sá, who wrested the colony from the Dutch, and to Pedro Alexandrino, a former governor, and is the terminus of the railway (190 miles) inland to Ambaca. The district of LOANDA stretches along the Atlantic from the river Loge to the Tapado, and has a population of 190,867, exclusive of Libollo and Songo. The trade reaches an annual value of 1¼ millions sterling, as compared with less than half a million sterling in 1888.

Lobánof-Rostofski, Alexis Borisovitch, PRINCE (1824–1896), Russian statesman, was born on 30th December 1824, and educated, like Prince Gortchakoff and so many other eminent Russians, at the lyceum of Tsarskoe Selo. At the age of twenty he entered the diplomatic service, and rose in the usual way till he became Minister at Constantinople in 1859. In 1863 a regrettable incident in his private life made him retire temporarily from the public service, but four years later he re-entered it and served for ten years as *adlatus* to the Minister of the Interior. At the close of the Russo-Turkish war in 1878 he was selected by the emperor to fill the post of ambassador at Constantinople, and for more than a year he carried out with great ability the policy of his Government, which aimed at re-establishing tranquillity in the Eastern Question, after the volcanic disturbances produced by the reckless action of his predecessor, Count Ignatief. In 1879 he was transferred to London, and in 1882 to Vienna; and in March 1895 he was appointed Minister of Foreign Affairs in succession to M. de Giers. In this important position he displayed much of the caution of his predecessor, but adopted a more energetic policy in European affairs generally and especially in the Balkan Peninsula. At the time of his appointment the attitude of the Russian Government towards the Slav nationalities had been for several years one of extreme reserve, and he had seemed as ambassador to sympathize with this attitude. But as soon as he became Minister of Foreign Affairs, Russian influence in the Balkan Peninsula suddenly revived. Servia received financial assistance; a large consignment of arms was sent openly from St Petersburg to the prince of Montenegro; Prince Ferdinand of Bulgaria became ostensibly reconciled with the Tsar, and his son Boris was received into the Eastern Orthodox Church; the Russian embassy at Constantinople tried to bring about a reconciliation between the Bulgarian Exarch and the Œcumenical Patriarch; Bulgarians and Servians professed, at the bidding of Russia, to lay aside their mutual hostility. All this seemed to foreshadow the creation of a Balkan confederation hostile to Turkey, and the Sultan had reason to feel alarmed. In reality Prince Lobánof was merely trying to establish a strong Russian hegemony among these nationalities, and he had not the slightest intention of provoking a new crisis in the Eastern Question so long as the general European situation did not afford Russia a convenient opportunity for solving it in her own interest without serious intervention from other Powers. Meanwhile he considered that the integrity and independence of the Ottoman Empire must be maintained so far as these other Powers were concerned. Accordingly, when Lord Salisbury proposed energetic action to protect the Armenians, the Cabinet of St Petersburg suddenly assumed the *rôle* of protector of the Sultan, and vetoed the proposal. At the same time efforts were made to weaken the Triple Alliance, the principal instrument employed being the *entente* with France, which Prince Lobánof helped to convert into a formal alliance between the two Powers. In the Far East he was not less active, and became the protector of China in the same sense as he had shown himself the protector of Turkey. Japan was compelled to give up her conquests on the Chinese mainland, so as not to interfere with the future action of Russia in Manchuria, and the financial and other schemes for increasing Russian influence in that part of the world were vigorously supported. Strange to say, all this activity, though combined with a haughty tone towards foreign Governments and diplomatists, did not produce much general apprehension, probably because there was a widespread conviction that he desired to maintain peace, and that his great ability and strength of character would enable him to control the dangerous forces which he boldly set in motion. However this may be, before he had time to mature his schemes, and when he had been the director of Russian policy for only eighteen months, he died suddenly of heart disease when travelling with the emperor on 30th August 1896. Personally Prince Lobánof was a *grand seigneur* of the Russian type, proud of being descended from the independent princes of Rostof, and at the same time an amiable man of wide culture, deeply versed in Russian history and genealogy, and perhaps the first authority of his time in all that related to the reign of the Emperor Paul. (D. M. W.)

Lobatchewsky, Nicolas Ivanovitch (1793–1856), Russian mathematician, was born at Makarief, Nijni-Novgorod, in 1793. His father died about 1800, and his mother, who was left in very poor circumstances, removed to Kazañ with her three sons, who went to school at the gymnasium of that town. In 1807 Nicolas, the second boy, entered as a student in the University of Kazañ, then recently established. Five years later, having completed the curriculum, he began to take part in the teaching, becoming assistant professor in 1814 and extraordinary professor two years afterwards. In 1823 he succeeded to the ordinary professorship of mathematics, and retained the chair until about 1846, when he seems to have fallen into official disfavour. At that time his connexion with the university to which he had devoted his life practically came to an end, except that in 1855, at the celebration of its jubilee, he brought it as a last tribute his *Pangéométrie*, in which he summarized the results of his geometrical studies. He died on 24th February (N.S.) 1856. Lobatchewsky's fame has probably become much greater since his death than ever it was in his lifetime. He was one of the first thinkers to apply a critical treatment to the fundamental principles of geometry, which, as laid down by Euclid, had been accepted almost without question for two thousand years, and he thus became a pioneer of that modern geometry which deals with space other than as defined by Euclid's postulates. His first contribution to the theory of hypergeometry is believed to have been given in a lecture at Kazañ in 1826, but the subject is treated in many of his subsequent memoirs, among which may be mentioned the *Geometrische Untersuchungen zur Theorie der Parallellinen* (Berlin, 1840), and the *Pangéométrie* already referred to, which in the sub-title is described as a précis of geometry founded on a general and rigorous theory of parallels. (See GEOMETRY, NON-EUCLIDEAN.) In addition to his geometrical studies, he made various contributions to other branches of mathematical science, among them being an elaborate treatise on algebra (Kazañ, 1834). Besides being a geometer of power and originality, Lobatchewsky possessed the gift, not vouchsafed to every great mathematician, of being an excellent man of business. Under his administration the University of Kazañ prospered as it had never done before; and he not only organized the teaching staff to a high degree of efficiency, but arranged and enriched its library, furnished instruments for its observatory, collected specimens for its museums, and provided it with proper buildings. In order to be able to supervise the erection of the last, he studied architecture, with such effect, it is said, that he was able to carry out the plans at a cost considerably below the original estimates.

Löbau, a town of Germany, on the Löbau water, 12 miles south-east of the town and in the circle of Bautzen, kingdom of Saxony, on the Dresden–Görlitz railway, with lines to Oberoderwitz and Ebersbach. There are three Protestant churches, one Catholic church, a seminary for teachers, a *real*, a commercial, and a burgher school. It has dye, agricultural implement, pianoforte, and button works, and a considerable trade in grain, yarns, linens, and stockings. Population (1890), 7523; (1900), 9627.

Lob-nor, or LOP-NOR, a lake of Central Asia, in the Gobi Desert, between the Altyn Tagh on the south and the Kurruk Tagh on the north. Previous to 1876 it was placed in nearly all maps at 42° 30′ N., a position which agreed with the accounts of ancient Chinese geographers. In the year mentioned the Russian Prjevalsky discovered two closely connected lake-basins, Kara-Buran and Kara-Koshun, fully one degree farther south, and considerably to the east of the site of the old Lop-nor, which lake-basins he nevertheless regarded as being identical with the old Lop-nor of the Chinese. But the water they contained he pronounced to be fresh water. This identification was disputed by baron von Richthofen, on the ground that the Lop-nor, the "Salt Lakes" of the Chinese geographers, could not be filled with fresh water; moreover, being the gathering basin of the desert stream the Tarim, it was bound to be salt, more especially as the lake had no outflow. Prjevalsky visited the Lop-nor region again in 1885, and adhered to his opinion. But ten years later it was explored anew by Dr Sven Hedin, the Swedish traveller, who ascertained that the Tarim empties part of its waters into another lake, or rather string of lakes (Avullu-köll, Kara-köll, Tayek-köll, and Arka-köll), which *are* situated in 42° 30′ N., and thus so far justified the views of von Richthofen, and confirmed the Chinese accounts. At the same time he advanced reasons for believing that Prjevalsky's lake-basins, the southern Lop-nor, are of quite recent origin—indeed, he fixed upon the year 1720 as the date of their formation. Besides this, he argued that there exists a close inter-relation between the northern Lop-nor lakes and the southern Lop-nor lakes, so that as the water in the one group increases, it decreases to the same proportion and volume in the other. He also argued that the four lakes of northern Lop-nor are slowly moving westwards under the incessant impetus of wind and sandstorm (*buran*). These conclusions were afterwards controverted by the Russian geographer, M. Kozloff, who visited the Lop-nor region in 1893–94—that is, before Dr Sven Hedin's examination. Finally, in 1900 the Swedish explorer, following up the course of the Kum-daria, discovered at the foot of Kurruk Tagh the basin of a desiccated salt lake, which he holds to be the true Lop-nor of the Chinese geographers; and at the same time he found that the Kara-Koshum or Lop-nor of Prjevalsky had extended towards the north, but shrunk in the south. Thus the old Lop-nor no longer exists, but in place of it there are a number of much smaller lakes of newer formation. From all this it may fairly be inferred that, owing to the uniform level of the region, the sluggish flow of the Tarim, its tendency to divide and reunite, conjoined with the violence of the winds (mostly from the east and north-east), and the rapid and dense growth of the reed-beds in the shallow marshes, the drainage waters of the Tarim basin gather now in greater volume in one depression, and now in greater volume in another; and this view derives support from the extreme shallowness of the lakes in both Dr Sven Hedin's northern Lop-nor and Prjevalsky's southern Lop-nor.

See the accounts (in Russian) of Prjevalsky's first (1876–77) and second (1885) journeys.—VON RICHTHOFEN. "Bemerkungen zu den Ergebnissen von Oberst-Lieutenant Prjewalskis Reise nach dem Lop-noor," in *Verhandl. der Gesch. f. Erdkunde zu Berlin*, 1878, pp. 121 *et seq.*—SVEN HEDIN. *Through Asia* (London, 1898), vol. i. pp. 15 *et seq.*, and vol. ii. pp. 864 *et seq.* (J. T. BE.)

LOCAL GOVERNMENT (ENGLAND AND WALES).

LOCAL Government may be defined as the government of a local area as distinguished from the kingdom at large. It is that part of the government of the State which the supreme legislature has thought fit to delegate to local authorities or bodies, and it is therefore restricted not merely in respect of area, but in respect of the character and extent of the powers and duties entrusted to the local body. The system of local government now existing in England may be said to have been founded in 1888, when the Local Government Act of that year was passed. Since then the entire system of the government of districts and parishes has been reorganized with due regard to the preceding legislation. The largest area of local government is the county; next to that the sanitary district, urban or rural, including under this head municipal boroughs, all of which are urban districts. The parish is, speaking generally, the smallest area, though, as will hereafter be seen, part of a parish may be a separate area for certain purposes; and there may be united districts or parishes for certain purposes. It will be convenient to follow this order in the present article. But before doing so, it should be pointed out that all local bodies in England are to some extent subject to the control of central authorities, such as the Privy Council, the Home Office, the Board of Agriculture, the Board of Trade, the Board of Education, or the Local Government Board.

The Local Government Board.

The subject of the Poor Law is separately treated, and the functions and duties of the Local Government Board as the successors of the Poor Law Board need not here be referred to. In 1848, pursuant to the Public Health Act of that year, the General Board of Health was established, and it continued in existence until 1854, when it was reconstituted. The existence of the new board, which was originally limited to one year, was extended from year to year until 1858, when it was allowed to expire, its powers under the various Acts for the prevention of diseases being transferred to the Privy Council, while those which related to the control of local authorities passed to the Secretary of State for the Home Department, to whose department the staff of officers and clerks formerly under the General Board of Health was transferred. This state of affairs continued until 1871, when the Local Government Board was constituted. It consists of a president appointed by His Majesty, and of the following *ex-officio* members: the president of the Privy Council, all the principal Secretaries of State for the time being, the Lord Privy Seal, and the Chancellor of the Exchequer. The board, as thus constituted, has power to appoint such secretaries, assistant-secretaries, inspectors, auditors, clerks, messengers, and other officers, as they may with the sanction of the Treasury determine. The president and one of the secretaries may sit in Parliament. To the board were transferred all the powers of the Secretary of State under the Public Health Act, 1848, and the numerous Acts relating to sanitary matters and the government of sanitary districts which had passed subsequently; together with all the powers and duties of the Privy Council under the Acts relating to the prevention of epidemic disease and to vaccination. Its powers and duties have been largely added to by subsequent legislation. A mere enumeration of them would be profitless. In so far as they affect local authorities, they will be mentioned hereafter under various heads.

The county and the county council.

The Administrative County.—For purposes of local government the geographical and the administrative county are generally the same. But this is not always the case. Thus each of the three Ridings of Yorkshire is an administrative county, as also is each of the three divisions of Lincolnshire, the eastern and western divisions of Sussex, the eastern and western divisions of Suffolk, the Isle of Ely and the residue of the county of Cambridge, the Soke of Peterborough and the rest of the county of Northampton. The metropolis forms the county of London. The administrative county includes all places within its area, with two important exceptions. The first of these consists of the county borough. The second is the quarter sessions borough, which forms part of the county for certain specified purposes only. But the county includes all other places, such as liberties and franchises, which before 1888 were exempt from contribution to county rate. For each administrative county a county council is elected. For purposes of election the entire county is divided into divisions corresponding to the wards of a municipal borough, and one councillor is elected for each electoral division.

County council elections.

The electors are the county electors, *i.e.*, in a borough the persons enrolled as burgesses, and in the rest of the county the persons who are registered as county electors, *i.e.*, those persons who possess in a county the same qualification as burgesses must have in a borough, and are registered.

The qualification of a burgess or county elector is substantially the occupation of rated property within the borough or county, residence during a qualifying period of twelve months within the borough or county, and payment of rates for the qualifying property. A person so qualified is entitled to be enrolled as a burgess, or registered as a county elector (as the case may be), unless he is alien, has during the qualifying period received union or parochial relief or other alms, or is disentitled under some Act of Parliament such as the Corrupt Practices Act, the Felony Act, &c. The lists of burgesses and county electors are prepared annually by the overseers of each parish in the borough or county, and are revised by the revising barrister at courts holden by him for the purpose in September or October of each year. When revised they are sent to the town clerk of the borough, or to the clerk of the peace of the county, as the case may be, by whom they are printed. The lists are conclusive of the right to vote at an election, although on election petition involving a scrutiny the vote of a person disqualified by law may be struck off, notwithstanding the inclusion of his name in a list of voters.

The qualification of a county councillor is similar to that required of a councillor in a municipal borough, with some modifications. A person may be qualified in any one of the following ways: viz., by being (1) enrolled as a county elector, and possessed of a property qualification consisting of the possession of real or personal property to the amount of £1000 in a county having four or more divisions, or of £500 in any other county, *or* the being rated to the poor rate on an annual value of £30 in a county having four or more divisions, or of £15 in any other county; (2) enrolled in the non-resident list, and possessed of the same property qualification (the non-resident list contains the names of persons who are qualified for enrolment in all respects save residence in the county or within seven miles thereof, and are actually resident beyond the seven miles and within fifteen miles); (3) entitled to elect to the office of county councillor (for this qualification no property qualification is required, but the office of a councillor elected on this qualification only becomes vacant if for six months he ceases to reside within the county); (4) a peer owning property in the county; (5) registered as a parliamentary voter in respect of the ownership of property in the county. Clerks in holy orders and ministers of religion are not disqualified as they are for being borough councillors, but in other respects the persons disqualified to be elected for a county are the same as those disqualified to be elected for a borough. Such disqualifications include the holding of any office or place of profit under the council other than the office of chairman, and the being concerned or interested in any contract or employment with, by, or on behalf of the council.

County councillors are elected for a term of three years, and at the end of that time they retire together. The ordinary day of election is the 8th March, or some day between the 1st and 8th March fixed by the council. Candidates are nominated in writing by a nomination paper signed by a proposer and seconder, and subscribed by eight other assenting county electors of the division; and in the event of there being more valid nominations than vacancies, a poll has to be taken in the manner prescribed by the Ballot Act, 1872. Corrupt and illegal practices at the election are forbidden by a statute passed in the year 1894, which imposes heavy penalties and disqualifications for the offences which it creates. These offences include not only treating, undue influence, bribery and personation, but certain others, of which the following are the chief:—Payment on account of the conveyance of electors to or from the poll; payment for any committee room in excess of a prescribed number; the incurring of expenses in and about the election beyond a certain maximum; employing, for the conveyance of electors to or from the poll, hackney carriages or carriages kept for hire; payments for bands, flags, cockades, &c.; employing for payment persons at the election beyond the prescribed number; printing and publishing bills, placards, or posters which do not disclose the name and address of the printer or publisher; using as committee rooms or for meetings any licensed premises, or any premises where food or drink is ordinarily sold for consumption on the premises, or any club premises where intoxicating liquor is supplied to members. In the event of an illegal practice, payment, employment, or hiring, committed or done inadvertently, relief may be given by the High Court, or by an Election Court, if the validity of the election is questioned on petition; but unless such relief is given (and it will be observed that it cannot be given for a *corrupt* as distinguished from an illegal practice), an infringement of the Act may avoid the election altogether. The validity of the election may be questioned by election petition. Indeed, this is the only method when it is sought to set aside the election on any of the usual grounds, such as corrupt or illegal practices, or the disqualification of the candidate at the date of election. Election petitions against county councillors and members of other local bodies (borough councillors, urban and rural district councillors, members of school boards and boards of guardians) are classed together as municipal election petitions, and are heard in the same way, by a commissioner who must be a barrister of not less than fifteen years' standing. The petition is tried in open court at some place within the county, the expenses of the court being provided in the first instance by the Treasury, and repaid out of the county rates, except in so far as the court may order them to be paid by either of the parties. If a candidate is unseated a casual vacancy is created which has to be filled by a new election. A county councillor is required to accept office by making and subscribing a declaration in the prescribed form that he will duly and faithfully perform the duties of the office, and that he possesses the necessary qualification. The declaration may be made at any time within three months after notice of election. If the councillor does not make it within that time, he is liable to a fine the amount of which, if not determined by bye-law of the council, is £25 in the case of an alderman or councillor, and £50 in the case of the chairman. Exemption may, however, be claimed on the ground of age, physical or mental incapacity, previous service, or payment of the fine within five years, or on the ground that the claimant was nominated without his consent. If during his term of office a member of the council becomes bankrupt, or compounds with his creditors, or is (except in case of illness) continuously absent from the county, being chairman for more than two months, or being alderman or councillor for more than six months, his office becomes vacant by declaration of the council. In the case of disqualification by absence, the same fines are payable as upon non-acceptance of office, and the same liability arises on resignation. Acting without making the declaration, or without being qualified at the time of making the declaration, or after ceasing to be qualified, or after becoming disqualified, involves liability to a fine not exceeding £50, recoverable by action.

Chairman, &c.

The councillors who have been elected come into office on the 8th March in the year of election. The first quarterly meeting of the newly-elected council is held on the 16th or on such other day within ten days after the 8th as the county council may fix. The first business at that meeting is the election of the chairman, whose office corresponds to that of the mayor in a borough. He is elected for the ensuing year, and holds office until his successor has accepted office. The chairman must by a fit person, elected by the council from their own body or from persons qualified to be councillors. He may receive such remuneration as the council think reasonable. He is by virtue of his office a justice of the peace for the county. Having elected the chairman, the meeting proceeds to the election of aldermen, whose number is one-third of the number of councillors, except in London, where the number is one-sixth. An alderman must be a councillor or a person qualified to be a councillor. If a councillor is elected he vacates his office of councillor, and thus creates a casual vacancy in the council. In every third year one-half of the whole number of aldermen go out of office, and their places are filled by election, which is conducted by means of voting papers. It will be observed, therefore, that while a county councillor holds office for three years, a county alderman holds office for six. The council may also appoint a vice-chairman who holds office during the term of office of the chairman; in London the council have power to appoint a paid deputy chairman.

Officers.

It may be convenient at this point to refer to the officers of the county council. Of these, the chief are the clerk, the treasurer, and the surveyor. Before 1888 the clerk of the peace was appointed in a county by the *custos rotulorum.* He held office for life or good conduct, and had power to act by a sufficient deputy. Under the Act of 1888 existing clerks of the peace became clerks of the councils of their counties, holding office by the same tenure as formerly, except in the county of London, where the offices were separated. Thereafter a new appointment to the offices of clerk of the peace and clerk of the county council was to be made by the standing joint-committee, at whose pleasure he is to hold office. The same committee appoint the deputy-clerk, and fix the salaries of both officers. The clerk of the peace was formerly paid by fees which were fixed by quarter sessions, but under recent enactments he is now generally if not in every case paid by salary, the fees received by him being paid into the county fund. The county council may also employ such other officers and servants as they may think necessary.

Business.

Subject to a few special provisions in the Local Government Act of 1888, the business of the county council is regulated by the provisions laid down in the Municipal Corporations Act, 1882, with regard to borough councils. There are four quarterly meetings in every year, the dates of which may be fixed by the council, with the exception of that which must be held on the 16th March or some day within ten days after the 8th of March as already noticed when treating of elections. Meetings are convened by notices sent to members stating the time and place of the meeting and the business to be transacted. The chairman, or in his absence the vice-chairman, or in the absence of both an alderman or councillor appointed by the meeting, presides. All questions are determined by the votes of the majority of those present and voting, and in case of equality of votes the chairman has a casting vote. Minutes of the proceedings are taken, and if signed by the chairman at the same or the next meeting of the council are evidence of the proceedings. In all other respects the business of the council is regulated by standing orders which the council are authorized to make. Very full power is given to appoint committees, which may be either general or special, and to them may be delegated, with or without restrictions or conditions, any of their powers or duties except that of raising money by rate or loan. Power is also given to appoint joint-committees with other county councils in matters in which the two councils are jointly interested, but a joint-committee so appointed must not be confounded with the standing joint-committee of the county council and the quarter sessions, which is a district statutory body and is elsewhere referred to. The finance committee is also a body with distinct duties.

Relation of county to boroughs.

In order to appreciate some of the points relating to the finance of a county council, it is necessary to indicate the relations between an administrative county and the boroughs which are locally situate within it. The Act of 1888 created a new division of boroughs into three classes; of these the first is the county borough. A certain number of boroughs which either had a population of not less than 50,000, or were counties of themselves, were made counties independent of the county council and free from the payment of county rate. In such boroughs the borough council have, in addition to their powers under the Municipal Corporations Act, 1882, all the powers of a county council under the Local Government Act. They are independent of the county council, and their only relation is that in some instances they pay a contribution to the county—*e.g.*, for the cost of assizes where there is no separate assize for the borough. The boroughs thus constituted county boroughs are enumerated in the schedule to the Local Government Act, 1888, but to the list therein contained there must now be added Grimsby, Oxford, and Newport (Mon.), which have been made county boroughs since 1888.

The larger quarter sessions boroughs, *i.e.*, those which had, according to the census of 1881, a population exceeding 10,000, form part of the county, and are subject to the control of the county council, but only for certain special purposes. The reason for this is that while in counties the powers and duties under various Acts were entrusted to the county authority, in boroughs they were exercised by the borough councils. In the class of boroughs now under consideration these powers and duties are retained by the borough council; the county council exercise no jurisdiction within the borough in respect of them, and the borough is not rated in respect of them to the county rate. The Acts referred to include those relating to the diseases of animals, destructive insects, explosives, fish conservancy, gas meters, margarine, police, reformatory and industrial schools, riot (damages), sale of food and drugs, weights and measures. But for certain purposes these boroughs are part of the county and rateable to county rate—*e.g.*, main roads, cost of assizes and sessions, and in certain cases pauper lunatics. The county councillors elected for one of these boroughs may not vote on any matter involving expenditure on account of which the borough is not assessed to county rate.

The third class of boroughs comprises those which have a separate court of quarter sessions, but had according to the census of 1881 a population of less than 10,000. All such boroughs form part of the county for the purposes of pauper lunatics, analysts, reformatory and industrial schools, fish conservancy, explosives, and, of course, the purposes for which the larger quarter sessions boroughs also form part of the county, such as main roads, and are assessed to county rate accordingly. And in a borough, whether a quarter sessions borough or not, which had in 1881 a population of less than 10,000, all the powers which the borough council formerly possessed as to police, analysts, diseases of animals, gas meters, and weights and measures cease and are transferred to the county council, the boroughs becoming in fact part of the area of the county for these purposes.

It will be seen therefore that for some purposes, called in the Act general county purposes, the entire county, including all boroughs other than county boroughs, is assessed to the county rate; while for others, called special county purposes, certain boroughs are now assessed. This explanation is necessary in order to appreciate what has now to be said about county finance. But before leaving the consideration of the area of the county it may be added that all liberties and franchises are now merged in the county and subject to the jurisdiction of the county council.

Finance.

The county council is a body corporate with power to hold lands. Its revenues are derived from various sources which will presently be mentioned, but all receipts have to be carried to the county fund, either to the general county account if applicable to general county purposes, or to the special county account if applicable to special county purposes. The county council may, with the consent of the Local Government Board, borrow money on the security of the county fund or any of its revenues, for consolidating the debts of the county; purchasing land or buildings; any permanent work or other thing, the cost of which ought to be spread over a term of years; making advances in aid of the emigration or colonization of inhabitants of the county; and any purpose for which quarter sessions or the county council are authorized by any Act to borrow. If, however, the total debt of the council will, with the amount proposed to be borrowed, exceed one-tenth of the annual rateable value of the property in the county, the money cannot be borrowed unless under a provisional order made by the Local Government Board and confirmed by Parliament. The period for which a loan is made is fixed by the county council with the consent of the Local Government Board, but may not exceed thirty years, and the mode of repayment may be by equal yearly or half-yearly instalments of principal or of principal and interest combined, or by means of a sinking fund invested and applied in accordance with the Local Government Acts. The loans authorized may be raised by debentures or annuity certificates under these Acts, or by the issue of county stock, and in some cases by mortgage.

The county council must appoint a finance committee for regulating and controlling the finance of the county, and the council cannot make any order for the payment of money out of the county fund save on the recommendation of that committee. Moreover, the order for payment of any sum must be made in pursuance of an order of the council signed by three members of the finance committee present at the meeting of the council, and countersigned by the clerk. The order is directed to the county treasurer, by whom authorized payments are then made.

The accounts of the receipts and expenditure of the county council are made up for the twelve months ending the 31st March in each year, and are audited by a district auditor. The form in which the accounts must be made up is prescribed by the Local Government Board. The auditor is a district auditor appointed by the Local Government Board under the District Auditors Act, 1879, and in respect of the audit the council is charged with a stamp duty, the amount of which depends on the total of the expenditure comprised in the financial statement. Before each audit the auditor gives notice of the time and place appointed, and the council publish the appointment by advertisement. A copy of the accounts has to be deposited for public inspection for seven days before the audit. The auditor has the fullest powers of investigation; he may require the production of any books or papers, and he may require the attendance before him of any person accountable. Any owner of property or ratepayer may attend the audit and object to the accounts, and either on such objection or on his own motion the auditor may disallow any payment and surcharge the amount on the persons who made or authorized it. Against any allowance or surcharge appeal lies to the High Court if the question involved is one of law, or to the Local Government Board, who have jurisdiction to remit a surcharge if, in the circumstances, it appears to them to be fair and equitable to do so. It will be seen that this is really an effective audit.

Revenue of county council.

The sources of revenue of the council are the Exchequer contribution, income from property and fees, and rates. Before 1888 large grants of money had been made annually to local authorities in aid of local taxation. Such grants represented a contribution out of taxation for the most part arising out of property other than real property, while local taxation fell on real property alone. By the Act of 1888 it was provided that for the future such annual grants should cease, and that other payments should be made instead thereof. The Commissioners of Inland Revenue pay into the Bank of England, to an account called "the local taxation account," the sums ascertained to be the proceeds of the duties collected by them in each county on what are called local taxation licences, which include licences for the sale of intoxicating liquor, licences on dogs, guns, establishment licences, &c. The amount so ascertained to have been collected in each county is paid under direction of the Local Government Board to the council of that county. The Commissioners of Inland Revenue also pay into the same account a sum equal to one and a half per cent. on the net value of personal property in respect of which estate duty is paid. Under the Customs and Inland Revenue Act, 1890, certain duties imposed on spirits and beer are also to be paid to "the local taxation account." The sums so paid in respect of the duties last above mentioned, and in respect of the estate duty and spirits and beer additional duties, are distributed among the several counties in proportion to the share which the Local Government Board certify to have been received by each county during the financial year ending the 31st March 1888, out of the grants theretofore made out of the Exchequer in aid of local rates. The payments so made out of "the local taxation account" to a county council are paid to the county fund, and carried to a separate account called "the Exchequer contribution account." The money standing to the credit of this account is applied: (i.) in paying any costs incurred in respect thereof or otherwise chargeable thereon; (ii.) in payment of the sums required by the Local Government Act, 1888, to be paid in substitution for local grants; (iii.) in payment of the new grant to be made by the county council in respect of the costs of union officers; and (iv.) in repaying to "the general county account" of the county fund the costs on account of general county purposes for which the whole area of the county (including boroughs other than county boroughs) is liable to be assessed to county contribution. Elaborate provision is made for the distribution of the surplus (if any), with a view to securing a due share being paid to the quarter sessions boroughs.

The payments which the county council have to make in substitution for the local grants formerly made out of Imperial funds include payments for or towards the remuneration of the teachers in poor-law schools and public vaccinators; school fees paid for children sent from a workhouse to a public elementary school; half of the salaries of the medical officer of health and the inspectors of nuisances of district councils; the remuneration of registrars for births and deaths; the maintenance of pauper lunatics; half of the cost of the pay and clothing of the police of the county, and of each borough maintaining a separate police force. In addition to the grants above mentioned, the county council is required to grant to the guardians of every poor-law union wholly or partly in their county an annual sum for the costs of the officers of the union and of district schools to which the union contributes. Another source is the income of any property belonging to the council, but the amount of this is usually small. The third source of revenue consists of the fees received by the different officers of the county councils or of the joint-committee. For example, fees received by the clerk of the peace, inspectors of weights and measures, and the like. These fees are paid into the county fund, and carried either to "the general county account" or, if they have been received in respect of some matter for which part only of the county is assessed, then to the special account to which the rates levied for that purpose are carried. The remaining source of income of a county council is the county rate, the manner of levying which is hereafter stated.

Powers transferred from quarter sessions.

Of the powers and duties of county councils, it may be convenient to treat of these first, in so far as they are transferred to or conferred on them by the Local Government Act, 1888, under which they were created, and afterwards in so far as they have been conferred by subsequent legislation. Before the passing of the Local Government Act, 1888, the only form of county government in England was that of the justices in quarter sessions. Quarter sessions were originally a judicial body, but being the only body having jurisdiction over the county as a whole, certain powers were conferred and certain duties imposed upon them with reference to various matters of county government from time to time. The principal object of the Act of 1888 was to transfer these powers and duties from the quarter sessions to the new representative body—the county council; and it may be said that substantially the whole of the administrative business of quarter sessions was thus transferred.

The subjects of such transfer include (i.) the making, assessing, and levying of county, police, hundred, and all rates, and the application and expenditure thereof, and the making of orders for the payment of sums payable out of any such rate, or out of the county stock or county fund, and the preparation and revision of the basis or standard for the county rate. With regard to the county rate, a few words of description may be sufficient here. The council appoint a committee called a county rate committee, who from time to time prepare a basis or standard for county rate—that is to say, they fix the amount at which each parish in the county shall contribute its quota to the county rate. As a general rule the poor-law valuations are followed, but this is not universally the case, some county councils adopting the assessment to income tax, schedule A, and others forming an independent valuation of their own. The overseers of any parish aggrieved by the basis may appeal against it to quarter sessions, and it is to be noticed that this appeal is not interfered with, the transfer of the duties of justices relating only to administrative and not to judicial business. When a contribution is required from county rate, the county council assess the amount payable by each parish according to the basis previously made, and send their precept to the guardians of the unions comprising the several parishes in the county, the guardians in their turn requiring the overseers of each parish to provide the necessary quota of that parish out of the poor rate, and the sum thus raised goes into the county fund. The police rate is made for the purpose of defraying the expenses of the county police. It is made on the same basis as the county rate, and is levied with it. The hundred rate is seldom made, though in some counties it may be made for purposes of main roads and bridges chargeable to the hundred as distinguished from the county at large; (ii.) the borrowing of money; (iii.) the passing of the accounts of and the discharge of the county treasurer; (iv.) shire halls, county halls, assize courts, the judges' lodgings, lock-up houses, court houses, justices' rooms, police stations and county buildings, works, and property; (v.) the licensing under any general Act of houses and other places for music or for dancing, and the granting of licences under the Racecourses Licensing Act, 1879; (vi.) the provision, enlargement, maintenance, and management and visitation of, and other dealing with, asylums for pauper lunatics; (vii.) the establishment and maintenance of, and the contribution to, reformatory and industrial schools; (viii.) bridges and roads repairable with bridges, and any powers vested by the Highways and Locomotives Amendment Act, 1878, in the county authority. It may be observed that bridges have always been at common law repairable by the county, although, with regard to bridges erected since the year 1805, these are not to be deemed to be county bridges repairable by the county unless they have been erected under the direction or to the satisfaction of the county surveyor. The common-law liability to repair a bridge extends also to the road or approaches for a distance of 300 feet on each side of the bridge. Of the powers vested in the county authority under the Highway Act, 1878, the most important are those relating to main roads, which are specially noticed hereafter. (ix.) The table of fees to be taken by and the costs to be allowed to any inspector, analyst, or person holding any office in the county other than the clerk of the peace and the clerks of the justices; (x.) the appointment, removal, and determination of salaries of the county treasurer, the county surveyor, the public analysts, any officer under the Explosives Act, 1875, and any officers whose remuneration is paid out of the county rate, other than the clerk of the peace and the clerks of the justices; (xi.) the salary of any coroner whose salary is payable out of the county rate, the fees, allowances, and disbursements allowed to be paid by any such coroner, and the division of the county into coroners' districts and the assignments of such districts; (xii.) the division of the county into polling districts for the purposes of parliamentary elections, the appointment of the places of election, the places of holding courts for the revision of the lists of voters, and the costs of and other matters to be done for the registration of parliamentary voters; (xiii.) the execution as local authority of the Acts relating to contagious diseases of animals, to destructive insects, to fish conservancy, to wild birds, to weights and measures, and to gas meters, and of the Local Stamp Act, 1869; (xiv.) any matters arising under the Riot (Damages) Act, 1886. Under this Act compensation is payable out of the police rate to any person whose property has been injured, stolen, or destroyed by rioters; (xv.) the registration of rules of scientific societies, the registration of charitable gifts, the certifying and recording of places of religious worship, the confirmation and record of the rules of loan societies. These duties are imposed under various statutes.

In addition to the business of quarter sessions thus transferred, there was also transferred to the county council certain business of the justices of the county out of session, that is to say, in petty or special sessions. This business consists of the licensing of houses or places for the public performance of stage plays, and the execution, as local authority, of the Explosives Act, 1875. Power was given by the Act to the Local Government Board to provide, by means of a provisional order, for transferring to county councils any of the powers and duties of the various central authorities which have been already referred to; but although such an order was at one time prepared, it has never been confirmed, and nothing has been done in that direction.

Police.

Apart from the business thus transferred to county councils, the Act itself has conferred further powers or imposed further duties with reference to a variety of other matters, some of which must be noticed. But before passing to them it is necessary here to call attention to one important subject of county government which has not been wholly transferred to the county council, namely, the police. It was matter of considerable discussion before the passing of the Act whether the police should remain under the control of the justices, or be transferred wholly to the control of the county council. Eventually a middle course was taken. The powers, duties, and liabilities of the quarter sessions and justices out of session with respect to the county police were vested in the quarter sessions and the county council jointly, and are now exercised through the standing joint-committee of the two bodies. That committee consists of an equal number of members of the county council and of justices appointed by the quarter sessions, the number being arranged between the two bodies or fixed by the Secretary of State. The committee are also charged with the duties of appointing or removing the clerk of the peace, and they have jurisdiction in matters relating to justices' clerks, the provision of accommodation for quarter sessions or justices out of session, and the like, and their expenses are paid by the county council out of the county fund. The standing joint-committee have power to divide their county into police districts, and, when required by Order in Council, are obliged to do so. In such a case, while the general expenditure in respect of the entire police force is defrayed by the county at large, the local expenditure, *i.e.*, the cost of pay, clothing, and such other expenses as the joint-committee may direct, are defrayed at the cost of the particular district for which it is incurred (see also POLICE).

County coroners.

Among the powers and duties given to county councils by the Local Government Act, 1888, the first to be mentioned, following the order in the Act itself, is that of the appointment of county coroners. The office of coroner is a very ancient one, and was formerly of much greater dignity and importance than it is at present. The duties of a coroner are now limited to the holding of inquiries into cases of death from causes suspected to be other than natural, and to a few miscellaneous duties of comparatively rare occurrence, such as the holding of inquiries relating to treasure trove, and acting instead of the sheriff on inquiries under the Lands Clauses Act, &c., when that officer is interested and thereby disabled from holding such inquiries. The office of coroner is a freehold one, that is to say, it is held for life or good conduct, and in a county the salary of the coroner is paid out of the county fund. Formerly he was elected by the freeholders of the county in pursuance of a writ *de coronatore eligendo*. The power of appointment is now given to the county council, who may appoint any fit person, not being a county alderman or county councillor, to fill the office, and in the case of a county divided into coroners' districts, may assign him a district. It has been decided, however, that the power hereby conferred does not extend to the appointment of a coroner for a liberty or other franchise who would not under the old law have been appointed by the freeholders. It may be mentioned that though a coroner may have a district assigned to him, he is nevertheless a coroner for the entire county throughout which he has jurisdiction.

Main roads.

It was provided by the Highway Act, 1878, that every road which was disturnpiked after the 31st December 1870 should be deemed to be a main road, the expenses of the repair and maintenance of which were to be contributed as to one-half thereof by the justices in quarter sessions, then the county authority. By another section of the same Act it was provided that where any highway in a county was a medium of communication between great towns, or a thoroughfare to a railway station, or otherwise such that it ought to be declared a main road, the county authority might declare it to be a main road, and thereupon one-half the expense of its maintenance would fall upon the county at large. Once a road became a main road it could only cease to be such by order of the Local Government Board. As already stated, the powers of the quarter sessions under the Act of 1878 were transferred to the county council under the Local Government Act of 1888, and that body alone has now power to declare a road to be a main road. But the Act of 1888 made some important changes in the law relating to the maintenance of main roads. It declared that thereafter not only the half but the whole cost of maintenance should be borne by the county. Provision is made for the control of main roads in urban districts being retained by the urban district council. In urban districts where such control has not been claimed, and in rural districts, the county council may either maintain the main roads themselves or allow or require the district councils to do so. The county council must in any case make a payment towards the costs incurred by the district council, and if any difference arises as to the amount of it, it has to be settled by the Local Government Board. In Lancashire the cost of main roads falls upon the hundred, as distinguished from the county at large, special provision being made to that effect. Special provision has also been made for the highways in the Isle of Wight and in South Wales, where the roads were formerly regulated by special acts, and not by the ordinary Highway Acts.

Rivers pollution prevention.

The county council have the same power as a sanitary authority to enforce the provisions of the Rivers Pollution Prevention Acts in relation to so much of any stream as passes through or by any part of their county. Under these Acts a sanitary authority is authorized to take proceedings to restrain interference with the due flow of a stream or the pollution of its waters by throwing into it the solid refuse of any manufactory or quarry, or any rubbish or cinders, or any other waste, or any putrid solid matter. They may also take proceedings in respect of the pollution of a stream by any solid or liquid sewage matter. They have the same powers with respect to manufacturing and mining pollutions, subject to certain restrictions, one of which is that proceedings are not to be taken without the consent of the Local Government Board. The county council may not only themselves institute proceedings under the Acts, but they may contribute to the costs of any prosecution under the Acts instituted by any other county or district council. The Local Government Board is further empowered by provisional order to constitute a joint-committee representing all the administrative counties through or by which a river passes, and confer on such committee all or any of the powers of a sanitary authority under the Acts.

Parliamentary and legal costs.

A county council has the same power of opposing Bills in Parliament and of prosecuting or defending any legal proceedings necessary for the promotion or protection of the interests of the inhabitants of a county as are conferred on the council of a municipal borough by the Borough Funds Act, 1872, with this difference, that in order to enable them to oppose a Bill in Parliament at the cost of the county rate, it is not necessary to obtain the consent of the owners and ratepayers within the county. The power thus conferred is limited to opposing Bills. The council are not authorized to promote any Bill, and although they frequently do so, they incur the risk that if the bill should not pass the members of the council will be surcharged personally with the costs incurred if they attempt to charge them to the county rate. Of course if the Bill passes, it usually contains a clause enabling the costs of promotion to be paid out of the county rate. It must not be supposed, however, that the county council have no power to institute or defend legal proceedings or oppose Bills save such as is expressly conferred upon them by the Local Government Act. In this respect they are in the same position as all other local authorities, with respect to whom it has been laid down that they may without any express power in that behalf use the funds at their disposal for protecting themselves against any attack made upon their existence as a corporate body or upon any of their powers or privileges.

Bye-laws.

The county council have also the same powers as a borough council of making bye-laws for the good government of the county and for the suppression of nuisances not already punishable under the general law. This power has been largely acted upon throughout England, and the courts of law have on several occasions decided that such bye-laws should be benevolently interpreted, and that in matters which directly arise and concern the people of the county, who have the right to choose those whom they think best fitted to represent them, such representatives may be trusted to understand their own requirements. Such bye-laws will therefore be upheld, unless it is clear that they are uncertain, repugnant to the general law of the land, or manifestly unreasonable. It may be mentioned that, while bye-laws relating to the good government of the county have to be confirmed by the Secretary of State, those which relate to the suppression of nuisances have to be confirmed by the Local Government Board. Such confirmation, however, though necessary to enable the council to enforce them, does not itself confer upon them any validity in point of law.

Medical officers.

The county council have power to appoint and pay one or more medical officers of health, who are not to hold any other appointment or engage in private practice without the express written consent of the council. The council may make arrangements whereby any district council or councils may have the services of the county medical officer on payment of a contribution towards his salary, and while such arrangement is in force the duty of the district council to appoint a medical officer is to be deemed to have been satisfied. Every medical officer, whether of a county or district, must now be legally qualified for the practice of medicine, surgery, and midwifery. Besides this, in the case of a county, or of any district or combination of districts of which the population exceeds 50,000, the medical officer must also have a diploma in public health, unless he has during the three consecutive years before 1892 been medical officer of a district or combination having a population of more than 20,000, or has before the passing of the Act been for three years a medical officer or inspector of the Local Government Board.

Alterations of local areas.

The only other powers and duties of a county council arising under the Local Government Act itself which it is necessary to notice are those relating to alterations of local areas. It may be convenient here to state that certain alterations of areas can only be effected through the medium of the Local Government Board after local inquiry. These cases include the alteration of the boundary of any county or borough, the union of a county borough with a county, the union of any counties or boroughs or the division of any county, the making of a borough into a county borough. In these cases the order of the Local Government Board is provisional only, and must be confirmed by Parliament. The powers of a county council to make orders for the alteration of local areas are as follows: When a county council is satisfied that a *primâ facie* case is made out as respects any county district not a borough, or as respects any parish, for a proposal for all or any of the things hereafter mentioned, they may hold a local inquiry after giving such notice in the locality and to such public departments as may be prescribed from time to time by the orders of the Local Government Board. The things referred to include the alteration of the boundary of the district or parish; the division or union thereof with any other district or districts, parish or parishes; the conversion of a rural district or part thereof into an urban district, or *vice versâ*. In these cases, after the local inquiry above referred to has been held, the county council, being satisfied that the proposal is desirable, may make an order for the same accordingly. The order has to be submitted to the Local Government Board, and that Board must hold a local inquiry in order to determine whether the order should be confirmed or not, if the council of any district affected by it, or one-sixth of the total number of electors in the district or parish to which it relates, petition against it. The Local Government Board have power to modify the terms of the order whether it is petitioned against or not, but if there is no petition, they are bound to confirm, subject only to such modifications. Very large powers are conferred upon county councils for the purpose of giving full effect to orders made by them under these provisions. A considerable extension of the same powers was made by the Local Government Act, 1894, which practically required every council to take into consideration the areas of sanitary districts and parishes within the entire administrative county, and to see that a parish did not extend into more than one sanitary district; to provide for the division of a district which did extend into more than one district into separate parishes, so that for the future the parish should not be in more than one county district; and to provide for every parish and rural sanitary district being within one county. An enormous number of orders under the Act of 1894 was made by county councils, and, speaking generally, it will now be found that no parish extends into more than one county or county district. Other powers and duties of the county council under the Act of 1894 will be noticed hereafter.

Of the statutes affecting county councils passed subsequent to 1888 mention need only be made of the chief.

Technical instruction.

Under the Technical Instruction Acts a county council are authorized out of the county fund to supply or aid the supply of technical or manual instruction. The amount to be raised in any one year is not to exceed the sum of one penny in the £. The county council is also empowered to make contributions for the purpose of technical education out of the sums received by them in respect of the residue of the English share of the local taxation (Customs and Excise) duties already referred to. Such contributions may be made over and above the limited amount which may be raised by rates. Provision is also made enabling the managers of any school for science and art or of any institution in the nature of a literary and scientific institution to transfer the school or institution to the county council.

Lunatics.

Part of the business transferred from quarter sessions to the council was that which related to pauper lunatics, but the whole subject of lunacy was consolidated by an Act of the year 1890, which again has been amended by a later Act. The councils of all administrative counties and county boroughs and the councils of a few specified quarter sessions boroughs, which before 1890 were independent areas for purposes of the Lunacy Acts, are local authorities for the purposes of the Lunacy Acts, and each of them is under an obligation to provide asylum accommodation for pauper lunatics. This accommodation may be provided by one council or by a combination of two or more, and such council or combination may provide one or more asylums. The county council exercise their powers through a visiting committee, consisting of not less than seven members, or, in the case of a combination, of a number of members appointed by each council in agreed proportions. In the case of a combination the expenses are defrayed by the several councils in such proportion as they may agree upon, and the proportion may be fixed with reference to either the accommodation required by each council or the population of the district. A county borough may also, instead of providing an asylum of its own, contract with the visiting committee of any asylum to receive the pauper lunatics from the borough. Private patients may be accommodated in the asylums provided by a county council, and received upon terms fixed by the visiting committee. The expenses of lunatic asylums are defrayed in the following manner: The guardians from whose union a lunatic is sent have to pay a fixed weekly sum, which may not exceed 14s. a week. A larger charge is made for lunatics received from unions outside the county, as these do not, of course, contribute anything towards the provision or up-keep of the asylum itself. In addition to the payments by guardians, there is a contribution of 4s. a week from "the Exchequer contribution account" already mentioned, and the remaining expenses are defrayed out of the county rate.

Allotments.

Under the Allotments Acts, if a district council fail to provide allotments upon being required so to do, application may be made to the county council, who may thereupon take upon themselves the powers of a district council and provide the allotments required in the district whose council have made default. Moreover, the county council under these Acts may give compulsory powers of purchase to a district council if the latter cannot obtain a sufficient quantity of suitable land by agreement. They cannot, however, make orders for this purpose except after local inquiry, and, in the event of objection, their orders must be confirmed by the Local Government Board. If the county council refuse to make an order, the Local Government Board may make it after holding local inquiry.

Small holdings.

A county council may, under the Small Holdings Act, 1892, acquire land by agreement, and improve and adapt it for the purpose of providing small holdings for persons who desire to have such holdings for cultivation. Such holdings must not exceed 50 acres in extent or £50 annual value. The purchaser has to pay down at least one-fifth of the purchase money; the balance is charged on the holding and may be repaid by instalments extending over a period not exceeding fifty years. A county council may borrow for purposes of the Act referred to.

Hospitals.

Under the Isolation Hospitals Act, 1893, a county council may provide for the establishment of isolation hospitals for the reception of patients suffering from infectious diseases on the application of any local authority within the county, or on the report of the medical officer of the county that hospital accommodation is necessary and has not been provided. The council by their order constitute a hospital district and form a committee for its administration. The committee have power to purchase land, erect a hospital, provide all necessary appliances, and generally administer a hospital for the purposes above mentioned.

Parish councils.

The powers and duties of a county council under the Local Government Act, 1894, are numerous and varied, and the chief of them are mentioned hereafter in connexion with parish councils. The county council may establish a parish council in a parish which has a population of less than 300, and may group small parishes under a common parish council; in every case they fix the number of members of the parish council. They may authorize a parish council to acquire land compulsorily, subject to confirmation of their order by the Local Government Board if it is petitioned against. They may make an order authorizing a parish council to hire land compulsorily for allotments. They may authorize the borrowing of money by a parish council, and they may lend money to a parish council. They may hear complaints by a parish council that a district council has failed to provide sufficient sewerage or water-supply, or has failed to enforce the provisions of the Public Health Acts in their district, and on such complaint they may transfer to themselves and exercise the powers of the defaulting council, or they may appoint a person to perform those duties. They may make orders for the custody and preservation of public books, writings, papers, and documents belonging to a parish. They may divide a parish into wards for purposes of elections or of parish meetings. They may authorize district councils to aid persons in maintaining rights of common. They may, on the petition of a district council, transfer to themselves the powers of a district council who have refused or failed to take the necessary proceedings to assert public rights of way or protect roadside wastes. They may dispense with the disqualification of a parish or district councillor arising only by reason of his being a shareholder in a water company or similar company contracting with the council, and, as has above been stated, they have large powers of altering the boundaries of parishes.

Diseases of animals.

Among the powers and duties of quarter sessions transferred to county councils were those arising under the Acts relating to contagious diseases of animals. These Acts were consolidated and amended by a statute of 1894, and the county council remain the local authority for the execution of that Act in counties.

Light railways.

Under the Light Railways Act, 1896, a county council may be authorized by order of the Light Railway Commissioners to construct and work or contract for the construction or working of a light railway, lend money to a light railway company, or join any other council in these matters.

Miscellaneous.

Among other statutes conferring powers or imposing duties upon county councils, mention may be made of such Acts as those relating to sea fisheries regulation, open spaces, police superannuation, railway and canal traffic, shop hours, weights and measures, fertilizing and feeding stuffs, wild birds' protection, land transfer, locomotives on highways, and the acquisition of small dwellings. Sufficient has been said to indicate that the Legislature from time to time recognizes the important position of the county council as an administrative body, and is continually extending their functions.

The municipal borough and the borough council.

A municipal borough is a place which has been incorporated by royal charter. In the year 1835 the Municipal Corporations Act was passed, which made provision for the constitution and government of certain boroughs which were enumerated in a schedule. That Act was from time to time amended, until in 1882 by an Act of that year the whole of the earlier Acts were repealed and consolidated. A few ancient corporations which were not enumerated in the schedule to the Act of 1835 continued to exist after that year, but by an Act of 1883 all of these, save such as should obtain charters before 1886, were abolished, the result being that all boroughs are now subject to the Act of 1882. A place is still created a borough by royal charter on the petition of the inhabitants, and when that is done the provisions of the Act of 1882 are applied to it by the charter itself. The charter also fixes the number of councillors, the boundaries of the wards (if any), and assigns the number of councillors to each ward, and provides generally for the time and manner in which the Act of 1882 is first to come into operation. The charter is supplemented by a scheme which makes provision for the transfer to the new borough council of the powers and duties of existing authorities, and generally for the bringing into operation of the Act of 1882. If the scheme is opposed by the prescribed proportion (one-twentieth) of the owners and ratepayers of the proposed new borough, it has to be confirmed by Parliament. The governing body in a borough is the council elected by the burgesses.

The qualification of a burgess has been incidentally mentioned in connexion with that of a county elector, and need not be further noticed. A borough councillor must be qualified in the same manner as a county councillor, and he is disqualified in the same way, with this addition, that a peer or ownership voter is not qualified as such, and that a person is disqualified for being a borough councillor if he is in holy orders or is the regular minister of a Dissenting congregation. Borough councillors are elected for a term of three years, one-third of the whole number going out of office in each year, and if the borough is divided into wards, these are so arranged that the number of councillors for each ward shall be three or a multiple of three. The ordinary day of election is the 1st November. At an election for the whole borough the returning officer is the mayor; at a ward election he is an alderman assigned for that purpose by the council. The nomination and election of candidates and the procedure at the election are the same as have already been described in the case of the election of county councillors. The law as to corrupt and illegal practises at the election is also similar, and the election may be questioned by petition in exactly the same way. A borough councillor must, within five days after notice of his election, make a declaration of acceptance of office under a penalty, in the case of an alderman or councillor of £50, and in the case of a mayor of £100, or such other sums as the council may by bye-law determine. A councillor may be disqualified in the same way as a county councillor, by bankruptcy or composition with creditors, or continuous absence from the borough (except in case of illness). In short it may be said that as the provisions relating to the election of borough councillors were merely extended to county councillors by the Local Government Act of 1888 with a few modifications, these provisions, as already stated when dealing with county councils, apply generally to the election of borough councillors. After the annual election on the 1st November the first quarterly meeting of the council is held on the 9th, and at that meeting the mayor and aldermen are elected. The election of the mayor and aldermen is again the same as has already been described in connexion with the election of the chairman and aldermen of a county council.

Officers.

The officers of a borough council are the town clerk and the treasurer, but the council have power to appoint such other officers as they think necessary. All these officers receive such remuneration as the council from time to time think fit, and hold office during pleasure. The provisions with respect to the transaction of the business of the council are also the same in the case of a borough as in that of a county council.

Finance audit.

The entire income of the borough council is paid into the borough fund, and that fund is charged with certain payments, which are specifically set out in the 5th schedule to the Act of 1882. These include the remuneration of the mayor, recorder, and officers of the borough, overseers' expenses, the expenses of the administration of justice in the borough, the payment of the borough coroner, police expenses, and the like. An order of the council for the payment of money out of the borough fund must be signed by three members of the council and countersigned by the town clerk, and any such order may be removed into the King's Bench Division of the High Court of Justice by writ of *certiorari*, and may be wholly or partly disallowed or confirmed on the hearing. This is really the only way in which the validity of a payment by a borough council can be questioned, for, as will be seen hereafter, the audit in the borough is not an effective one. The borough fund is derived, in the first instance, from the property of the corporation. If the income from such property is insufficient for the purposes to which it is applicable, as usually is the case, it has to be supplemented by a borough rate, which may be a separate rate made by the council or may be levied through the overseers as part of the poor rate by means of a precept addressed to them. In the event of the borough fund being more than sufficient to meet the demands upon it without recourse to a borough rate, any surplus may be applied in payment of any expenses of the council as a sanitary authority or in improving the borough or any part thereof by drainage, enlargement of streets, or otherwise. The borough treasurer is required to make up his accounts half-yearly, and to submit them, with the necessary vouchers and papers, to the borough auditors. These auditors are three in number—two of them elected annually by the burgesses. An elective auditor must be qualified to be a councillor, but may not be a member of the council. The third auditor is appointed by the mayor and is called the mayor's auditor. The auditors so appointed are charged with the duty of auditing the accounts of the treasurer, but they have no power of disallowance or surcharge, and their audit is therefore quite ineffective.

Jurisdiction of justices; quarter sessions.

Where a borough has not a separate court of quarter sessions, but has a separate commission of the peace, the justices of the county in which the borough is situate have a concurrent jurisdiction with the borough justices in all matters arising within the borough. Where, however, the borough has a court of quarter sessions, the county justices have no jurisdiction within the borough. In all cases, whether the borough has quarter sessions or a separate commission or not, the mayor, by virtue of his office, is a justice for the borough, and continues to be such justice during the year next after he ceases to be mayor. He takes precedence over all justices acting in and for the borough, and is entitled to take the chair at all meetings at which he is present by virtue of his office of mayor. A separate commission of the peace may be granted to a borough on the petition of the council. A borough justice is required to take the oaths of allegiance and the judicial oaths before acting; he must while acting reside in or within seven miles of the borough, or occupy a house, warehouse, or other property in the borough; but he need not be a burgess nor have the qualification by estate required of a county justice. Where the borough has a separate commission, the borough justices have power to appoint a clerk, who is now paid by salary, the fees and costs pertaining to his office being paid into the borough fund, out of which his salary is paid. The council may by petition obtain the appointment of a stipendiary magistrate for the borough. The Crown may also on petition of the council grant a separate court of quarter sessions for the borough, and in that event a recorder has to be appointed by the Crown. He must be a barrister of not less than five years' standing, and he holds office during good behaviour; he receives a yearly salary. The recorder sits as sole judge of the court of quarter sessions of the borough. He has all the powers of a court of quarter sessions in a county, including the power to hear appeals from the borough justices; but to this there are a few exceptions, notably the power to grant licences for the sale of intoxicating liquor. The grant of a separate court of quarter sessions also involves the appointment by the council of a clerk of the peace for the borough. It should be added that the grant of a court of quarter sessions to any borough other than a county borough after the passing of the Local Government Act, 1888, does not affect the powers, duties, or liabilities of the county council as regards that borough, nor exempt the parishes in the borough from being assessed to county rate for any purposes to which such parishes were previously liable to be assessed.

Sheriff, coroner.

When a borough is a county of itself the council appoint a sheriff on the 9th November in every year. And where the borough has a separate court of quarter sessions the council appoint a fit and proper person, not an alderman or councillor, to be the borough coroner, who holds office during good behaviour. If the borough has a civil court the recorder, if there is one, is judge of it. If there is no recorder, the judge of the court is an officer of the borough appointed under the charter.

Power to acquire land.

The provisions of the Municipal Corporations Act, 1882, relate chiefly to the constitution of the municipal corporation. It does not itself confer many powers or impose many duties upon the council as a body. It does, however, enable a municipal corporation to acquire corporate land and buildings, the buildings including a town hall, council house, justices' room, police stations and cells, sessions house, judges' lodgings, polling stations, and the like. The council may borrow money for the erection of such buildings; they may acquire and hold land in mortmain by virtue of their charter or with the consent of the Local Government Board. Corporate land cannot be alienated without the consent of the same board. The council may convert corporate land, with the approval of the Local Government Board, into sites for workmen's dwellings.

Borough bridges.

Another duty imposed upon a borough council by the Act of 1882 is the maintenance of bridges within the borough which are not repairable by the county in which the borough is locally situate. It may here be mentioned that a city or borough which is a county of itself is liable at common law to repair all public bridges within its limits. In a borough which is not a county of itself the inhabitants are only liable to repair bridges within the borough by immemorial usage or custom.

Bye-laws.

Of the other powers possessed by the council of a borough under the Act of 1882, one of the most important is the power to make bye-laws for the good rule and government of the borough, and for the prevention and suppression of nuisances not already punishable in summary manner by virtue of an Act in force throughout the borough. It will be observed that these bye-laws are of two classes. The former do not come into force until the expiration of forty days after a copy of them has been sent to the Secretary of State, during which forty days the Sovereign in council may disallow any bye-law or part thereof. The latter require to be confirmed by the Local Government Board.

Under the Act of 1882 every municipal borough might have its own separate police force. As has already been stated when dealing with county councils, boroughs having a population of less than 10,000 according to the census of 1881 can no longer have a separate police force. But for some time before that year it had become the rule not to grant to any new borough with a population of less than 20,000 a separate police force. The subject of police is separately treated in the *Encyclopædia Britannica*, and it is not necessary to supplement what is there stated. Under an Act of 1893 the borough police may, in addition to their ordinary duties, be employed to discharge the duties of a fire brigade.

Police.

The district and the district council.

The powers and duties of a borough council in the Municipal Corporations Act do not arise or exist to any great extent under that Act. In a few cases, those namely of county boroughs, the councils have the powers of county councils. In the quarter sessions boroughs other than county boroughs they have some only of these powers. But in every case the council of the borough have the powers and duties of an urban district council, and, except where they derive their authority from local Acts, it may be said that their principal powers and duties consist of those which they exercise or perform as an urban council. These will now be considered.

Before the year 1848 there was not outside the municipal boroughs any system of district government in England. It is true that in some populous places which were not corporate boroughs local Acts of Parliament had been passed appointing improvement commissioners for the government of these places. In many boroughs similar Acts had been obtained conferring various powers relating to sanitary matters, streets and highways, and the like. But there was no general system, nor was there, save by special legislation, any means by which sanitary districts could be constituted. In the year 1848 the first Public Health Act was passed. It provided for the formation of local boards in boroughs and populous places, such places outside boroughs being termed local government districts. In boroughs the town council were generally appointed the local board for purposes of the Act. It was not, however, until 1872 that a general system of sanitary districts was adopted. By the Public Health Act of that year the whole country was mapped out into urban and rural sanitary districts, and that system has been maintained until the present time, with some important changes introduced by the Public Health Act, 1875, and the Local Government Act, 1894.

Constitution of district councils.

The whole of England and Wales is divided into districts, which are either urban or rural. Urban districts include boroughs and places which were formerly under the jurisdiction of local boards or improvement commissioners. The power to constitute new urban districts is now conferred upon county councils, as already stated. There is a concurrent power in the Local Government Board under the Public Health Act, 1875, but that power is now rarely exercised, and new urban districts are in practice created only by orders of county councils made under the Local Government Act, 1888, section 57. Rural districts were first created in 1872. Before that time there was practically no sanitary authority outside the urban district, for although the vestry of a parish had in some cases power to make sewers and had also some other sanitary powers, there was no authority for such a district as now corresponds to a rural district. There were, indeed, highway boards and burial boards which had powers for special purposes, but district authority in the sense in which it is now understood there was none. Before the year 1894 the rural district consisted of the area of the poor-law union, exclusive of any urban district which might be within it, and the guardians of the poor were the rural sanitary authority. Since 1894 this has been changed. By the Local Government Act of that year the guardians ceased to be the rural sanitary authority. The union was preserved as the rural sanitary district, with this qualification, that if it extended into more than one county it was divided so that no rural district should extend into more than one county. Rural district councillors are elected for each parish in the rural district, and they become by virtue of their office guardians of the poor for the union comprising the district, so that there is now no election of guardians in a rural district. Guardians are still elected as such for urban districts, but the rural district council have ceased to be the same body as the guardians and are now wholly distinct. A district councillor, whether urban or rural, holds office for a term of three years. One-third of the whole council retire in each year, the annual elections being held in March, but there may be a simultaneous retirement of the whole council in every third year if the county council at the instance of the district council so order. The qualification and disqualification of district councillors, whether urban or rural, now depend upon the Local Government Act, 1894. Property qualification is abolished. Any person may be elected who is either a parochial elector of some parish within the district or has during the whole of the twelve months preceding his election resided in the district, and no person is disqualified by sex or marriage. The electors both in urban and rural districts are the body called the parochial electors. These are practically the persons whose names appear in the Parliamentary Register or in the Local Government Register as being entitled to vote at elections for members of Parliament or county or parish councillors as the case may be. The election takes place subject to rules made by the Local Government Board, these rules being largely founded upon adaptations of the Municipal Corporations Act, 1882. The rules issued 1st January 1898 will be found in the *Statutory Rules and Orders, 1898*, pp. 264, 302. The election is by ballot on the same lines as those prescribed for a municipal election, and the Corrupt Practices Act, the provisions of which have been referred to when dealing with county councils, applies to the elections of district councils. The provisions with reference to election petitions, the grounds upon which they may be presented and the procedure upon them, are the same in every respect as have already been mentioned when dealing with county councils. It may be convenient here to state that the Local Government Board has power to unite any number of districts or parts of districts into what is called a united district for certain special purposes such as water-supply, sewerage, or the like. This is done by means of a provisional order made by the board and confirmed by Parliament. In such a united district the governing body is a joint board constituted in manner provided by the order, and it has under the order such of the powers of a district council as are necessary for the purposes for which the united district is created. Thus a joint sewerage board would generally be invested by the order with all the powers of a district council relating to the provision and control of sewers and the disposal of sewage. It may also be convenient here to mention another special kind of district authority, that is, a port sanitary authority. It is also constituted by order of the Local Government Board, and it may include one or more sanitary districts or parts of districts abutting upon a port. In this case also the authority consists of such members and is elected in such manner as the order determines, and it has such of the powers of an ordinary district council as the order may confer upon it. These relate for the most part to nuisances and infectious disease, having special reference to ships. It has been thought convenient to deal here with district councils, whether urban or rural, together, but the powers of the former are much more extensive than those of the latter, and as the consideration of the subject proceeds it will be necessary to indicate what powers and duties are conferred or imposed upon urban district councils only. It must be pointed out, however, that when the necessity arises for conferring upon a rural district council any of the powers exercisable only by an urban district council, that can be done by means of an order of the Local Government Board. The necessity for this provision arises because it sometimes happens that in a district otherwise rural there are some centres of population, hardly large enough to be constituted urban districts, which nevertheless require the same control as an urban district. Thus it may be desirable to confer upon a rural district council in respect of such a populous area the power to make up private streets, or to make bye-laws relating to new streets and buildings, and similar purposes.

United districts.

Port sanitary authority.

Powers of urban and rural councils compared.

Business and offices.

A district council may from time to time make regulations with respect to summoning, notice, place, management, and adjournment of their meetings and generally with respect to the transaction and management of their business. Three members must be present to constitute a quorum. At the annual meeting, which is held as soon as convenient after the 15th April in each year, a chairman for the succeeding year has to be appointed. He presides at all meetings, and in his absence another member appointed by the meeting takes his place. Questions are determined by the majority present and voting, the chairman having the casting vote. Minutes are taken and, if signed at the meeting or the next ensuing meeting, are made evidence. The officers of the council consist of a clerk, a medical officer, a surveyor, one or more inspectors of nuisances, and a treasurer. Of these all but the medical officer of health and inspectors of nuisances hold office at pleasure and receive such remuneration as the council may determine. If the urban district is a borough, the town clerk and borough treasurer fulfil the same office for purposes of the Public Health Acts. The salaries of the medical officer of health and inspectors of nuisances are, as to one moiety thereof, paid out of "the Exchequer contribution account" by the county council, if they are appointed in accordance with the requirements of the Local Government Board as to qualification, appointment, duties, salary, and tenure of office. The orders of the Local Government Board as to these matters are set out in the *Statutory Rules and Orders, 1891*, pp. 527, 539. District councils may also employ such other officers and servants as may be necessary and proper for the fulfilment of their duties. Officers and servants are prohibited from being concerned or interested in any bargain or contract made with their council, and from receiving under cover of their office or employment any fee or reward whatsoever other than their proper salaries, wages, and allowances, under penalty of being rendered incapable of holding office under any district council, and of a pecuniary penalty of £50. There are some exceptions to this provision somewhat similar to those already mentioned with respect to the disqualification of members of the council. It may be mentioned here that by an Act, called the Public Bodies' Corrupt Practices Act, 1889, severe penalties are imposed alike upon members and officers of public bodies for corruption in office.

Committees.

A district council may appoint committees consisting wholly or partly of members of their own body for the exercise of any powers which in their opinion can properly be exercised by such committees. Such committees do not, however, hold office beyond the next annual meeting of the council, and their acts must be submitted to the council for their approval. If they are appointed for any purposes of the Public Health or Highway Acts, the council may authorize them to institute any proceedings or do any act which the council might have instituted or done, other than the raising of any loan or the making of any rate or contract. A rural district council may delegate their entire powers in any parish to a parochial committee. Such committee may consist wholly of members of their own body or of members of the parish council, or partly of members of both. Such a committee may be subject to any regulations and restrictions imposed upon it by the rural district council.

Public Health Acts.

In dealing with the powers and duties of district councils it will be convenient to treat of these first as they arise under the Public Health Acts, and afterwards as they arise under other statutes. In so far as such powers and duties are common to urban and rural district councils alike they will be referred to as appertaining to district councils. When reference is made to any power or duty of an urban council it is to be understood that the rural council have no such power or duty unless conferred or imposed upon them by order of the Local Government Board. And it must be borne in mind that in a borough the borough council are the urban district council.

Sewerage and drainage.

The district council are required to cause to be made such sewers as may be necessary for effectually draining their district. This duty may be enforced by the Local Government Board on complaint made to them that the council have failed in performing it, and in the case of a rural district by the county council on complaint of the parish council. All sewers, whether made by the council, by their predecessors, or by private persons, vest in the district council—that is to say, become their property, with some exceptions, of which the principal is sewers made by a person for his own profit. The owner or occupier of any premises is entitled as of right to cause his drain to be connected with any sewer, on condition only of his giving notice and complying with the regulations of the council as to the mode in which the communication is to be made, and subject to the control of any person appointed by the council to superintend the work. Moreover, the owner or occupier of premises without the district has the same right, subject only to such terms and conditions as may be agreed or, in case of dispute, settled by justices or by arbitration. If a house does not possess a sufficient drain, the occupier may be required to provide one, and to cause it to discharge into a sewer if there is one within 100 feet of the house, otherwise into a cesspool, as the council may direct. In the case of new houses, these may not be built or occupied in an urban district without their being first provided with sufficient drains as the council may require; and in an urban district it is forbidden to cause any building to be newly erected over a sewer without the consent of the council. For the purpose of sewage disposal a district council may construct any works and contract for the use or purchase or lease of any land, buildings, engines, materials, or apparatus, and contract to supply for a period not exceeding twenty-five years any person with sewage. It may be pointed out here that these expressions are defined by the Act, the effect of the definitions being shortly that a drain is a conduit for the drainage of one building or of several within the same curtilage, while a sewer comprises every kind of drain except that which is covered by the definition of a drain as above stated. The result has been that district councils frequently find themselves in the position of being responsible for the repair and condition of drains which, by reason of having been laid for more than one house, are sewers vested in and repairable by them. An attempt was made to remedy this state of things by the Public Health Amendment Act, 1890, section 19, but the remedy so provided was very partial, and may be said to be confined to the case where two or more houses belonging to different owners are drained into a common drain laid under private land, and ultimately discharging into a sewer in a road or street.

Sanitary accommodation for houses.

The district council are charged with the duty of enforcing the provision of proper sanitary accommodation (water-closets, privies, ashpits, &c.) for all dwelling-houses, new or old, and for factories, and the maintenance of such conveniences in proper condition. The urban council have power to provide and maintain and make provision for the regulation of urinals, water-closets, earth-closets, privies, ashpits, and other similar conveniences for public accommodation. In the event of a complaint being made in a district council that any drain, closet, privy, ashpit, or cesspool is a nuisance or injurious to health, the council may empower their surveyor to enter and examine the premises, and, if the complaint is well founded, they may require the owner to do the necessary works. The district council are not bound to undertake the removal of house refuse from premises, or the cleansing of closets, privies, ashpits, and cesspools. They may, however, undertake these duties, and, if the Local Government Board require, they must do so. An urban council and a rural council, if invested with the requisite power by the Local Government Board, may, and when required by order of that Board must, provide for the proper cleansing of streets, and may also provide for the proper watering of streets. When they have undertaken, or are required to perform these duties, a penalty is imposed upon them for neglect. If they do not undertake these duties, they may make bye-laws imposing on the occupiers of premises the duty of cleansing footways and pavements, the removal of house refuse, and the cleansing of earth-closets, privies, ashpits, and cesspools; and an urban council may also make bye-laws for the prevention of nuisances arising from snow, filth, dust, ashes, and rubbish, and for the prevention of the keeping of animals on any premises so as to be injurious to health. The keeping of swine in a dwelling-house, or so as to be a nuisance, is made an offence punishable by a penalty in an urban district, as also is the suffering of any waste or stagnant water to remain in any cellar, or within any dwelling-house after notice, and the allowing of the contents of any closet, privy, or cesspool to overflow or soak therefrom. Provision is also made for enforcing the removal of accumulations of manure, dung soil, or filth from any premises in an urban district, and for the periodical removal of manure or other refuse from mews, stables, or other premises.

Removal of refuse.

Water-supply.

With regard to water-supply, district councils have extensive powers. They may provide their district or any part of it with a supply of water proper and sufficient for public and private purposes, and for this purpose they may construct and maintain waterworks, dig wells, take on lease or hire any waterworks, purchase waterworks or water, or right to take or convey water either within or without their district, and any rights, powers, and privileges of any water company, and contract with any person for the supply of water. They may not, however, commence to construct waterworks within the limits of supply of any water company empowered by Act of Parliament or provisional order to supply water without giving notice to the company, and not even then so long as the company are able and willing to supply the necessary water. Any dispute as to whether the company are able and willing has to be settled by arbitration. Where the council do supply water, they have the same powers of carrying mains under streets or through private lands as they have with respect to the laying of sewers, as already mentioned. They can charge water rents which depend upon agreements with consumers, or they may charge water rates assessed on the net annual value of the premises supplied. It is to be observed that they are not bound to charge for a supply of water at all, unless they are required to do so in an urban district by at least ten persons, rated to the poor rate, or in a parish in a rural district by at least five persons so rated in the parish. Even then the amount of the rate is left to the council, any deficiency in the cost of the water, in so far as it is not defrayed out of water rates or rents, being borne in an urban district by the general district rate, and in a rural district by the separate sanitary rates made for the parish or contributory place supplied. For the purpose of enabling them to supply water, most of the provisions of the Waterworks Clauses Acts are incorporated with the Public Health Act, and are made available for the district council. They are empowered to supply water by measure if they think fit, and may charge a rent for water-meters. The power of the district council to supply water is strictly limited to their own district, but they may, with the sanction of the Local Government Board, supply water to the council of an adjoining district on such terms as may be agreed upon, or as, in case of dispute, may be settled by arbitration. If any house is without a sufficient supply, and it appears that a supply can be furnished at a reasonable cost, as defined in the Public Health Act and the Public Health Water

Act, 1878, the owner may be required to provide the supply, and, if he fails, the council may themselves provide the supply and charge the owner with the cost. All public sources of water-supply, such as streams, pumps, wells, reservoirs, conduits, aqueducts, and works used for the gratuitous supply of water to the inhabitants of the district are vested in the council, who may cause all such works to be maintained and plentifully supplied with pure and wholesome water for the gratuitous use of the inhabitants, but not for sale by them. The council may supply water to public baths or wash-houses, or for trade or manufacturing purposes. In the case of the former the supply may be gratuitous. In the latter case it is to be on terms agreed between the parties. The urban council are required to cause fire-plugs, and all necessary works, machinery, and assistance for securing a supply of water in case of fire, to be provided and maintained, and for this purpose they may enter into an agreement with any water company or person. Provision is made for preventing the pollution of water by gas refuse and enabling a district council, with the sanction of the Attorney-General, to take any proceedings they may think fit for preventing the pollution of any stream in their district by sewage. The district council are also empowered to obtain an order of justices directing the closing of any well, tank, or cistern, public or private, or any public pump the water from which is likely to be used for drinking or domestic purposes, or for manufacturing drinks for the use of man, if such water is found to be so polluted as to be injurious to health.

Cellar dwellings.

Power is given to prohibit the use as dwellings of any cellars, vaults, or underground rooms built or occupied after 1875, and with regard to such cellars as were occupied as dwellings before 1875, the continued occupation of these is also forbidden unless they comply with certain stringent requirements as to the height of the rooms, height of the ceilings above the surface of the street, open areas in front, effectual drainage, sanitary conveniences appurtenant to the cellars, and the provision of fireplaces.

Common lodging-houses.

District councils are required to keep a register of the common lodging-houses in their district. No person is allowed to keep a common lodging-house unless he is registered, and a house may not be registered until it has been inspected and approved for the purpose by an officer of the council. Further, the council may refuse to register a keeper unless he produces a certificate of character in a prescribed form. The council are empowered to make bye-laws for fixing the number of lodgers and separating the sexes therein, promoting cleanliness and ventilation, giving of notices and taking precautions in case of any infectious disease, and generally for the well-ordering of such houses. The keepers of common lodging-houses are required to limewash their walls and ceilings in the months of April and October in every year, and if paupers or vagrants are received to lodge, they may be required to report as to the persons who have resorted thereto. They must give notice of any infectious disease to the medical officer of health and to the poor-law relieving officer, and they must give free access for inspection. There is no definition of the expression "common lodging-house" in the Public Health Act, and at one time the courts decided that shelters for the destitute kept by charitable persons were not common lodging-houses. That idea is now exploded, and the Act applies to charitable institutions which receive persons of the class ordinarily received into common lodging-houses.

Houses let in lodgings.

Bye-laws may also be made relating to houses let in lodgings which are not common lodging-houses. These bye-laws are in practice limited to those inhabited by the poorer classes, although the Act imposes no such restriction.

Nuisances.

The Public Health Act, 1875, contains elaborate provisions for dealing with nuisances. Those which are dealt with summarily are thus enumerated :—(1) any premises in such a state as to be a nuisance or injurious to health ; (2) any pool, ditch, gutter, watercourse, privy, urinal, cesspool, drain, or ashpit so foul or in such a state as to be injurious to health ; (3) any animal so kept as to be a nuisance or injurious to health ; (4) any accumulation or deposit which is a nuisance or injurious to health ; (5) any house or part of a house so overcrowded as to be dangerous or injurious to the health of the inmates, whether or not members of the same family ; (6) any factory, workshop, or workplace not already under the operation of any general Act for the regulation of factories or bakehouses not kept in a cleanly state or not ventilated in such a manner as to render harmless as far as practicable any gases, vapours, dust, or other impurities generated in the course of the work carried on therein that are a nuisance or injurious to health, or so overcrowded while work is carried on as to be dangerous or injurious to the health of those employed therein ; (7) any fireplace or furnace which does not as far as practicable consume the smoke arising from the combustible used therein, and which is used for working engines by steam or in any mill, factory, dye-house, brewery, bakehouse, or gas work, or in any manufacturing or trade process whatsoever, and (8) any chimney not being the chimney of a private dwelling-house sending forth black smoke in such quantity as to be a nuisance. The nuisances above enumerated are said to be nuisances liable to be dealt with summarily. It is the duty of every district council to inspect their district with a view to the discovery of any such nuisances. In the event of such discovery by them or of information given to them of the existence of any such nuisance, the district council are required to serve a notice requiring the abatement of the nuisance on the person by whose act, default, or sufferance it arises or continues, or, if such person cannot be found, on the owner or occupier of the premises at which the nuisance arises. The notice must require the abatement of the nuisance within a specified time, and must prescribe the works which in the opinion of the council are necessary to be done. If the nuisance arises from the absence or defective construction of any structural convenience, or if there is no occupier of the premises, the notice must be served upon the owner. If the person who causes the nuisance cannot be found, and it is clear that the nuisance does not arise or continue by the act, default, or sufferance of the owner or occupier of the premises, the local authority may themselves abate the nuisance without further order. If the person on whom the notice is served objects to give effect to it, he may be summoned before justices, and the justices may make an order upon him to abate the nuisance or prohibiting the recurrence of the nuisance if this is likely, and directing the execution of the necessary works. If the nuisance is such as to render a dwelling-house unfit for human habitation, the justices may close it until it is rendered fit for that purpose. Disobedience under the order of justices involves a penalty and a daily penalty for every day during which default continues. Private persons may complain to justices in respect of nuisances by which they are personally aggrieved, and if the district council make default in doing their duty, the Local Government Board may authorize any officer of police to institute any necessary proceedings at the cost of the defaulting council. The district council may, if in their opinion proceedings before justices afford an inadequate remedy, take proceedings in the high court, but in that case, if the nuisance is of a public nature, they must proceed by action in the name of the Attorney-General. The provisions as to nuisances are extended to ships by an Act of 1885.

It is forbidden to establish within an urban district without the consent of the council any offensive trade, business, or manufacture. With regard to any offensive trade which has been established or may be consented to in any urban district, if it is verified by the medical officer or any two legally qualified medical practitioners, or by any ten inhabitants of the district, to be a nuisance or injurious to health, the urban district council are required to take proceedings before magistrates with a view to the abatement of the nuisance complained of.

Unsound meat.

Any medical officer or inspector of nuisances may inspect any meat, &c., exposed for sale or deposited in any place for the purpose of sale or of preparation for sale and intended for the food of man. This power of inspection is, in districts where the Public Health Act, 1890, has been adopted, extended to all articles intended for the food of man. If upon such inspection the meat, &c., appears to be diseased, unsound, or unwholesome, it may be taken before a justice for the purpose of being condemned, and the person to whom the meat, &c., belongs or in whose possession it was found is liable to a penalty or, in the discretion of the justices, to imprisonment for three months without the option of a fine.

Infectious diseases.

The Public Health Acts contain important provisions relating to infectious disease. Local authorities may require premises to be cleansed and disinfected ; they may order the destruction of bedding, clothing, or other articles which have been exposed to infection ; they may provide proper places for the disinfection of infected articles free of charge ; they may provide ambulances, &c. In the case of a person found suffering from infectious disease who has not proper lodging or accommodation, or is lodging in a room occupied by more than one family, or is on board any ship or vessel, such person may by means of a justice's order be removed to a hospital ; and any person exposing himself or any other in his charge while suffering from infectious disease, or exposing infected bedding, clothing, or the like, is made liable to a penalty. Owners and drivers of public conveyances used for the carriage of persons suffering from infectious disease are required to disinfect them ; but any person who enters a public conveyance while so suffering or takes an infected person into it without notifying the fact to the driver is liable to a penalty. It is also forbidden to let houses or rooms in which infected persons have been lodging, or to make false statements to persons negotiating for the hire of such rooms. An Act was passed in the year 1890, called the Infectious Diseases Prevention Act, which may be adopted by any local authority. When adopted it enables an urban or district council to obtain the inspection of dairies where these are suspected to be the cause of infectious disease, with a view to prohibiting the supply of milk from such dairies if the fact is established. The Act also forbids the keeping for more than forty-eight hours of the body of a person who has died of infectious disease in a room used at the time as a dwelling-place, sleeping-place, or workshop. It provides for the bodies of persons dying of infectious diseases in a hospital being removed only for burial, and gives power to justices in certain cases to order bodies to be buried. The diseases to which the Act applies are smallpox, cholera, membranous croup, erysipelas, scarlatina or scarlet fever, typhus, typhoid, enteric, relapsing, continued or puerperal fever, and any other infectious disease to which the Act has been applied by the local authority of the district in the prescribed manner. The most important provision, however, relating to infectious disease is that contained in the Infectious Disease Notification Act, 1889. That was originally an adoptive Act, but it is now extended to all districts in England and Wales. It requires the notification to the medical officer of health of the district of every case in which a person is suffering from one of the diseases above mentioned. The duty of notification is imposed upon the head of the family, and also upon the medical practitioner who may be in attendance on the patient. The medical attendant is entitled to receive in respect of each notification a fee of 2s. 6d. if the case occurs in his private practice, and of 1s. if the case occurs in his practice as medical officer of any public body or institution. These fees are paid by the urban or rural district council as the case may be. The provisions as to notification are applied to every ship, vessel, boat, tent, van, shed, or similar structure used for human habitation in like manner as nearly as may be as if it were a building. Exception is made, however, in the case of a ship, vessel, or boat belonging to a foreign government. It is not too much to say that this Act has been one of the most effectual means of preventing the spread of infectious disease in modern times.

Hospitals.

The district council are empowered to provide hospitals or temporary places for the reception of the sick. They may build them, contract for the use of them, agree for the reception of the sick inhabitants of their district into an existing hospital, or combine with any other district council in providing a common hospital. As has already been mentioned when dealing with county councils, if a district council make default in providing hospital accommodation, the county council may put in operation the Isolation Hospitals Act. The power given to provide hospitals must be exercised so as not to create a nuisance, and much litigation has taken place in respect of the providing of hospitals for smallpox. Up to the present time, however, the courts have refused to accept as a principle that a smallpox hospital is necessarily a source of danger to the neighbourhood, and for the most part applications for injunction on that ground have failed.

Epidemics.

Where any part of the country appears to be threatened with or is affected by any formidable epidemic, endemic, or infectious disease, the Local Government Board may make regulations for the speedy interment of the dead, house-to-house visitation, the provision of medical aid and accommodation, the promotion of cleansing, ventilation, and disinfection, and the guarding against the spread of disease. Such regulations are made and enforced by the district councils. The provisions of the Public Health Acts relating to infectious disease are for the most part extended to ships by an Act of the year 1885.

Mortuaries.

District councils may and, if required by the Local Government Board, are required to provide mortuaries, and they may make bye-laws with respect to the management and charges for the use of the same. Where the body of a person who has died of an infectious disease is retained in a room where persons live or sleep, or the retention of any dead body may endanger health, any justice on the certificate of a medical practitioner may order the removal of the body to a mortuary and direct the body to be buried within a time limited by the friends of the deceased or in their default by the relieving officer. A district council may also provide and maintain a proper place (otherwise than at a workhouse or at a mortuary) for the reception of dead bodies during the time required to conduct any *post mortem* examination ordered by a coroner.

Cemeteries.

Under an Act of 1879 the district council have power to provide and maintain a cemetery either within or without their district, and they may purchase or accept a donation of land for that purpose. The provisions of the Cemeteries Clauses Act, 1847, apply to a cemetery thus provided. These cannot all be referred to here, but it may be noted that no part of the cemetery need be consecrated, but that if any part is, such part is to be defined by suitable marks, and a chapel in connexion with the Established Church must be erected in it. A chaplain must also be appointed to officiate at burials in the consecrated portion. The power to provide a cemetery under the Act under consideration must not be confounded with that of providing a burial ground under the Burial Acts. These Acts will be mentioned later in connexion with the powers of parish councils, for in general they are adopted for a parish, part of a parish, or combination of parishes, and are administered by a burial board, except where that body has been superseded by a parish council or joint committee. It may be mentioned, however, that under the Local Government Act, 1894, where a burial board district is wholly in an urban district, the urban council may resolve that the powers, duties, and liabilities of the burial board shall be transferred to the council, and thereupon the burial board may cease to exist. And it is provided by the same Act that the Burial Acts shall not hereafter be adopted in any urban parish without the approval of the urban council. The distinction between a burial ground provided under the Burial Acts and a cemetery provided under the Act of 1879 is important in many ways, of which one only need be mentioned here—the expenses under the Burial Acts are paid out of the poor rate, while the expenses under the Act of 1879 are paid in an urban district out of the general district rate, the incidence of which differs materially from that of the poor rate, as will be seen hereafter.

Highways.

In an urban district the urban council have always had all the powers and duties of a surveyor of highways under the Highway Acts. But before 1894 a rural district council had no power or duty in respect of highways except in a few cases where, by virtue of a provision in the Highway Act, 1878, the rural sanitary authority of a district coincident in area with a highway district were empowered to exercise all the powers of a highway board. Except in these cases the highway authority in a parish was the surveyor of highways, elected annually by the inhabitants in vestry, or in a highway district consisting of a number of parishes united by order of quarter sessions, the highway board composed of waywardens representing the several parishes. By the Local Government Act, 1894, there were transferred to the district council of every rural district all the powers, duties, and liabilities of every highway authority, surveyor, or highway board within their district, and the former highway authorities ceased to exist. The highway authority in every district, rural as well as urban, is therefore the district council. Of the chief duties of a district council with regard to highways, the first and most obvious is the duty to repair. This duty was formerly enforceable by indictment of the inhabitants of the parish, but it is not quite clear whether this procedure is applicable, now that the liability to repair is transferred to a council representing a wider area. Under the Highway Acts it is enforceable by summary proceedings before justices and by orders of the county council, but in either case, if the liability to repair is disputed, that question has to be decided on indictment preferred against the highway authority alleged to be in default. In a rural district any parish council may complain to the county council that the district council have made default in keeping any highway in repair, and the county council may thereupon transfer to themselves and execute the powers of the district council at the cost of the latter body, or they may make an order requiring the district council to perform their duty, or they may appoint some person to do so at the cost of the district council. It is important to observe, however, that an action does not lie against a district council in respect of the failure to repair a highway even at the suit of a person who has thereby been injured. The reason assigned for this doctrine is that the council as highway surveyor stand in the same position as the inhabitants of the parish, against whom such an action would not lie. The district council are, however, liable for any injury caused through negligence on the part of their officers or servants in carrying out the work of repair.

Streets.

But while rural as well as urban district councils have the powers and duties of surveyors of highways, the provisions of the Public Health Acts relating to streets apply only in urban districts, except in so far as the Local Government Board may by order have conferred urban powers upon a rural district council. These provisions have now to be referred to. It may be convenient to state that the expression "street" is here used in a sense much wider than its ordinary meaning. It is defined by the Act to include any highway and any public bridge (not being a county bridge), and any road, lane, footway, square, court, alley, or passage, whether a thoroughfare or not. For certain purposes streets as thus defined are divided into two classes, viz., those which are and those which are not highways repairable by the inhabitants at large. But it has to be borne in mind that it is not every highway that is repairable by the inhabitants at large. Before the year 1836 as soon as a way was dedicated to public use and the public had by user signified their acceptance of it, it became without more notice repairable by the parish. Therefore every highway—whether carriage-way, driftway, bridleway, or footway—which can be shown to have been in use before 1836, is presumably repairable by the inhabitants at large, the only exceptions being such highways as are repairable by private persons or corporate bodies *ratione clausuræ*, *ratione tenuræ*, or by prescription. But in the year 1836, when the Highway Act, 1835, came into operation, the law was altered. It was possible, just as formerly, to dedicate a way to the use of the public, and it thereupon became a highway to all intents and purposes. But mere dedication did not make the way repairable by the public. That result was not to follow unless certain stringent requirements were fulfilled. When it is shown, therefore, that a highway has been dedicated after 1836, it is not repairable by the inhabitants at large unless it can be shown that these provisions have been complied with, or that it has been declared to be repairable under provisions of the Public Health Acts presently to be mentioned. (There was also power given to justices by the Highway Act, 1862, to declare a private road or occupation road in a highway district to be a public highway repairable by the parish; but this power does not appear to have been acted upon to any extent.)

All streets being highways repairable by the inhabitants at large within an urban district, are vested in and under the control of the urban council. After much litigation it has now been established that this provision does not give the council an absolute property in the soil of the street, but merely such a qualified property in the surfaces as enables them to exercise control. The urban council are required from time to time to cause all such streets to be made up and repaired as occasion may require, and they are empowered to raise, lower, or alter the soil of the street, and to place and keep in repair fences and posts for the safety of foot-passengers. The other class of streets consists of those which are not highways repairable by the inhabitants at large. Under the Public Health Act, 1875, such streets may be dealt with in manner following:—If any such street or part thereof is not sewered, levelled, paved, metalled, flagged, channelled, made good, or lighted to the satisfaction of the council, the council may cause it to be made up at the expense of the owners of premises fronting the street in proportion to their several frontages. When all or any of the works aforesaid have been executed in the street, and the council are of opinion that the street ought to become a highway repairable by the inhabitants at large, they may by notice to be fixed up in the street declare it to be a highway repairable by the inhabitants at large, and the declaration will be effective unless, within one month after the notice has been put up, the majority of the owners in the street object thereto. An alternative procedure has been provided by the Private Street Works Act, which may be adopted by any urban council. One important point of difference is that under the latter Act the council may resolve that the expenses shall be apportioned among the owners not merely according to frontage, but according to the greater or less degree of benefit to be derived by any premises from the works.

Where a house or building in a street is taken down to be rebuilt, the urban district council may prescribe the line to which it is to be rebuilt, paying compensation to the building owner for any damage which he may sustain consequent upon the requirement. Save to this extent, no power is given by the general law to a district council to prescribe a building line. But under an Act of 1888 it is provided that it shall not be lawful in any urban district without the consent of the urban authority to erect or bring forward any house or building in any street or any part of such house or building beyond the front main wall of the house or building on either side thereof in the same street.

The control exercised by an urban district council over streets and buildings is to a very large extent exercised through bye-laws which they are empowered to make for various purposes relating to the laying out and formation of new streets, the erection and construction of new buildings, the provision of sufficient air-space about buildings to secure a free circulation of air, and the provision of suitable and sufficient sanitary conveniences. The manner in which such bye-laws are made and confirmed will be hereafter noticed. In general, the bye-laws require plans of new streets to be submitted to the council, and they are required to approve or disapprove of these plans within a month. They cannot disapprove of a plan unless it contravenes the provisions of some statute or bye-law; but if a person builds otherwise than according to an approved plan he does so at the risk of having his work pulled down or destroyed. Among the miscellaneous powers of an urban council with respect to streets may be mentioned the power to widen or improve, and certain powers incorporated from the Towns Improvement Clauses Act, 1847, with respect to naming streets, numbering houses, improving the line of streets, removing obstructions, providing protection in respect of ruinous or dangerous buildings, and requiring precautions to be taken during the construction and repair of sewers, streets, and houses. An urban council may also provide for the lighting of any street in their district, and may contract with any person or company for that purpose. If there is no company having statutory powers of supply within their district, they may themselves undertake the supply of gas, and they may purchase the undertaking of any gas company within their district.

Public parks.

An urban council may acquire and maintain lands for the purpose of being used as public walks or pleasure-grounds, and may support or contribute to the support of such walks or grounds if provided by any other person. They may also contribute to the cost of laying out, planting, or improvement of lands provided for this purpose by any person, in their own district or outside that district, if it appears that the walks or grounds could eventually be used by the inhabitants of that district. An urban council may also provide public clocks or pay for the reasonable cost of repairing and maintaining any public clocks in the district, though not vested in them.

Markets and slaughter-houses.

Where an urban council are the council of a borough, and in other cases with the consent of the owners and ratepayers of the district, they may provide market accommodation for their district. They may not, however, establish any market so as to interfere with any market already established in the district under a franchise or charter. For purposes of markets certain provisions of the Markets and Fairs Clauses Act, 1847, are incorporated with the Public Health Act. The only one of these that need be noticed is that which provides that after the market is opened for public use every person, other than a licensed hawker, who shall sell or expose for sale in any place within the district, except in his own dwelling-place or shop, any articles in respect of which tolls are authorized to be taken shall be liable to a penalty. The tolls which may be taken by an urban council must be approved by the Local Government Board; and any bye-laws which they make for the regulation of the market must be confirmed by the same body. An urban council may also provide slaughter-houses and make bye-laws with respect to the management and charges for the use of them. Where they do not provide slaughter-houses, all previously existing slaughter-houses have to be registered and new ones licensed; and no person may lawfully use a slaughter-house which is not either registered or licensed. Licences may be suspended by justices in the event of their being used contrary to the provisions of the Act or of the bye-laws, and on a second conviction the licence may be revoked. On a conviction of selling or exposing for sale, or having in his possession or on his premises, unsound meat, the court may also revoke the licence.

Hackney carriages, &c.

Certain police regulations contained in the Town Police Clauses Act, 1847, are by virtue of the Public Health Act, 1875, in force in all urban districts. These relate to obstructions and nuisances in streets, fires, places of public resort, hackney carriages, and public bathing. An urban council may also license proprietors, drivers, and conductors of horses, ponies, mules, or asses standing for hiring in the district in the same way as in the case of hackney carriages, and they may also license pleasure-boats and vessels, and the boatmen or persons in charge thereof, and they may make bye-laws for all these purposes.

Contracts, purchase of lands.

Every district council may enter into such contracts as are necessary for carrying into execution the various purposes of the Public Health Acts. A district council being a corporation, the general law applies in the case of a rural council that they must contract under their common seal, the exception to this rule including the doing of acts very frequently recurring or too insignificant to be worth the trouble of affixing the common seal. In the case of an urban council certain stringent regulations are laid down. A contract made by an urban council, whereof the value and amount exceed £50, must be under seal, and certain other formalities must be observed, some of which are imperative; for example, the taking of sureties from the contractor, and the making provision for penalties to be paid by him in case the terms of the contract are not observed. Every local authority may also, for purposes of the Act, purchase or take on lease, sell or exchange, any lands. Such lands as are not required for the purpose for which they were purchased must, unless the Local Government Board otherwise direct, be sold. Powers of compulsory purchase of lands are also given under the Lands Clauses Acts, but before these can be put in operation certain conditions must be observed. The Local Government Board must make inquiry into the propriety of allowing the lands to be taken, and the power to acquire the lands compulsorily can only be conferred by means of a provisional order confirmed by Parliament.

Bye-laws.

With regard to the bye-laws which district councils may make for many purposes, the subjects of which have been already from time to time mentioned, it is only necessary to state that these require to be confirmed by the Local Government Board. Such confirmation does not, however, give validity to a bye-law which cannot be justified by the provisions of the Act, and many bye-laws which have been so confirmed have been held to be invalid under the general law as being uncertain, unreasonable, or repugnant to the law of the realm. For the guidance of local authorities, the Local Government Board have from time to time issued model series of bye-laws dealing with the various subjects for which bye-laws may be made, and these are for the most part followed throughout England and Wales.

Finance.

As a general rule, all the expenses of carrying into execution the Public Health Acts in an urban district fall upon a fund which is called the general district fund, and that fund is provided by means of a rate called the general district rate. To this there are some exceptions. First, in the case of boroughs where from the time of the first adoption of the Sanitary Acts these expenses have been paid out of the borough rate, the expenses continue to be so paid; and in an urban district which was formerly subject to an Improvement Act, the expenses may be payable out of the improvement rate authorized by that Act. The general rule, however, prevails over by far the greater part of England and Wales. The general district rate is made and levied on the occupiers of all kinds of property for the time being assessable to any rate for the relief of the poor, subject to a few exceptions and conditions. Of these the first is that the owner may be rated instead of the occupier, at the option of the urban authority, where the value of the premises is under £10, where the premises are let to weekly or monthly tenants, or where the premises are let in separate apartments, or the rents become payable or are collected at any shorter period than quarterly. When the owner is rated he must be assessed upon a certain proportion only of the net annual value of the premises. The owners or occupiers of certain specified properties are assessed in respect of the same in the proportion of one-fourth part only of the net annual value thereof. These properties include tithes, tithe commutation rent charge, land used as arable, meadow or pasture ground only, or as woodlands, market gardens or nursery grounds, orchards, allotments, any land covered with water such as the reservoir of a waterworks company, or used only as a canal or towing-path of the same, or as a railway constructed under the powers of any Act of Parliament for public conveyance. The reason for these partial exemptions apparently is that sanitary arrangements are made chiefly for the benefit of houses and buildings, while the properties just enumerated do not receive the same amount of benefit. The only other point to be noticed in this connexion is that an urban council may divide their district into parts for all or any of the purposes of the Act, rating each part separately for those purposes. The expenses of highways in an urban district fall as a rule upon the general district rate, but under certain conditions, which need not be here set out, a separate highway rate may have to be levied. The urban council have extensive powers of amending the rate, and the rate is collected in such manner as the urban authority may appoint.

The expenses of a rural district council are of two kinds. Of these the first is called general expenses, and it includes the expense of the establishment and officers of the council, of disinfection, providing of conveyance for infected persons, and the expenses of highways. These expenses are payable out of a common fund which is raised out of the poor rate of the several parishes in the district, according to the rateable value of each. Special expenses include the expenses of the construction and maintenance and cleansing of sewers, providing water supply, and all other expenses incurred or payable in respect of a parish or contributory place within the district determined by order of the Local Government Board to be special expenses. The expression "contributory place" means a place other than a parish chargeable with special expenses. For the most part it has reference only to what is called a special drainage district—that is to say, a district formed out of one or more parishes or parts of parishes for the purpose of the provision of a common water supply, or scheme of sewerage, or the like, and in the event of such a district including part only of a parish, the remaining portion would, so far as the special expenses for which the district was created are concerned, be a separate contributory place. These special expenses are chargeable to each parish or contributory place, and they are defrayed by means of special sanitary rates, such rates being raised on all property assessed to the relief of the poor, but with the same exemptions of certain properties as have been mentioned under the head of general district rate in urban districts.

Borrowing powers.

District councils are empowered to borrow with the sanction of the Local Government Board, subject to certain restrictions and regulations. The money must be borrowed for permanent works, the expenses of which ought in the opinion of the Local Government Board to be spread over a term of years which must not exceed sixty. The sums borrowed must not exceed, with the outstanding loans, the amount of the assessable value for two years of the district for which the money is borrowed; and if the sum borrowed would, with the outstanding loans, exceed the assessable value for one year, the sanction of the Local Government Board may not be given except after local inquiry. The money may be repaid by equal instalments of principal, or of principal and interest, or by means of a sinking fund.

Audit.

Where the urban council are the council of a borough, their accounts as urban council are made up and audited in the same ineffective manner as has already been mentioned in the case of the accounts of the council under the Municipal Corporations Act, but each of the borough auditors receives remuneration for auditing the accounts of the council as urban district council. Where the urban council are not the council of a borough, the accounts are made up annually, and audited by the district auditor in the same effective manner as has already been mentioned in the case of the accounts of a county council. The accounts of a rural district council are made up half-yearly, and are audited in the same way.

Proceedings against district councils.

The Public Authorities Protection Act, 1893, was passed to repeal the numerous provisions contained in many Acts of Parliament, whereby, before legal proceedings could be taken against a public body, notice of action had to be given and the proceedings commenced within a certain limited time. The Act applies to all public authorities, including, of course, district councils, and it provides in effect that where any action or legal proceeding is taken against a council for any act done in pursuance or execution, or intended execution, of an Act of Parliament, or of any public duty or authority, the action must be commenced within six months next after the act, neglect, or default complained of, or in the case of a continuance of injury or damage, within six months next after the ceasing thereof. And it provides further that, in the event of the judgment of the court being given in favour of the council, the council shall be entitled to recover their costs taxed as between solicitor and client. Notice of action is abolished in every case.

Housing of the working classes.

Among other Acts which are either incorporated with the Public Health Acts or have been passed subsequently to them, one of the most important is the Housing of the Working Classes Act, 1890. It contains three distinct parts. Under the first an urban district council may, by means of a scheme, acquire, rearrange, and reconstruct an area which has been proved to be insanitary. The scheme has to be confirmed by the Local Government Board, and carried out by means of a provisional order. The second part of the Act deals with unhealthy dwelling-houses, and requires the urban district council to take steps for the closing of any dwelling-houses within their district which are unfit for human habitation. The third part of the Act deals with what is called in the Act working-class lodging-houses. But the expression is a little misleading, for it includes separate houses or cottages for the working classes, whether containing one or several tenements, and the expression "cottage" may include a garden of not more than half an acre, provided that the estimated annual value of such garden shall not exceed £3. This part of the Act may be adopted by a rural district council, but an urban district council can carry it into execution without formal adoption. Land may be acquired for erecting lodging-houses as above defined, and these, when erected, may be managed and let by the council.

Baths and wash-houses.

The urban district council may adopt the provisions of the Baths and Washhouses Acts, and thereunder provide public baths, wash-houses, open bathing-places, covered swimming baths, which they may close in the winter months and use as gymnasia.

Tramways.

Under the Tramways Act, 1870, the urban district council may obtain from the Board of Trade a provisional order authorizing the construction of tramways in their district by themselves. Any private persons, and any corporation or company, may, with the consent of the council, obtain the like authority, but the Board of Trade have power in certain cases to dispense with the consent of the local authority. Where the order is obtained by a person or body other than the district council, the council may purchase the undertaking at the end of twenty-one years after the tramways have been constructed or at the expiration of every subsequent period of seven years, and the terms of purchase are that the person or company must sell the undertaking upon payment of the then value, exclusive of any allowance for past or future profits of the undertaking, or any compensation for compulsory sale or other consideration whatsoever of the tramway, and all lands, buildings, works, materials, and plant suitable to and used for the purposes of the undertaking. It should be observed, however, that although the local authority may themselves construct, and may acquire from the original promoters, a system of tramways, they may not themselves work them without special authority of the legislature, and must in general let the working of the undertaking to some person or company.

Bills in Parliament and legal proceedings.

Under the Borough Funds Act, 1872, the urban district council may, if in their judgment it is expedient, promote or oppose any local and personal Bill or Bills in Parliament, or may prosecute or defend any legal proceedings necessary for the promotion or protection of the interests of the district, and may charge the costs incurred in so doing to the rates under their control. The power to incur parliamentary costs, however, is subject to several important restrictions. The resolution to promote or oppose the Bill must in the first instance have been carried by an absolute majority of the whole number of the council at a meeting convened by special notice, and afterwards confirmed by the like majority. The resolution must have been published in newspapers circulated in the district, and must have received the consent of the Local Government Board or of a Secretary of State, if the matter is one within its jurisdiction; and further, the expenses must not be incurred unless the promotion or opposition has been assented to by the owners and ratepayers of the district assembled at a meeting convened for the purpose of considering the matter, and if necessary, signified by a poll. Moreover, the expenses must, before they can be charged to the rates, be examined and allowed by some person authorized by a Secretary of State or the Local Government Board, as the case may be.

Under the Pawnbrokers Act, 1872, the licences to pawnbrokers, which were formerly granted by justices, are now granted by district councils.

Adulteration.

Under the Sale of Food and Drugs Acts certain important duties devolve upon medical officers and inspectors of nuisances who are officers of district councils. But for the most part the Acts do not impose upon district councils themselves any special powers or duties, although, as a matter of fact, prosecutions for offences are usually undertaken by the district councils, and the expenses of the execution of the Acts are paid out of their funds. In quarter sessions boroughs, however, where the council have the duty of appointing a public analyst, they are under an obligation to put the Acts in force from time to time, as occasion may arise. The Acts themselves must be consulted for the procedure, beginning with the taking of samples and ending with the conviction of an offender.

Rivers pollution.

The powers and duties of a district council under the Rivers Pollution Prevention Act, 1876, have been incidentally noticed when dealing with county councils, whose powers under the Acts are precisely the same.

Electric lighting.

Under the Electric Lighting Acts the Board of Trade may license any district council to supply electricity, or may grant to them a provisional order for the same purpose. A similar licence or order may be granted to a private person or company to supply electricity within the district of a district council, but in that case the consent of the district council must be given, unless the Board of Trade, for special reasons, dispense with such consent. These licences are now rarely applied for or granted, and the provisions which were formerly contained in the provisional orders have now been consolidated by the Electric Lighting Clauses Act, 1899, the effect of which will be to make provisional orders uniform for the future. It is now almost the exception, at least in urban districts, to find a district council which has not obtained a provisional order under these Acts, and for the most part the undertakings of local authorities in the way of supplying electricity have been very prosperous.

Allotments.

Under the Allotments Acts district councils are empowered to provide allotments for the labouring population of their district, if they are satisfied that there is a demand for allotments, that these cannot be obtained at a reasonable rent by voluntary arrangement, and that the land can be let at such a price as will not involve a loss to the council. The district council may acquire land, let it and regulate it, and they may, in certain cases, provide common pasture.

Public libraries.

The urban district council execute the Public Libraries Acts for their district, and the rate for the expenses of the Acts, which may not exceed 1d. in the £, is in a borough in the nature of a borough rate, and in any other urban district in the nature of a general district rate. Under the Acts not only public libraries, but also public museums, schools for science, art galleries, and schools for art, with the necessary buildings, furniture, fittings, and conveniences, may be provided for the inhabitants of the district. Land may be acquired, and money borrowed, for the purposes of the Acts.

A great number of other statutes confer powers or impose duties upon district councils, such as the Acts relating to town gardens, agricultural gangs, fairs, petroleum, infant life protection, commons, open spaces, canal boats, factories and workshops, margarine, sale of horse-flesh, and shop hours.

The parish and the parish council.

Before the passing of the Local Government Act, 1894, there was really nothing in the form of local government for a parish. It is true that the inhabitants in vestry had certain powers. They could adopt various Acts, which will be more particularly referred to hereafter, and they could appoint the persons who were to carry these Acts into execution. They elected the churchwardens and overseers, the highway surveyor, if the parish was a separate unit for highway purposes, and the waywardens if it was included in a highway district. But there was nothing in the nature of a representative body exercising any powers of government in the parish regarded as a separate area. Under the Act of 1894 this was changed. In every rural parish, that is to say, in every parish which is not included within an urban district, there is a parish meeting, which consists of the parochial electors of the parish. As already stated, these are the persons whose names are on the parliamentary and local government registers. If the parish has a population exceeding 300, a parish council must be elected. If it has a population of 100 or upwards, the county council are bound to make an order for the election of a parish council if the parish meeting so resolves. Where there is no parish council, as will be seen hereafter, the various powers conferred upon a council are exercised by the parish meeting itself. Two or more parishes may be grouped together under a common parish council by order of the county council if the parish meetings of each parish consent. An annual parish meeting in every rural parish must be held on the 25th day of March or within seven days before or after that date; and if there is no parish council, there must be at least one other parish meeting in the year. At the annual parish meeting the parish council, if there is one, is elected, and the members of the council, who originally held office for one year only, now, under a subsequent Act, hold office for three years. Any person who is a parochial elector, or who has for twelve months preceding the election resided in the parish, or within three miles thereof, may be elected parish councillor, and the number of councillors is to be fixed from time to time by the county council, not being less than five nor more than fifteen. Women, whether married or single, are eligible.

Powers to appoint overseers.

The council are elected in manner provided by the rules of the Local Government Board. The rules now in force will be found in the *Statutory Rules and Orders* for 1898, p. 692. They are very similar to those which are in force with reference to the elections of district councils, which have already been noticed. If a poll is demanded, it must be taken under the Ballot Act, as applied by the Rules, and for all practical purposes it may be taken that the election proceeds in the same manner as that of a district council. The parish council elects a chairman annually. He may be one of their own number, or some other person qualified to be a parish councillor. The council is a body corporate, may hold land in mortmain, and can appoint committees for its own parish or jointly with any other parish council. Among the powers conferred upon a parish council are those of appointing overseers and of appointing and revoking the appointment of assistant overseers. In future, churchwardens are no longer to be overseers, and the parish council may appoint as overseers a number of persons equal to the number formerly appointed as overseers and churchwardens. It may be useful to mention here that for purposes of the administration of the poor law, overseers no longer act, their duties in that respect having been superseded by the guardians. They remain, however, the rating authority so far as regards the poor rate and nearly all other rates, the exceptions being the general district rate in an urban district and the borough rate in a borough, made by the town council. They still have power to give relief to poor persons in case of sudden and urgent necessity, but their principal duty is that of rating authority, and they are bound to make out the lists for their parishes of jurors and electors. No payment is made to them. The office is compulsory, but certain persons are privileged from being elected to it. The assistant overseer, who was formerly nominated by the inhabitants and vestry and then formally appointed by justices, is now, as has been stated, appointed by the parish council. He holds office at pleasure, and receives such remuneration as the council fix, and he performs all the duties of an overseer, or such of them as may be prescribed by the terms of his appointment. There may be in a parish a collector of rates appointed by the guardians. In that event, an assistant overseer cannot be appointed to perform the duties of collector of rates, but, on the other hand, the parish council may invest the collector with any of the powers of an overseer. The parish council may appoint a clerk, who may be either one of their own number without payment, or the assistant overseer, rate collector, or some other fit person, with remuneration.

Powers and duties of parish councils.

Among the duties transferred to parish councils may be mentioned the provision of parish books and of a vestry room or parochial office, parish chest, fire engine or fire escape, the holding or management of parish property, other than property relating to affairs of the church or held for an ecclesiastical charity, the holding or management of village greens or of allotments, the appointment of trustees of parochial charities other than ecclesiastical charities in certain cases, and certain limited powers with reference to the supply of water to the parish, the removal of nuisances, and the acquisition of rights of way which are beneficial to the inhabitants.

Among the most important of the matters which concern a rural parish is the administration of what are commonly called the adoptive Acts. These include the Lighting and Watching Act, the Baths and Washhouses Acts, the Burial Acts, the Public Improvement Act, and the Public Libraries Acts. The Lighting and Watching Act was formerly adopted for a parish, or part of a parish, by the inhabitants in vestry, who elected lighting inspectors, of whom one-third went out of office in every year. **Lighting and Watching Act.** The inspectors took the necessary steps for having the parish lighted (the provisions as to watching having been obsolete for many years), and the expenses of lighting were raised by the overseers upon an order issued to them by the inspectors. The owners and occupiers of houses, buildings, and property, other than land, pay a rate in the £ three times greater than that at which the owners and occupiers of land are rated and pay for the purposes of the Act. Now this Act, like the other adoptive Acts, can only be adopted by the parish meeting, and where adopted for part only of a parish, must be adopted by a parish meeting held for that part. After the adoption of the Act, it is carried into execution by the parish council, if there is one, and if not, by the parish meeting, and the expenses are raised in the same manner as heretofore. **Baths and Washhouses Acts.** The Baths and Washhouses Acts have already been referred to in dealing with district councils, and it is sufficient to say that they are now adopted and administered in a rural parish in the manner pointed out with reference to the Lighting and Watching Act. **Burial Acts.** The same may be said of the Burial Acts, but these are sufficiently important to require special notice. These Acts contain provisions whereby burials may be prohibited in urban districts, and churchyards or burial grounds already existing may be closed when full. Formerly, when the Acts had been adopted by the vestry, it was necessary to appoint a burial board to carry the Acts into execution and provide and manage burial grounds. Now, in a rural parish which is co-extensive with an area for which the Acts have been adopted, the burial board is abolished and the Acts are administered by the parish council; and the Acts cannot be adopted in a rural parish save by the parish meeting. If the area under a burial board in 1894 was partly in a rural parish and partly in an urban district, the burial board was superseded, and the powers of the board are exercised by a joint committee appointed partly by the urban district council and partly by the parish council, or parish meeting, as the case may be. In a rural parish where there is no parish council, though the Acts are adopted by the parish meeting, it is still necessary to elect the burial board, and that board will be elected by the parish meeting. The distinction between a burial ground under the Burial Acts and a cemetery provided under the Public Health Acts has already been noticed. A burial ground, properly so called, has to be divided into consecrated and unconsecrated portions, and the former really takes the place of the parish churchyard; and the incumbent of the parish church, the clerk, and the sexton continue to receive the same fees upon burials in the consecrated portion as they would have done in the parish churchyard. It has been mentioned that a portion of the burial ground must be left unconsecrated. But this is subject to one important exception, that the parish meeting may unanimously resolve that the whole of the burial ground shall be consecrated. In that case, however, the parish council may, within ten years thereafter, determine that a separate unconsecrated burial ground shall also be provided for the parish. The expenses of the execution of the Burial Acts are provided by the overseers out of the poor rate upon the certificate of the body entrusted with the execution of them. In the event of the Acts being adopted for a portion only of a rural parish, the burial board, or the parish meeting, may by resolution transfer all the powers of the board to the parish council.

Public Improvement Act. The Public Improvement Act, when adopted, enables a parish council to purchase or lease, or accept gifts of land for the purpose of forming public walks, exercise or play grounds, and to provide for the expense by means of a parish improvement rate. Before any such rate is imposed, however, a sum in amount not less than at least half of the estimated cost of the proposed improvement must have been raised by private subscription or donation, and the rate must not exceed sixpence in the £.

Public Libraries Acts. The Public Libraries Acts enable the authority adopting them to provide public libraries, museums, schools for science, art galleries, and schools for art. The expenses in a rural parish are defrayed by means of a rate raised with, and as part of, the poor rate, with a qualification to the effect that agricultural land, market gardens, and nursery grounds are to be assessed to the rate at one-third only of their rateable value.

Finance: expenses of parish council. The expenses of a parish council may not, without the consent of a parish meeting, exceed the amount of a rate of threepence in the £ for the financial year; but with the consent of the parish meeting the limit may be increased to sixpence, exclusive of expenses under the adoptive Acts. If it is necessary to borrow, the consent of the parish meeting and of the county council must be obtained. The expenses are payable out of the poor rate by the overseers on the precept of the parish council.

One of the most important powers conferred upon a parish council is that which enables them to prevent stoppage or diversion of any public right of way without their consent and without the approval of the parish meeting. The council may also complain to the county council that the district council have failed to sewer their parish or provide a proper water supply, or generally to enforce the provisions of the Burial Acts; and upon such complaint, if ascertained to be well founded, the county council may transfer to themselves the powers and duties of the district council, or may appoint a competent person to perform such powers and duties. In a parish which is not sufficiently large to have a parish council, most of the powers and duties conferred or imposed on the parish council are exercised by the parish meeting. It may be convenient here to add that where, under the Local Government Act, 1894, the powers of a parish council are not already possessed by an urban district council, the Local Government Board may by order confer such powers on the urban council. This has been done almost universally, as far as regards the power to appoint overseers and assistant overseers, and in many cases urban councils have also obtained powers to appoint trustees of parochial charities.

General observations. The foregoing is a sketch of the scheme of local government carried out in England and Wales. No attempt has been made to deal with poor law (*q.v.*) or education (*q.v.*). The local administration of justice devolving upon the justices in quarter or petty sessions is hardly a matter of local government, although in one important respect, that, namely, of the licensing of premises for the sale of intoxicating liquors, it may be thought that the duties of justices fall within the scope of local government. It will be seen that the scheme, as at present existing, has for its object the simplification of local government by the abolition of unnecessary independent authorities, and that this has been carried out almost completely, the principal exception being that in some cases burial boards still exist which have not been superseded either by urban district councils or by parish councils or parish meetings. There are also some matters of local administration arising under what are called commissions of sewers. These exist for the purpose of regulating drainage, and providing defence against water in fen lands or lands subject to floods from rivers or tidal waters. The commissioners derive their authority from the Sewers Commission Acts, which date from the time of Henry VIII., from the Land Drainage Act, 1861, and from various local Acts. It is unnecessary, however, to consider in any detail the powers exercised by commissioners of sewers in the few areas under their control.

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Loch, Henry Brougham Loch, 1st BARON (1827–1900), British administrator, son of Mr James Loch, M.P., of Drylaw, Midlothian, was born on 23rd May 1827. At first destined for a naval career, he soon quitted the navy for the East India Company's military service, and in 1842 obtained a commission in the Bengal Light Cavalry. On the outbreak of the Sikh war in 1845 he was given an appointment on the staff of Sir Hugh Gough, and served throughout the Sutlej campaign, where he displayed the cool courage and unshakeable resolution which continued to characterize his subsequent career. In 1852 he became second in command of that famous corps, Skinner's Horse. At the outbreak of the Crimean war in 1854, Loch, eager for service at the front, severed his connexion with India, and obtained leave to raise a body of irregular Bulgarian cavalry, which he commanded throughout the war. In 1857 he was appointed attaché to Lord Elgin's mission to the East, was present at Tientsin, and brought home the Treaty of Yedo in the following year. He now abandoned his military career, and in 1859 went out again as secretary to Lord Elgin's second mission to China. Here he was involved in an adventure which came near costing him his life. He had advanced with a small guard to a place called Tungchow, to arrange the preliminaries for the negotiations, when he found that the Chinese had treacherously gathered a great army to surprise the British forces. He rode back to warn Sir Hope Grant, and then returned through the enemy's lines to rejoin his companions, Bowlby and Parkes. Before they could effect their retreat, the battle had begun; they were seized by the beaten Chinese, and hurried off to Peking, where they were put into cages and subjected to other indignities. Loch was rescued in the nick of time. Returning home, he was made C.B., and for a while occupied the less adventurous post of private secretary to Sir George Grey, who was then at the Home Office. In 1863 he was appointed Lieutenant-Governor of the Isle of Man. His long and successful tenure of this post coincided with a period of active progress in the island. It was during this time that the House of Keys was transformed into an elective assembly, the first line of railway was opened, and the influx of tourists began to bring fresh prosperity. In 1882 Sir H. Loch, who had become K.C.B. in 1880, accepted a Commissionership of Woods and Forests, and two years later was made Governor of Victoria, where he won the esteem of all classes. In 1889 he succeeded Sir Hercules Robinson as Governor of Cape Colony and High Commissioner of South Africa. His term of office coincided with a period of unrest that called for a firm hand. Immediately after his arrival he held a conference with President Kruger, and concluded the Swaziland Convention of 1890, which offered the Transvaal an outlet to the sea at Kosi Bay on condition of its joining the South African Customs Union. The Banyailand "trek" of 1891 was nipped in the bud by his prompt action. When the commandeering difficulty of 1894 had roused the Uitlanders in the Transvaal to a dangerous pitch of excitement, he travelled to Pretoria to use his personal influence with President Kruger. He was received with a memorable outburst of enthusiasm, and, with characteristic prudence, cancelled his projected visit to Johannesburg, for fear his presence might be the signal for excesses that could only injure the Uitlanders. Sir H. Loch, by the firm attitude he took up, obtained the withdrawal of the obnoxious commandeering regulations; but a memorandum, pressing for redress of the Uitlanders' whole position, was cancelled at the last moment by order of the Colonial Secretary, Lord Ripon. In the following year he entered a strong protest against the new franchise law; and finding that President Kruger had not fulfilled the conditions of the Swaziland Convention, he declared it abrogated, and annexed the Zambaan and Umbegesa territories to the British Crown. This was the last important act of his administration. He had, by his openness of mind and his personal charm of manner, won the goodwill of British and Dutch alike, including President Kruger himself. At critical moments he had behaved with coolness and resolution, and, both at the time of the Banyailand "trek" and during the Johannesburg agitation, had not hesitated to make such military dispositions as he believed necessary for the safeguarding of Imperial interests. But, whether from his own fault, or from dissensions on Imperial questions in the Home Government, he had contented himself with a settlement of each separate difficulty as it arose, while the general situation assumed year by year a more threatening aspect. Mr Rhodes, then Prime Minister of Cape Colony, was strongly in favour of a more energetic policy, and in 1895 the High Commissioner, finding himself out of touch with his ministers, resigned his office and returned home. In the same year he was raised to the peerage. He died in London on 20th June 1900. (H. SY.)

Loches, chief town of arrondissement, department of Indre-et-Loire, France, on the river Indre, 25 miles south-east of Tours by rail. The castle of Loches was in the Middle Ages a fortress of the first class. The outer enclosure, nearly two miles in circumference, surrounds (1) a collegiate church (now the parish church), founded in the 10th century, and in some respects unique in French architecture; (2) a royal lodge (now the sub-prefecture), built by Charles VII. over subterranean chambers, rediscovered in 1869; and (3) the fortress proper, which eventually came to be used as a state prison, the terrors of which almost equalled those of the Bastille. Population (1901), 5161.

Lochgelly, a police burgh and railway station of Fifeshire, Scotland, 7½ miles north-east of Dunfermline. The town, which takes its name from a small lake, half a mile to the south-east, is of modern origin, and owes its prosperity to its iron-works and the large collieries in the immediate vicinity. The majority of the houses are small, but the town is regularly built, and the water and sewerage arrangements are satisfactory. There are some good shops, and the public buildings include a music hall, a co-operative hall, and a commodious and handsome drill hall. To the north-west of the lake is Lochgelly House, a seat of the Earl of Minto. Population (1881), 2601; (1900), 5472.

Lockerbie, a police burgh and market town of Annandale, Dumfriesshire, Scotland, 14½ miles east-north-east of Dumfries by rail. It is an important centre for the dispersal of lambs—126,000 were sold in the autumn of 1899. There is an ancient square tower—once a family seat, and afterwards for many years a gaol,—a town hall, and a mechanics' hall. Population (1881), 2029; (1901), 2358.

Locker-Lampson, Frederick (1821–1895), better known as FREDERICK LOCKER, English man of letters, was born, on the 29th of May 1821, at Greenwich Hospital. His father, who was Civil Commissioner of the Hospital, was Edward Hawke Locker, youngest son of that Captain William Locker who gave Nelson the memorable advice, "to lay a Frenchman close, and beat him." His mother, Eleanor Mary Elizabeth Boucher, was a daughter of the Rev. Jonathan Boucher, vicar of Epsom and friend of George Washington. After a desultory education, Frederick Locker began life in a colonial broker's office. Soon deserting this uncongenial calling, he obtained a clerkship in Somerset House, whence he was transferred to Lord Haddington's private office at the Admiralty. Here he ultimately became deputy-reader and *précis* writer. In 1850 he married Lady Charlotte Bruce, daughter of the Lord Elgin who brought the famous marbles to England, and sister of Lady Augusta Stanley. After his marriage he left the Civil Service, in consequence of ill-health. In 1857 he published *London Lyrics*, a slender volume of 90 pages, which, with subsequent extensions, constitutes his poetical legacy. *Lyra Elegantiarum* (1867), an anthology of light and familiar verse, and *Patchwork* (1879), a book of extracts, were his only other publications. In 1872 Lady Charlotte Locker died. Two years later Locker married Miss Hannah Jane Lampson, the only daughter of Sir Curtis Miranda Lampson, Bart., of Rowfant, Sussex, and in 1885 took his wife's surname. At Rowfant he died, 30th May 1895. Chronic ill-health debarred Locker from any active part in life, but it did not prevent his delighting a wide circle of friends by his gifts as a host and *raconteur*, and from accumulating many treasures as a connoisseur. His books are catalogued in the volume called the *Rowfant Library*, 1886, to which an appendix (1900) was added, after his death, under the superintendence of his eldest son. As a poet, Locker belongs to the choir who deal with the gay rather than the grave in verse—with the polished and witty rather than the lofty or emotional. His good taste kept him as far from the broadly comic on the one side as his kind heart saved him from the purely cynical on the other. To something of Prior, of Praed, and of Hood he added qualities of his own which lent his work distinction—a distinction in no wise diminished by his unwearied endeavour after directness and simplicity. A posthumous volume of Memoirs, entitled *My Confidences* (1896), and edited by his son-in-law, Mr Augustine Birrell, gives an interesting idea of his personality and a too modest estimate of his gifts as a poet. (A. D.)

Lockhart, Sir William Stephen Alexander (1841–1900), British general, was born in Scotland, 2nd September 1841, his father being a Lanarkshire clergyman. He entered the Indian army in 1858, in the Bengal native infantry, and rose to be captain (1868), lieut.-colonel (1879), major-general (1891), lieut.-general (1894), and general (1896). He served in the Indian Mutiny, the Bhutan campaign (1864–66), the Abyssinian expedition (1867–68; mentioned in despatches), the Hazara Black Mountain expedition (1868–69; mentioned in despatches). From 1869 to 1879 he acted as deputy-assistant and assistant quartermaster-general in Bengal. In 1877 he was military attaché with the Dutch army in Acheen. He served in the Afghan war of 1878–80, was mentioned in despatches and made a C.B., and from 1880 to 1885 was D.Q.G. in the intelligence branch at headquarters. He commanded a brigade in the Burmese war (1886–87), and was made K.C.B., C.S.I., and received the thanks of the Government. An attack of fever brought him to England, and he was employed as assistant military secretary for Indian affairs; but in 1890 he returned to India to take command of the Punjab frontier force, and for five years was engaged in various expeditions against the hill tribes. After the Waziristan campaign in 1894–95 he was made K.C.S.I. In 1897 he was given the command against the Afridis and Mohmands, and conducted the difficult Tirah campaign (*q.v.*) with great skill. He was made G.C.B., and in 1898 became commander-in-chief in India. His career was cut short, however, by his death on 18th March 1900. Sir William Lockhart was not only a first-rate soldier, but also had a great gift for dealing with the native tribesmen. Among the latter he had the *sobriquet* of Amir Sahib, on account of their respect and affection for him.

Lock Haven, a city of Pennsylvania, U.S.A., capital of Clinton county, on the west branch of the Susquehanna river, on the Pennsylvania canal and the Pennsylvania and the Beechcreek (part of the New York Central system) railways, at an altitude of 579 feet. It is in a lumber region, has several saw-mills, and ships annually large quantities of lumber. Population (1880), 5845; (1890), 7358; (1900), 7210, of whom 618 were foreign-born and 122 negroes.

Lockport, a village of Will county, Illinois, U.S.A., on the Des Plaines river, five miles above Joliet, on the Chicago and Alton, and the Atchison, Topeka, and Santa Fé railways, at an altitude of 570 feet. Population (1880), 1679; (1890), 2449; (1900), 2659.

Lockport, a city of New York, U.S.A., capital of Niagara county, on the Erie canal, and on the Erie and the New York Central and Hudson River railways, at an altitude of 594 feet. The locks in the Erie canal, from which the city derives its name, are ten in number, five for ascending and five for descending the 60-feet rise in the canal at this point. The surplus water from Tonawanda creek, after supplying the canal, furnishes an excellent water-power, which has been put to use in a variety of manufactures. Among them are plants for the Holly heating system, by which steam is supplied through street mains to homes and other buildings from a central generator. Population (1890), 16,038; (1900), 16,581, of whom 2936 were foreign-born and 160 were negroes.

Lockroy, Edouard [ETIENNE-AUGUSTE-EDOUARD SIMON] (1838– ——), French politician, son of Joseph Philippe Simon (1803–1891) dramatist and actor (who took the name of Lockroy), was born in Paris, 18th July 1838. He began by studying as an artist, but in 1860 took part in Garibaldi's expedition to Sicily, and, after acting as secretary to Renan on his tour in Palestine (1864), took to journalism in Paris as a fierce opponent of the Empire. He commanded a battalion during the siege of Paris in 1870, and in 1872 was elected deputy for the Seine. During the stormy period that followed he was several times imprisoned for his violent articles in the press, but his name became known to the public, and he was elected deputy for Bouches-du-Rhone in 1873, and in 1876 for Aix. He continued afterwards to be returned to the Chamber, and took a prominent part in affairs as one of the Extreme Left. In 1877 he had married the widow of Victor Hugo's son. He was minister of commerce in the cabinets of M. Freycinet and M. Goblet (1886–87), minister of education under M. Floquet (1888–89), and minister of marine under M. Bourgeois (1895–96), under M. Brisson (1898), and M. Dupuy (1898–99). He devoted both his pen and his policy to the reorganization of the French navy on modern lines, and became the best-known advocate of naval reform in France; and the activity shown in French naval matters towards the end of the century was largely owing to his persistence.

Lockwood, Sir Frank (1846–1897), English lawyer, was born at Doncaster in 1846. His grandfather and great-grandfather were mayors of Doncaster, and the former for some years filled the office of judge on the race-course. He was educated at a private school, at Manchester Grammar School, and Caius College, Cambridge. Called to the bar at Lincoln's Inn in 1872, he joined the old Midland circuit, afterwards going to the north-eastern, and did well enough to make in his first year 120 guineas, and in the next 265 guineas. From that time he had a career of uninterrupted success. In 1882 he was made a Queen's Counsel, in 1884 he was made Recorder of Sheffield, and in 1894 he became Solicitor-General in Lord Rosebery's ministry, and was knighted, having first entered Parliament as member for York in 1885, after two unsuccessful attempts, the one at King's Lynn in 1880, the other at York in 1883. He was Solicitor-General for less than a year. In 1896 Lord Chief Justice Coleridge, Mr Montague Crackanthorpe, and Sir Frank Lockwood went to the United States to attend, as specially invited guests, the nineteenth meeting of the American Bar Association, and to represent the power, learning, and humour of the English bar thereat. On this trip Sir Frank Lockwood sustained the reputation which he enjoyed in England as a humorous after-dinner speaker, and helped to strengthen the bond of friendship which unites the bench and bar of the United States with the bench and bar of England. He died in London on 18th December 1897.

A brief epitome of Sir Frank Lockwood's legal achievements can give no idea of his unique personality, and of the manner in which it contributed to his success. He was a big, cheery, rubicund Yorkshireman, with a jovial manner, a sonorous voice, a ready tongue, and a sense of humour that never deserted him. No one can doubt that Frank Lockwood owed his success in a grave profession as much to this sense of humour and to his power to excite merriment as to any of his other qualities. His first brief was in the Rolls Court, a solemn tribunal now no more. "What brings *you* here?" asked Lord Romilly, as he rose to address the court. "Three and one, my Lord," replied young Lockwood, after an eloquent glance at the fee marked in guineas on his brief. The precise effect of the answer on the Master of the Rolls is not recorded, but the story clung to Lockwood as long as he remained at the bar, among hundreds of others, some possibly apocryphal, all enhancing his reputation for quick retort and imperturbable coolness. He had, moreover, considerable talent for drawing, inherited from his father, which he employed chiefly for the amusement of himself and his friends, in the making of admirable caricatures in pen and ink, and of sketches of humorous incidents, real or imaginary, relating to the topic nearest at hand, many of which, being made in court, found their way into the possession of his friends and others near him, sometimes of the judge who tried the case. An exhibition of them was held soon after his death. Many have been reproduced, some in Mr Augustine Birrell's excellent little biography, and more in *The Frank Lockwood Sketch-Book* (1898). Sir Frank Lockwood neither was nor pretended to be a profound lawyer, but he was an advocate who would influence juries, an incisive and ready cross-examiner, an eloquent and, as a rule, tactful speaker, with great power of bringing his adversary's case or witness into ridicule and contempt, where such a course seemed likely to prove effective. In these circumstances, although he was engaged in many heavy cases, such as the Parnell Commission, he won his reputation at the bar mainly in the class of trial popularly defined as *causes célèbres*, in the Divorce Court, in trials connected with the turf, in the exposure of fraud, in the prosecution, and still more in the defence, of prisoners. In private life he had a vast number of friends and no enemies. With inherited tastes for sport, he was fond of riding, of shooting, and of the race-course; in early life he was very fond of acting, and, although he perhaps never seriously contemplated adopting the theatrical profession, he went on tour with his friends, Mr and Mrs Kendal, and always took considerable interest in the stage. He was a great admirer of Dickens, and a lecture on "The Law and Lawyers of Pickwick," delivered by him at York, and afterwards at the Morley Hall, Hackney, to some of the constituents of his friend, Sir Charles Russell (afterwards Lord Chief Justice), was published by the Roxburghe Press, with a sketch of Sergeant Buzfuz by the author as a frontispiece. Sir Frank Lockwood married, in 1874, Julia, second daughter of Mr Salis Schwabe, by whom he had a family. (E. A. Ar.)

Lockyer, Sir Joseph Norman (1836- ——), English astronomer, was born at Rugby on the 17th May 1836. After completing his education on the Continent, he obtained a clerkship in the War Office in 1857. His leisure was devoted to the study of astronomy, and the proofs of scientific skill and of business capacity which he gave led to his appointment as secretary of the duke of Devonshire's commission on science in 1870. In 1875 he was transferred to the Science and Art Department at South Kensington, and on the foundation of the Royal College of Science he became Director of the Solar Physical Observatory and Professor of Astronomical Physics. He was leader of the British Government expeditions for observation of the solar eclipses occurring from 1870 to 1897. In 1874 he received the Rumford medal of the Royal Society, of which he became a Fellow in 1869, for his spectroscopic researches on the sun and on the chemical elements. In 1868 he was able to communicate to the Royal Society and the Paris Academy a report of his successful observations of the solar prominences in broad daylight by the aid of the spectroscope. It happened that Dr Janssen, who had observed the spectra of the prominences during the total eclipse of August 1868, had applied his instrument to them on the following day, and his report reached the Paris Academy of Sciences a few days after that body had received Lockyer's communication. But, as Sir Joseph Hooker, the President of the Royal Society, said, when handing Lockyer the Rumford medal, "nothing interferes with the perfect independence with which the two physicists established the possibility of detecting the prominences at any time." The names of both astronomers appear on a medal which was struck by the French Government in 1872 to commemorate the discovery. In addition to numerous contributions to the *Proceedings* of the Royal and the Royal Astronomical societies, Sir Norman Lockyer is the author of several popular books on astronomy, and also of some ambitious treatises in which he passes from the explanatory to the theoretical. Eminent as a spectroscopist, although in this department some of his conclusions are not established, he has, in the *Dawn of Astronomy*, *The Meteoritic Hypothesis*, *The Sun's Place in Nature*, and other works, propounded various theories which have failed to commend themselves to the majority of astronomers; dissent has been especially expressed by competent spectroscopists and physicists from his theory of the origin of cosmical systems, namely, that all the varied orders of bodies which the heavens present to view are alike composed of meteorites, "the chief difference between the several orders being due either to the degree of aggregation of meteorites in the swarm, or, in the case of consolidated swarms, to the time which has elapsed since their complete evaporization." His later investigations into an assumed relation between sun-spots and rainfall on the globe remain in the speculative stage. He was created K.C.B. in 1897.

Locle, Le, a town in the Swiss canton of Neuchâtel, 23¾ miles by rail north-west of Neuchâtel. The watchmaking industry dates from 1680. The subterranean mills of the Col des Roches (the railway now traverses this gorge by means of four tunnels) in the neighbourhood, as also the Lac des Brenets, and waterfall of the Doubs on the French frontier, are worth a visit. The population has risen from 10,215 in 1870 to 10,387 in 1880 and 12,624 in 1900, mainly Protestants and French-speaking. The church (built in 1521) is the only old building in the town.

Łodz (*Łódź*, and more correctly *Łodzia*), a manufacturing town of Russian Poland, government Piotrków, 87 miles by rail south-west of Warsaw. It is situated on the Łodz plateau, which at the beginning of the 19th century was covered with impenetrable forests. Now it is the centre of quite a group of industrial towns—Zgerź, Łęczica, Pabianice, &c., and is connected by a branch railway with the main line from Warsaw to Vienna, and five macadamized main roads radiate from it. Chiefly owing to a considerable immigration of German capitalists and workers, Łodz has grown with American-like rapidity. It consists chiefly of one main street, 6 miles long, and is a sort of Polish Manchester, manufacturing cottons, woollens, and mixed stuffs. One of the very few educational institutions is a professional school. The population, which was only 50,000 in 1872, reached 315,209 in 1897, the Poles numbering about 40 per cent., Germans 33 per cent., and Jews 27 per cent.

Lofoten and Vesteraalen, two groups of islands on the west coast of Norway. The permanent population is 35,000 to 40,000, and about the same number are added in the fishing season (January–April). There are factories for fish guano at the fishing-stations of Henningvær, Kabelvaag, and Svolvær on Öst-Vaag Island, at Lödingen on Hind Island, and at Brettesnäs on South Molla. The total trade is valued at £20,000 to £70,000 annually. The violent tempests which sweep over the Vest Fjord are graphically described in Jonas Lie's *Den Fremsynte* (1870) and in H. Schultze's *Udvalgte Skrifter* (1883), as the Maelström, which is near the southern end of the group, is imaginatively by Edgar Allan Poe.

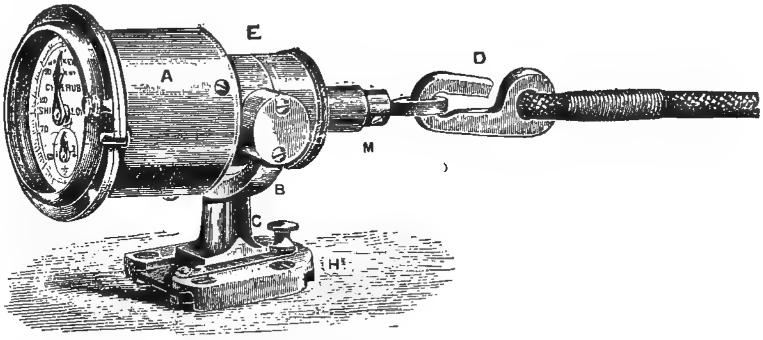

Fig. 2.—The Cherub Log.

Log.—On leaving the land and before the position of a ship can be ascertained by astronomical observations, the intermediate positions are required for the safe navigation of the ship. For this purpose speed indicators were introduced, known as the common and patent logs; the number of revolutions made by the engines may also, in favourable circumstances, be utilized for this purpose.

Common Log.—With high speeds the reel held by men has been superseded by a fixed reel with winch for heaving in the log line, and fitted with a brake to check the line when running out. In a steamer running at high speed on an ocean route, engines working smoothly and uniformly, a careful officer, with correct log line and glass, will attain most accurate results from the common log (see Log, *Ency. Brit.* vol. xiv. p. 769).

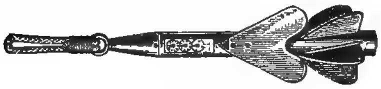

Fig. 1.—The A1 Harpoon Ship Log.

Patent Log.—Under this heading may be placed the pressure and electric logs now discarded, and the present screw or fan log, known generally as the patent log. The crude germ of the latter invention, with the substitution of wheels in a closed box for a rotating screw, is probably due to Humphry Cole about 1570. Foxon of Deptford in 1772, Guerimand of Middlesex in 1776, and Gower in 1792 by mechanical means practically demonstrated the registration of a vessel's speed; the method in 1807 of Viscount de Vaux was with water pressure. In 1802 Edward Massey produced a patent log (Log, 9th edition), which came into general use in 1836 and continued until 1861; in the latter year Walker's harpoon or frictionless log was introduced. The wheelwork was enclosed in a cylindrical case of the same diameter as the body of the rotator or fan, and the latter brought close up to the register, thus forming a compact machine and avoiding the previous use of the 6-feet line. Two years later a heart-shaped float plate was attached to the case, and the log was called the A1 Harpoon ship log (Fig. 1), the one usually employed for towing. The log should be washed in fresh water when practicable, to prevent oxidization of the wheels, and be lubricated with suitable oil through a hole in the case. Alexander Bain in 1846 suggested enclosing the wheelwork in the rotator. With quick passages and well-surveyed coasts, the problems in coastal navigation required a patent log that could be readily consulted from the deck, and one from which the distance run in thick weather under varying speeds could be quickly ascertained. To meet this requirement in 1878 Walker introduced the Cherub log (Fig. 2), a taffrail one, which, however, is not as a rule used for speeds over 18 knots. Owing to the increased friction produced by a rotator making approximately 900 revolutions per mile, towed at the end of a line varying from 40 fathoms for a 12-knot speed to 60 fathoms for 20 knots, the pull of the line and rotator is borne by cone rollers, having their outlines tapering to a common point in their rotation, thus giving a broad rolling surface. Strong worms and wheels are also substituted for the light clockwork. In Fig. 2 the shoe H is secured to the taffrail, the rotator in the water is hooked to the eye of the spindle M by the hook D. The case A contains the registering wheelwork and a sounding bell. The half gimbal B pivoting in the socket of the base C allows the register to receive the strain in the direct line. The bearings and rollers are lubricated with castor-oil every twelve hours through holes in the sliding case E, and can be examined by unscrewing the case E and the eye M. When not in use, the register is removed from the shoe by lifting a small screw button near C. The tow-line is usually plaited, and to avoid a knot close to the rotator, the latter is secured to the former by a knot inside an egg-shaped shell (Fig. 3, Neptune pattern). Walker's Neptune log (Fig. 4)

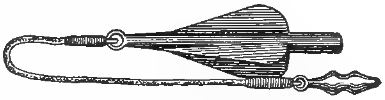

Fig. 3.—Neptune Pattern for securing Rotator.

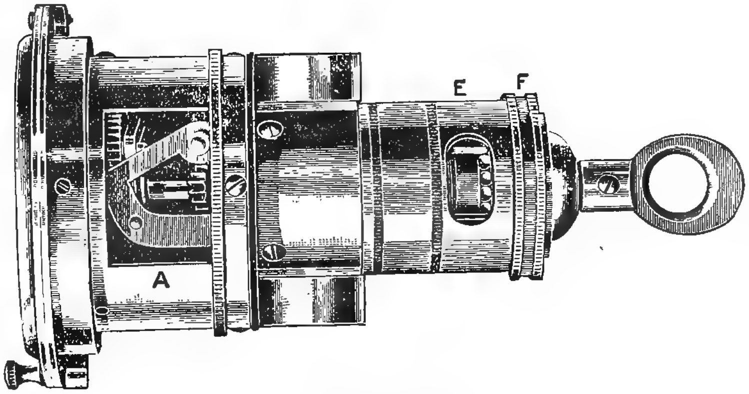

Fig. 4.—Walker's Neptune Log.

is used for vessels of high speed. Case A contains the wheelwork, E the spindle and steel bearings; in each case are openings, closed by sliding tubes, for examination and lubrication. In Fig. 4 the cases A and E are shown open. Fig. 5 shows the dial-plate. In Fig. 6 the ball bearings are shown unscrewed from the body of the log, with eye, cap, and spindle. The ball bearings consist of two necklaces of balls rolling in two pairs of V races or grooves. The outer pair receive the strain of the rotator, and the inner are for adjustment and to prevent lateral movement. The balls and races are enclosed in a skeleton cage (Fig. 7), unscrewing from the cap F (Fig. 4) for cleaning or renewal; the adjustment of the bearings is made by screwing up the cage cap *b*, locked by a special washer and the two screws *a*, *a* (Figs. 6, 7). If the outer races become worn, the complete cage and bearings are reversed; the strain of the line is then transferred to what had previously been the inner with practically unworn balls and races. It is for this purpose that the skeleton cage is screwed internally at both ends, fitting a screwed ring inside the cap F (Fig. 4). Walker's Rocket log (Fig. 8) is a taffrail one, with bearings of hardened steel, and is intended to be slung or secured to the taffrail by a line; the gimbal pattern has a fitting for the deck. In taffrail logs the movement of the line owing to its length becomes spasmodic and jerky, increasing the vibration and friction; to obviate this a governor or fly-wheel is introduced, the hook of the tow-line K (Fig. 9) and the eye of the register M being secured to the governor. Fig. 9 represents the arrangement fitted to the Neptune log; with the Cherub log a small piece of line is introduced between the governor and the eye of the register. The two principal American taffrail logs are the Negus and Bliss (Messrs Norie and Wilson). The former bears a general resemblance to the Cherub log, but the dial-plate is horizontal and the faces turn upwards. The main shaft bearings are in two sets and composed of steel balls running in steel cones and cups; the governor is an iron rod about 16 inches long, with 1-inch circular balls at the extremities. The Bliss resembles the Rocket log in shape, and is secured to the taffrail by a rope, or slung. A governor is not employed. The blades of the rotator are adjustable, being fitted into its tube or body by slits and holes and then soldered. The outer ends of the blades are slit (Fig. 10) to form two tongues, and with the wrench (Fig. 10) the angle of the pitch is altered. All patent logs have errors, which should be ascertained by shore observations when passing a well-surveyed coast in tideless waters on a calm day. Constant use, increased friction (more especially at high speeds), and damage to the rotator will alter an ascertained log error; head or following seas, strong winds, currents, and tidal streams affect the correctness of a patent log.

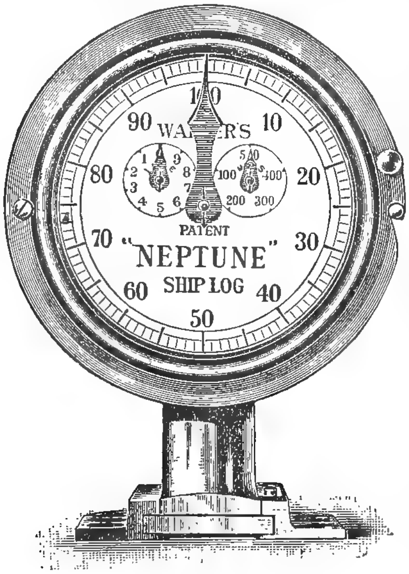

Fig. 5.—Dial-plate of Neptune Log.

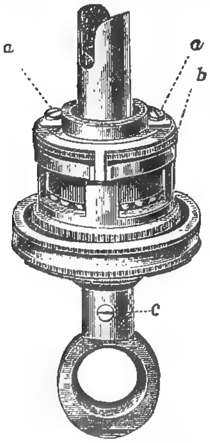

Fig. 6.—Ball Bearings of Neptune Log.

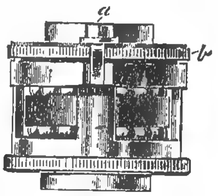

Fig. 7.—Ball Bearings of Neptune Log in Skeleton Case.

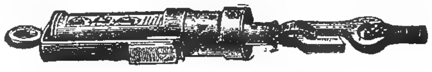

Fig. 8.—Rocket Log.

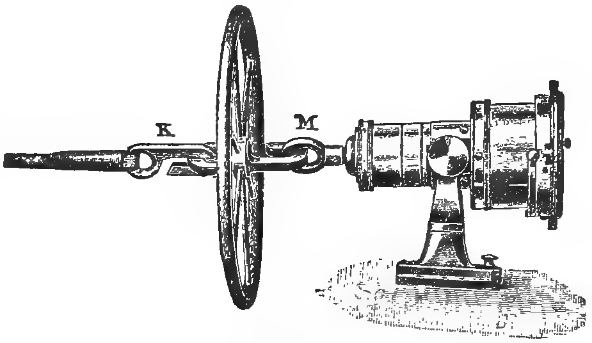

Fig. 9.—Neptune Log fitted with Governor.

Log Book is a marine or sea journal, containing, in the Royal Navy, the speed, course, leeway, direction and force of the wind, state of the weather, and barometric and thermometric observations. Under the heading "Remarks" are noted (for vessels with sail power) making, shortening, and trimming sails; and (for all ships) employment of crew, times of passing prominent landmarks, altering of course, and any subject of interest or importance. The deck log-book, kept by the officers of the watch in pencil, is copied in ink into the ship's log-book by the navigating officer, and the latter is an official journal. In steam vessels a rough and fair engine-room register are kept, giving information with regard to the engines and boilers. In the British mercantile marine all ships (except those employed exclusively in trading between ports on the coasts of Scotland) are compelled to keep an official log-book in a form approved by the Board of Trade. A mate's log and engine-room register are not compulsory, but are usually kept. (J. W. D.)

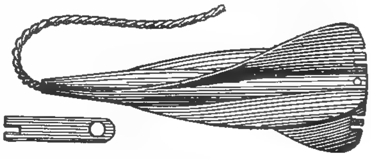

Fig. 10.—Bliss Log.

Logan, John Alexander (1826–1886), American soldier and politician, was born in Jackson county, Illinois, on the 9th of February 1826. As a boy he was disinclined for schooling, and in the Mexican war he became lieutenant in an Illinois regiment. Later he studied and practised law, but soon drifted into politics as a Democrat, and served several terms in the State Legislature. In 1858 and 1860 he was elected to Congress, but at the outbreak of the Civil War he resigned his seat and entered the Union army as colonel of volunteers. As a fighting officer his career was distinguished. In Grant's campaigns, terminating at Vicksburg, he rose to the rank of major-general, and under Sherman he commanded an army corps, and eventually the army of the Tennessee. When the war closed Logan resumed his political career, but as a member of the Republican party, and served in Congress, with but slight intermission (1877–78–79), from 1866 till his death at Washington on the 26th of December 1886. He was always a violent partisan. In 1868 he was one of the managers in the impeachment of President Johnson, and in the Senate he was identified with the Radical wing of his party. This latter fact contributed to his nomination for Vice-President in 1884. His impetuous oratory, though popular on the platform, was less adapted to the halls of legislation.

Logan, a city of Utah, U.S.A., capital of Cache county, in Cache Valley, at the west base of Bear River Range, at an altitude of 4506 feet. It is regularly laid out on a level site, and is on a branch of the Oregon Short Line railway. Its inhabitants are almost entirely Latter Day Saints. The surrounding region is highly cultivated, being supplied with water for irrigation from the numerous streams coming out of the mountains. Population (1880), 3396; (1890), 4565; (1900), 5451, of whom 1440 were foreign-born.

Logansport, a city of Indiana, U.S.A., capital of Cass county, at the junction of the Wabash and the Eel rivers, at an altitude of 724 feet. It is on the Wabash and Erie canal, and on the Pittsburg, Cincinnati, Chicago and St Louis, the Vandalia, and the Wabash railways. It has extensive manufactures of varied description. Population (1890), 13,328; (1900), 16,204, of whom 1432 were foreign-born.

Logia (Λόγια Ἰησοῦ: "Sayings of our Lord").—Several early Christian writers speak of *λόγια τοῦ κυρίου*, or *τὰ κυριακὰ λόγια*, *i.e.*, oracles of (or concerning) the Lord. For example, Polycarp speaks of those "who pervert the oracles of the Lord" (*Philipp.* 7), and Papias, according to Eusebius (*Hist. Eccl.* iii. 39), wrote a work with the title, "Expositions of the Oracles of (or concerning) the Lord." The expression has been variously interpreted. It need mean no more, as Lightfoot has shown (*Essays on Supernatural Religion,* 172 *f.*), than "narratives of (or concerning) the Lord"; this would be fully in accordance with the existing Jewish usage, and it is probable that Papias uses it in this sense. It is capable, however, of a more definite meaning. Resch has endeavoured to prove that there was a primitive gospel, written in Hebrew, containing a narration of the miracles and discourses of the Lord, and known as *λόγια Ἰησοῦ* (דִּבְרֵי יֵשׁוּעַ), or the like (*Agrapha*); whilst others have surmised that the Logia consisted of a collection of sayings of our Lord, which formed the nucleus of the four canonical Gospels. In these circumstances, great interest was roused by the publication in 1897, by Messrs B. P. Grenfell and A. S. Hunt, of some eight "Sayings of the Lord" (or possibly seven: Dr Swete thinks that the fourth *λόγιον* is really part of the third). They were found amongst the great mass of papyri acquired by the Egyptian Exploration Fund from the ruins of Oxyrhynchus, one of the chief early Christian centres in Egypt, situated some 120 miles south of Cairo. This fragment, which the editors believe to have been written "not much later than A.D. 200," certainly before 300, is numbered 11, so that it was preceded by ten other leaves, which may probably have contained "Sayings" of the same kind. No others, however, have as yet been discovered. The Logia have been much discussed, without, however, any very determinate result being reached. It is generally agreed that they do not take us behind the existing canonical Gospels, but that they are themselves based on them and on later writings, known and unknown. Harnack maintains that they are excerpts from the lost *Gospel of the Egyptians.* Anyhow, their chief interest on external grounds lies in the evidence that they supply that such collections were really made.

The eight "Sayings" have, however, no little intrinsic interest. They are given as follows, in their revised form, by the discoverers:—

1. . . . *καὶ τότε διαβλέψεις ἐκβαλεῖν τὸ κάρφος τὸ ἐν τῷ ὀφθαλμῷ τοῦ ἀδελφοῦ σου.*

2. *Λέγει Ἰησοῦς ἐὰν μὴ νηστεύσητε τὸν κόσμον οὐ μὴ εὕρετε τὴν βασίλειαν τοῦ θεοῦ· καὶ ἐὰν μὴ σαββατίσητε τὸ σάββατον οὐκ ὄψεσθε τὸν πατέρα.*

3. *Λέγει Ἰησοῦς ἔ[σ]την ἐν μεσῷ τοῦ κόσμου καὶ ἐν σαρκὶ ὤφθην αὐτοῖς, καὶ εὗρον πάντας μεθύοντας καὶ οὐδένα εὗρον διψῶντα ἐν αὐτοῖς, καὶ πονεῖ ἡ ψυχή μου ἐπὶ τοῖς υἱοῖς τῶν ἀνθρώπων, ὅτι τυφλοί εἰσιν τῇ καρδίᾳ αὐτῶ[ν] κ[αὶ] ο̣ὐ̣ βλ̣έ[πουσιν]. . . .*

4. [Illegible: possibly joins on to 3] . . . . *[τ]ὴν πτωχείαν.*

5. *[Λέγ]ει [Ἰησοῦς ὅπ]ου ἐὰν ὦσιν [β, οὐκ] ε[ἰσὶ]ν ἄθεοι· καὶ [ὅ]που ε[ἷs] ἐστιν μόνοσ, [λέ]γω, ἐγώ εἰμι μετ' αὐτ[οῦ]· ἔγει[ρ]ον τὸν λίθον κἀκεῖ εὑρησεῖs με, σχίσον τὸ ξύλον κἀγὼ ἐκεῖ εἰμι.*

6. *Λέγει Ἰησοῦσ οὐκ ἔστιν δεκτὸς προφήτης ἐν τῇ πατρίδι αὐτ[ο]ῦ, οὐδὲ ἰατρὸς ποιεῖ θεραπείας εἰς τοὺς γινώσκοντας αὐτόν.*

7. *Λέγει Ἰησοῦς οἰκοδομημένη ἐπ' ἄκρον ὄρους ὑψηλοῦ καὶ ἐστηριγμένη οὔτε πε[σ]εῖν δύναται οὔτε κρυ[β]ῆναι.*

8. *Λέγε Ἰησοῦς ἀκούεις [ε]ἰ̣s τ̣ὸ ἓ̣ν̣ ὠ̣τ̣ίον σοῦ τὸ [δὲ ἕτερον συνέκλεισας].*

Letters in brackets are missing in the original: letters which are dotted beneath are doubtful. No. 5 is Dr Blass's reconstruction, No. 8 that of Dr Swete.

1. ". . . and then shalt thou see clearly to cast out the mote that is in thy brother's eye."

2. "Jesus saith, Except ye fast to the world, ye shall in no wise find the kingdom of God; and except ye make the sabbath a real sabbath, ye shall not see the Father."

3. "Jesus saith, I stood in the midst of the world and in the flesh was I seen of them, and I found all men drunken, and none found I athirst among them, and my soul grieveth over the sons of men, because they are blind in their heart, and see not. . . ."

4. ". . . poverty . . ."

5. "Jesus saith, Wherever there are two, they are not without God, and wherever there is one alone, I say, I am with him. Raise the stone and there thou shalt find me, cleave the wood and there am I."

6. "Jesus saith, A prophet is not acceptable in his own country, neither doth a physican work cures upon them that know him."

7. "Jesus saith, A city built upon the top of a high hill and stablished can neither fall nor be hid."

8. "Jesus saith, Thou hearest with one ear [but the other ear hast thou closed]."

The greater number of these are clearly based upon, or parallel with, passages in the Gospels; but the second, third, and the latter part of the fifth have a special interest, because of their novelty. The second can only be our Lord's if it is to be understood metaphorically. Dr J. B. Mayor has adduced parallels from Clement of Alexandria which are so to be understood, but it may be doubted whether this does not rather come from some Ebionitic sect which unduly exalted fasting and the sabbath. The third may be taken from some unknown apocryphal work, and its language appears to be based upon Baruch iii. 38. The fifth is perhaps the most interesting of all. Various interpretations have been suggested: that the Lord is in all things, since in Him they are made; that the emphasis is to be laid on the difficulty of the acts, and their danger; or that the Stone and the Wood are types of Him. Some modification of the second view is strongly suggested by Eccl. x. 9: "Whoso removeth stones shall be hurt therewith, and he that cleaveth wood shall be endangered thereby"; on the other hand, the first is by no means impossible.

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(W. E. CO.)

LOGIC.

§ 1. General Tendencies of Recent Logic.

THERE are several grounds for hope in the logic of our day. In the first place, it tends to take up an intermediate position between the extremes of Kant and Hegel. It does not, with the former, regard logic as purely formal in the sense of abstracting thought from being, nor does it follow the latter in amalgamating metaphysics with logic by identifying being with thought. Secondly, it does not content itself with the mere formulæ of thinking, but pushes forward to theories of method, knowledge, and science; and it is a hopeful sign to find this epistemological spirit, to which England was accustomed by Mill, animating German logicians such as Lotze, Dühring, Schuppe, Sigwart, and Wundt. Thirdly, there is a determination to reveal the psychological basis of logical processes; not merely to describe them as they are in adult reasoning, but to explain also how they arise from simpler mental operations and primarily from sense. This attempt is connected with the psychological turn given to recent philosophy by Wundt and others, and is dangerous only so far as psychology itself is hypothetical. Unfortunately, however, these merits are usually connected with a less admirable characteristic — contempt for tradition. Writing his preface to his second edition in 1888, Sigwart says: — "Important works have appeared by Lotze, Schuppe, Wundt, and Bradley, to name only the most eminent; and all start from the conception which has guided this attempt. That is, logic is grounded by them, not upon an effete tradition, but upon a new investigation of thought as it actually is in its psychological foundations, in its significance for knowledge, and its actual operation in scientific methods." How strange! The spirit of every one of the three reforms above enumerated is an unconscious return to Aristotle's *Organon.* Aristotle's was a logic which steered, as Trendelenburg has shown, between formalism and metaphysics; it was a logic which in the Analytics investigated the syllogism as a means to understanding knowledge and science; it was a logic which, starting from the psychological foundations of sense, memory, and experience, built up the logical structure of induction and deduction on the profoundly Aristotelian principle that "there is no process from universals without induction, and none by induction without sense." Wundt's comprehensive view that logic looks backward to psychology and forward to epistemology was hundreds of years ago one of the many discoveries of Aristotle.

§ 2. Judgment.

(1) *Judgment and Conception.*—The emphasis now laid on judgment, the recovery from Hume's confusion of beliefs with ideas and the association of ideas, and the distinction of the mental act of judging from its verbal expression in a proposition, are all healthy signs in recent logic. The most fundamental question, before proceeding to the investigation of inference, is not what we say but what we think in making the judgments which, whether we express them in propositions or not, are both the premisses and the conclusion of inference; and, as this question has been diligently studied of late, but has been variously answered, it will be well to give a list of the more important theories of judgment as follows: —

(*a*) It expresses a relation between the content of two ideas, not a relation of these ideas (Lotze).

(*b*) It is consciousness concerning the objective validity of a subjective combination of ideas, *i.e.*, whether between the corresponding objective elements an analogous combination exists (Ueberweg).

(*c*) It is the synthesis of ideas into unity and consciousness of their objective validity, not in the sense of agreement with external reality but in the sense of the logical necessity of their synthesis (Sigwart).

(*d*) It is the analysis of an aggregate idea (*Gesammtvorstellung*) into subject and predicate; based on a previous association of ideas, on relating and comparing, and on the apperceptive synthesis of an aggregate idea in consequence; but itself consisting in an apperceptive analysis of that aggregate idea; and requiring will in the form of apperception or attention (Wundt).

(*e*) It requires an idea, because every object is conceived as well as recognized or denied; but it is itself an assertion of actual fact, every perception counts for a judgment, and every categorical is changed into an existential judgment without change of sense (Brentano, who derives his theory from Mill except that he denies the necessity of a combination of ideas, and reduces a categorical to an existential judgment).

(*f*) It is a decision of the validity of an idea requiring will (Bergmann, following Brentano).

(*g*) Judgment (*Urtheil*) expresses that two ideas belong together: "by-judgment" (*Beurtheilung*) is the reaction of will expressing the validity or invalidity of the combination of ideas (Windelband, following Bergmann, but distinguishing the decision of validity from the judgment).

(*h*) Judgment is consciousness of the identity or difference and of the causal relations of the given; naming the actual combinations of the data, but also requiring *à priori* categories of the understanding, the notions of identity, difference, and causality, as principles of thought or laws, to combine the plurality of the given into a unity (Schuppe).

(*i*) Judgment is the act which refers an ideal content recognized as such to a reality beyond the act, predicating an idea of a reality, a what of a that; so that the subject is reality and the predicate the meaning of an idea, while the judgment refers the idea to reality by an identity of content (Bradley and Bosanquet).

(*k*) Judgment is an assertion of reality, requiring comparison and ideas which render it directly expressible in words (Hobhouse, mainly following Bradley).

These theories are of varying value in proportion to their proximity to Aristotle's point that predication is about things, and to Mill's point that judgments and propositions are about things, not about ideas. The essence of judgment is belief that something is (or is not) determined, either as existing (*e.g.*, "I am," "A centaur is not"), or as something in particular (*e.g.*, "I am a man," "I am not a monkey"). Neither Mill, however, nor any of the later logicians whose theories we have quoted, has been able quite to detach judgment from conception; they all suppose that an idea, or ideas, is a condition of all judgment. But judgment starts from sensation (*Empfindung*) and feeling (*Gefühl*), and not from idea (*Vorstellung*). When I feel pleased or pained, or when I use my senses to perceive a pressure, a temperature, a flavour, an odour, a colour, a sound, or when I am conscious of feeling and perceiving, I cannot resist the belief that something sensible is present; and this belief that something exists is already a judgment, a judgment of existence, and, so far as it is limited to sense without inference, a true judgment. It is a matter of words whether or not we should call this sensory belief a judgment; but it is no matter of choice to the logician, who regards all the constituents of inference as judgments; for the fundamental constituents are sensory beliefs, which are therefore judgments in the logical sense. Sense is the evidence of inference; directly of analogical and inductive, directly or indirectly of deductive, inference; and therefore, if logic refuses to include sensory beliefs among judgments, it will omit the fundamental constituents of inference, inference will no longer consist of judgments but of sensory beliefs plus judgments, and the second part of logic, the logic of judgment, the purpose of which is to investigate the constituents of inference, will be like *Hamlet* without the Prince of Denmark. If, then, all the constituents of inference are judgments, there are judgments of sense (the *judicia sensus* of the Epicureans); and the evidence of the senses means that a judgment of sense is true, while a judgment of inference is true so far as it is directly or indirectly concluded from judgments of sense. Now a sensory judgment, *e.g.*, that a sensible pressure is existing, is explained by none of the foregoing theories, because it requires nothing but sensation and belief. It requires no will, but is usually involuntary, for the stimulus forces one's attention, which is not always voluntary: not all judgment then requires will, as Wundt supposes. It requires no reference to reality beyond the sensible pressure, so long as it is merely a belief that this exists without inference of the external stimulus or any inference at all: not all judgment then requires the reference of subjective to objective supposed by Ueberweg, or the consciousness of logical necessity supposed by Sigwart. It requires, in addition to the belief that something exists, no consideration as to whether the belief itself be true, because a man who feels pressure believes in the thing without further question about the belief: not all judgment then requires a decision of validity, as Bergmann supposes. It requires nothing beyond the sensation and belief in the given existence of the given pressure: not all judgment then requires categories of understanding, or notions of identity, difference, and causality, or even of existence, such as Schuppe supposes. It requires no comparison in order to express it in words, for a judgment need not be expressed, and a sensory judgment of pressure is an irresistible belief that a real pressure exists, without waiting for words, or for a comparison which is wanted not to make a sensation a judgment, but to turn a judgment into language: not all judgment then requires comparison with a view to its expression, as supposed by Hobhouse. Lastly, all the authors of the above-quoted theories err in supposing that all judgment requires conception; for even Mill thinks a combination of ideas necessary, and Brentano, who comes still nearer to the nature of sensory judgment when he says, "Every perception counts for a judgment," yet thinks that an idea is necessary at the same time in order to understand the thing judged. In reality, the sensation and the belief are sufficient; when I feel a sensible pressure, I cannot help believing in its reality, and therefore judging that it is real, without any *tertium quid*—an idea of pressure, or of existence, or of pressure existing—intervening between the sensation and the belief. Only after sensation has ceased does an idea, or representation of what is not presented, become necessary as a substitute for a sensation and as a condition not of the first judgment that there is, but of a second judgment that there was, something sensible. Otherwise there would be no judgment of sensible fact, for the first sensation would not give it, and the idea following the sensation would be still farther off. The sensory judgment then, which is nothing but a belief that something sensible exists at the moment of sense, is a proof that not all judgment requires conception, or synthesis or analysis of ideas, or decision about the content, or about the validity, of ideas, or reference of an ideal content to reality, as commonly, though variously, supposed in the logic of our day. Curiously enough, the origin of the fallacy that conception is necessary to judgment lurks in the very tradition which recent logicians despise. By piecing together different statements of Aristotle, not he, but his interpreters, arrived at the imagination that we have first sensations, then ideas, then judgments, finally inferences. But had our logicians probed the foundation on which they unconsciously rest, they would have found that they are accepting without proof a fancied order of thought, not certified by consciousness, but arising from interpretation. Aristotle himself did not separate sensation from judgment. He defines sensation as a congenital critical power. He says, indeed, in the *De Interpretatione* that a name is the sign of a conception without the alternative of true or false which requires composition and division, and the addition of being or not-being. He says also in the *De Anima* that conception does not admit falsity, and that the alternative of false or true requires composition of conceptions. But he never identified combinations of conceptions with all judgment. On the contrary, he rightly recognized that there is a judgment in sense; that a sensation of its special object is always true; that sense is a kind of knowledge—knowledge of a particular, not of a universal; that sensations are the data of all inference; and that sense is the origin of science, though not science itself. Judgment of and from sense is the true tradition of Greek logic: to insert ideas between sense and judgment is the work of scholastic interpretation surviving, largely through Cartesian influences, in modern logic, because "the evil that men do lives after them."

Not, however, that all judgment is sensory: after the first judgments of sense follow judgments of memory, and memory requires ideas. Yet memory is not mere conception, as Aristotle, and Mill after him, have perceived. To remember, we must have a present idea; but we must also have a belief that the thing, of which the idea is a representation, was (or was not) determined; and this belief is the memorial judgment, *e.g.*, "Cæsar was murdered." Originally such judgments arise from sensory judgments followed by ideas, and are judgments of memory after sense that something sensible existed: afterwards come judgments of memory after inference. Finally, most judgments are inferential. These are conclusions which primarily are inferred from sensory and memorial judgments; and so far as inference starts from sense of something sensible in the present, and from memory after sense of something sensible in the past, and concludes similar things, inferential judgments are indirect beliefs in being and in existence beyond ideas. When from the sensible pressures between the parts of my mouth, which I feel and remember and judge that they exist and have existed, I infer another similar pressure (*e.g.*, of the food which presses and is pressed by my mouth in eating), the inferential judgment with which I conclude is a belief that the latter exists as well as the former (*e.g.*, the pressure of food without as well as the sensible pressures within). Inference, no doubt, is closely involved with conception. So far as it depends on memory, an inferential judgment presupposes memorial ideas in its data; and so far as it infers universal classes and laws, it produces general ideas. But even so the part played by conception is quite subordinate to that of belief. In the first place, the remembered datum, from which an inference of pressure starts, is not the conceived idea, but the belief that the sensible pressure existed. Secondly, the conclusion in which it ends is not the general idea of a class, but the belief that a class, represented by a general idea, exists, and is (or is not) otherwise determined (*e.g.*, that things pressing and pressed exist and move). Thirdly, there are questions which have never been answered about inference. How far do we infer without memory and ideas, by combining sensory judgments present together (*e.g.*, from different pressures felt at once)? How far can we form ideas of the things which we judge inferentially to exist? We infer the existence of molecules, of æther, of God, and the inferential judgment produces some idea, but how far does it produce an adequate idea of the thing as we infer it? The answers to these questions are *desiderata* of modern logic. But whatever may be the answers, two things are certain about inferential judgment: one, that when inference is based on sense and memory, inferential judgment starts from a combination of sensory and memorial judgments, both of which are beliefs that things exist; the other, that in consequence inferential judgment is a belief that similar things exist. There are thus three primary judgments: judgments of sense, of memory after sense, and of inference from sense. All these are beliefs in being and existence, and this belief is first in sense, and afterwards transferred to memory and inference. Moreover, it is transferred in the same irresistible way: frequently we cannot help either feeling pressure, or remembering it, or inferring it; and as there are involuntary sensation and attention, so there are involuntary memory and inference. Again, in a primary judgment existence need not be expressed; but if expressed, it may be expressed either by the predicate, *e.g.*, "I exist," or by the subject, *e.g.*, "I who exist think." There are indeed differences between primary judgments, in that the sensory is a belief in present, the memorial in past, and the inferential in present, past, and future existence. But these differences in detail do not alter the main point that all these are beliefs in the existing, in the real as opposed to the ideal, in actual things which are not ideas. A primary judgment does not always even require an idea, because sensation produces judgments prior to any ideas, and inference produces judgments about things prior to ideas of those things. Memory, it is true, requires ideas, yet it is a belief in things; and inference from sense and memory concludes, not from ideas, but from sensory and memorial judgments which are beliefs in things, and with an inferential judgment which is a belief in things. In short, a primary judgment is a belief in something existing apart from our idea of it; and not because we have an idea of it, or by comparing an idea with, or referring an idea to, reality; but because we have a sensation of it, or a memory of it, or an inference of it. Sensation, not conception, is the origin of judgment.

(2) *Different Significations of Being in different Kinds of Judgment.*—As Aristotle remarked both in the *De Interpretatione* and in the *Sophistici Elenchi*, "not-being is thinkable" does not mean "not-being exists." In the latter treatise he added that it is a *fallacia a dicto secundum quid ad dictum simpliciter* to argue from the former to the latter; "for," as he says, "it is not the same thing to be something and to exist absolutely." Without realizing their debt to tradition, Herbart, Mill, and recently Sigwart, have repeated Aristotle's separation of the copula from the verb of existence, as if it were a modern discovery that "is" is not the same as "exists." It may be added that they do not quite realize what the copula exactly signifies: it does not signify existence, but it does signify a fact, namely, that something is (or is not) determined, either absolutely in a categorical judgment, or conditionally in a conditional judgment. Now we have seen that all primary judgments signify more than this fact; they are also beliefs in the existence of the thing signified by the subject. But, in the first place, primary judgments signify this existence never by the copula, but sometimes by the predicate, and sometimes by the subject; and, secondly, it does not follow that all judgments whatever signify existence. Besides inference of existence there is inference of non-existence, of things inconsistent with the objects of primary judgments. Hence secondary judgments, which no longer contain a belief that the thing exists, *e.g.*, the judgment, "not-being is thinkable," cited by Aristotle; the judgment, "A square circle is impossible," cited by Herbart; the judgment, "A centaur is a fiction of the poets," cited by Mill. These secondary judgments of non-existence are partly like and partly unlike primary judgments of existence. They resemble them in that they are beliefs in being signified by the copula. They are beliefs in things of a sort; for, after all, ideas and names are things; their objects, even though non-existent, are at all events things conceivable or nameable; and therefore we are able to make judgments that things, non-existent but conceivable or nameable, are (or are not) determined in a particular manner. Thus the judgment about a centaur is the belief, "A conceivable centaur is a fiction of the poets," and the judgment about a square circle is the belief, "A so-called square circle is an impossibility." But though beliefs that things of some sort are (or are not) determined, these secondary judgments fall short of primary judgments of existence. Whereas in a primary judgment there is a further belief, signified by subject or predicate, that the thing is an existing thing in the sense of being a real thing (*e.g.*, a man), different from the idea of it as well as from the name for it; in a secondary judgment there is no further belief that the thing has any existence beyond the idea (*e.g.*, a centaur), or even beyond the name (*e.g.*, a square circle): though the idea or name exists, there is no belief that the thing conceived or named exists. Starting, then, from this fundamental distinction between judgments of existence and judgments of non-existence, we may hope to steer our way between two extreme views which emanate from two important thinkers, each of whom has produced a flourishing school of psychological logic.

On the one hand, early in the 19th century Herbart started the view that a categorical judgment is never a judgment of existence, but always hypothetical; on the other hand, in the latter part of the century Brentano started the view that all categorical judgments are existential. The truth lies between these contraries. The view of Herbart and his school is contradicted by our primary judgments of and from sense, in which we cannot help believing existence; and it gives an inadequate account even of our secondary judgments in which we no longer indeed believe existence, but do frequently believe that a non-existent thing is (or is not) somehow determined unconditionally. It is true, as Herbart says, that the judgment, "A square circle is an impossibility," does not contain the belief, "A square circle is existent"; but when he goes on to argue that it means, "If a square circle is thought, the conception of impossibility must be added in thought," he falls into a *non-sequitur*. To be categorical, a judgment does not require a belief in existence, but only that something, existent or not, is (or is not) determined; and there are two quite different attitudes of mind even to a non-existent thing, such as a square circle, namely, unconditional and conditional belief. The judgment, "A non-existent but so-called square circle is an impossibility," is an unconditional, or categorical judgment of non-existence, quite different from any hypothetical judgment, which depends on the conditions "if it is thought," or "if it exists," or any other "if." On the other hand, the view of Brentano and his school is contradicted by these very categorical judgments of non-existence; and while it applies only to categorical judgments of existence, it does so inadequately. To begin with the latter objection, Brentano proposed to change the four

Aristotelian forms of judgment, A, E, I, O, into the following existential forms:—

A. "There is not an immortal man."
E. "There is not a live stone."
I. "There is a sick man."
O. "There is an unlearned man."

This reconstruction, which merges subject and predicate in one expression, in order to combine it with the verb of existence, is repeated in similar proposals of recent English logicians. Venn, in his *Symbolic Logic*, proposes the four forms, $x\bar{y}=0, xy=0, xy>0, x\bar{y}>0$ (where $\bar{y}$ means "not-*y*"), but only as alternative to the ordinary forms. Bradley says that "'S–P is real' attributes S–P, directly or indirectly, to the ultimate reality," and agrees with Brentano that "'is' never stands for anything but 'exists'"; while Bosanquet, who follows Bradley, goes so far as to define a categorical judgment as "that which affirms the existence of its subject, or, in other words, asserts a fact." Now, it is true that our primary judgments do contain a belief in existence; but they do not all contain it in the same way, but are beliefs sometimes that something is determined as existing, and sometimes that something existing is particularly determined. Brentano's forms do not express such a judgment of existence, as "All existing men are mortal." Nor does Bradley's form, "Reality includes S–P." Metaphysically, all realities are parts of one ultimate reality; but logically, even philosophers think more often only of finite realities, existing men, dogs, horses, &c.; so that the normal form of a judgment of existence is either "S is a real P," or "A real S is P." Hence the reconstruction of all categorical judgments by merging subject and predicate, either on Brentano's or on Bradley's plan, is a misrepresentation even of normal categorical judgments of existence. Secondly, it is much more a misrepresentation of categorical judgments of non-existence. No existential form suits a judgment such as "A centaur is a fiction," when we do not believe that there is a centaur, or that reality includes a centaur. As Mill pointed out, it cannot be implied that a centaur exists, since the very thing asserted is that the thing has no real existence. In a correspondence with Mill, Brentano rejoined that the centaur exists in imagination; Bradley says, "inside our heads." According to one, then, the judgment becomes "There is an imaginary centaur"; according to the other "Reality includes an imaginary centaur." The rejoinder, however, though partly true, is not to the point. The idea of the centaur does exist in our imagination, and inside our heads, and the name of it in our mouths. But the point is that the centaur conceived and named does not exist beyond the idea of it and the name for it; it is not, like a man, a real thing which is neither the idea of it nor the name for it; it is not an existing thing in the ordinary sense. Accordingly, no amount of subtlety will remove the difference between a categorical judgment of existence, *e.g.*, "An existing man is mortal," and a categorical judgment of non-existence, *e.g.*, "A conceivable centaur is a fiction," because in the former we believe and mean that the thing exists beyond the idea, and in the latter we do not. If, contrary to usage, we choose to call the latter a judgment of existence, there is no use in quarrelling about words; but we must insist that new terms must in that case be invented to express so fundamental a difference as that between judgments about real men and judgments about ideal centaurs. So long, however, as we use words in the natural sense, and call the former judgments of existence, and the latter judgments of non-existence, then "is" will not be, as Bradley supposes, the same as "exists," for we use "is" in both judgments, but "exists" only in the first kind. Bosanquet's definition of a categorical judgment contains a similar confusion. To assert a fact and to affirm the existence of a subject are not, as he makes out, the same thing: a judgment often asserts a fact and denies existence in the same breath, *e.g.*, "Jupiter is non-existent." Here, as usual in logic, tradition is better than innovation. All categorical judgment is an unconditional belief in the fact, signified by the copula, that a thing of some sort is (or is not) determined; but some categorical judgments are also beliefs that the thing is an existing thing, signified by the subject or by the predicate, while others are not beliefs that the thing exists at all, but are only beliefs in something conceivable, or nameable, or in something or other, without particularizing what. Judgment then always signifies being, but not always existence.

(3) *Particular and Universal Judgments.*—Aristotle, by distinguishing affirmative and negative, particular and universal, made the fourfold classification of judgments, A, E, I, and O, the foundation both of opposition and of inference. With regard to inference, he remarked that a universal judgment means by "all," not every individual we know, but every individual absolutely; so that, when it becomes a major premiss, we know in it every individual universally, not individually, and often do not know a given individual individually until we add a minor premiss in a syllogism. Whereas, then, a particular judgment is a belief that some, a universal judgment is a belief that all the individuals of a kind, or total of similar individuals, are similarly determined, whether they are known or unknown individuals. Now, as we have already seen, what is signified by the subject may be existing or not, and in either case a judgment remains categorical so long as it is a belief without conditions. Thus, "Some existing men are poets," "All existing men are mortal," "Some conceivable centaurs are human in their forequarters," "All conceivable centaurs are equine in their hindquarters," are all categorical judgments. Nevertheless these obvious applications of Aristotelian traditions have been recently challenged, especially by Sigwart, who holds in his *Logic* (secs. 27, 36) that while a particular is a categorical judgment of existence, a universal is hypothetical, on the ground that it does not refer to a definite number of individuals, or to individuals at all, but rather to general ideas, and that the appropriate form of "all M is P" is "if anything is M it is P." This view, which has influenced not only German but also English logicians, such as Venn, Bradley, and Bosanquet, destroys the fabric of inference, and reduces scientific laws to mere hypotheses. In reality, however, particular and universal judgments are too closely connected to have such different imports. In opposition, a categorical particular is the contradictory of a universal, which is also categorical, not hypothetical, *e.g.*, "not all M is P" is the contradictory of "all M is P," not of "if anything is M it is P." In inference, a particular is an example of a universal, which in its turn may become a particular example of a higher universal. For instance, in the history of mechanics it was first inferred from some that all terrestrial bodies gravitate, and then from these as some that all ponderable bodies, terrestrial and celestial, gravitate. How absurd to suppose that here we pass from a particular categorical to a universal hypothetical, and then treat this very conclusion as a particular categorical to pass to a higher universal hypothetical! Sigwart, indeed, is deceived both about particulars and universals. On the one hand, some particulars are not judgments of existence, *e.g.*, "some imaginary deities are goddesses"; on the other hand, some universals are not judgments of non-existence, *e.g.*, "every existing man is mortal." Neither kind is always a judgment of existence, but each is sometimes the one and sometimes the other. In no

case is a universal hypothetical, unless we think it under a condition; for in a universal judgment about the non-existing, *e.g.*, about all conceivable centaurs, we do not think, "If anything is a centaur," because we do not believe that there are any; and in a universal judgment about the existent, *e.g.*, about all existing men, we do not think, "If anything is a man," because we believe that there is a whole class of men existing at different times and places. The cause of Sigwart's error is his misconception of "all." So far as he follows Aristotle in saying that "all" does not mean a definite number of individuals he is right; but when he says that we mean no individuals at all he leaves Aristotle and goes wrong. By "all" we mean every individual whatever of a kind; and when from the experience of sense and memory we start with particular judgments of existence, and infer universal judgments of existence and scientific laws, we further mean those existing individuals which we have experienced, and every individual whatever of the kind which exists. We mean neither a definite number of individuals, nor yet an infinite number, but an incalculable number, whether experienced or inferred to exist. We do not mean existing here and now, nor yet out of time and place, but at any time and place (*semper et ubique*)—past, present, and future being treated as simply existing, by what logicians used to call *suppositio naturalis.* We mean then by "all existing" every similar individual whatever, whenever, and wherever existing. Hence Sigwart is right in saying that "All bodies are extended" means "Whatever is a body is extended," but wrong in identifying this form with "If anything is a body it is extended." "Whatever" is not "if anything." For the same reason it is erroneous to confuse "all existing" with a general idea. Nor does the use of abstract ideas and terms make any difference. When Bosanquet says that in "Heat is a mode of motion" there is no reference to individual objects, but "a pure hypothetical form which absolutely neglects the existence of objects," he falls far short of expressing the nature of this scientific judgment, for in his *Theory of Heat* Clerk Maxwell describes it as "believing heat as it exists in a hot body to be in the form of kinetic energy." As Bacon would say, it is a belief that all individual bodies *qua* hot are individually but similarly moving in their particles. When, again, Bradley and Bosanquet speak of the universal as if it always meant one ideal content referred to reality, they forget that in universal judgments of existence, such as "All men existing are mortal," we believe that every individually existing man dies his own death individually, though similarly to other men; and that we are thinking neither of ideas nor of reality, but of all existent individual men being individually but similarly determined. A universal is indeed one whole; but it is one whole of many similars, which are not the same with one another. This is indeed the very essence of distribution, that a universal is predicable, not singly or collectively, but severally and similarly of each and every individual of a kind, or total of similar individuals. So also the essence of a universal judgment is that every individual of the kind is severally but similarly determined. Finally, such a judgment is often a judgment of existence; but whether it is so or not it remains categorical, so long as it introduces no hypothetical antecedent about the existence of the thing signified by the subject. It is true that even in universal judgments of existence there is often a hypothetical element; for example, "All men are mortal" contains a doubt whether every man whatever, whenever, and wherever existing, must die. But this is only a doubt whether all the things signified by the subject are similarly determined as signified by the predicate, and not a doubt whether there are such things at all. Hence the hypothetical element is not a hypothetical antecedent "If anything is a man," but an uncertain conclusion that "All existing men are mortal." In other words, a categorical universal is often problematic, but a problematic is not the same as a hypothetical judgment.

(4) *The Judgment and the Proposition.*—Judgment in general is the mental act of believing that something is (or is not) determined. A proposition is the consequent verbal expression of such a belief, and consists in asserting that the thing as signified by the subject is (or is not) determined as signified by the predicate. But the expression is not necessary. Sensation irresistibly produces a judgment of existence without needing language. Children think long before they speak; and indeed, as mere vocal sounds are not speech, and as the apprehension that a word signifies a thing is a judgment, judgment is originally not an effect, but a cause of significant language. At any rate, even when we have learnt to speak, we do not express all we think, as we may see not only from the fewness of words known to a child, but also from our own adult consciousness. The principle of language is to speak only so far as to understand and be understood. Hence speech is only a curtailed expression of thought. Sometimes we express a whole judgment by one word, *e.g.*, "Fire!" or by a phrase, *e.g.*, "What a fire!" and only usually by a proposition. But even the normal proposition in the full logical form *tertii adjacentis*, with subject, predicate, and copula, is seldom a complete expression of the judgment. The consequence is that the proposition, being different from a judgment, arising after judgment, and remaining an imperfect copy of judgment, is only a superficial evidence of its real nature. Fortunately, we have more profound evidences, and at least three evidences in all: the linguistic expression of belief in the proposition; the consciousness of what we mentally believe; and the analysis of reasoning, which shows what we must believe, and have believed, as data for inference. In these ways we find that a judgment is both different from, and more than, a proposition. But recent logicians, although they perceive the difference, nevertheless tend to make the proposition the measure of the judgment. This makes them omit sensory judgments, and count only those which require ideas, and even general ideas expressed in general terms. Sigwart, for example, gives as instances of our most elementary judgments, "This is Socrates," "This is snow,"—beliefs in things existing beyond ourselves which require considerable inferences from many previous judgments of sense and memory. Worse still, logicians seem unable to keep the judgment apart from the proposition. Herbart says that the judgment "A is B" does not contain the usually added thought that A is, because there is no statement of A's existence; as if that mattered. So Sigwart, in order to reduce universals to hypotheticals, while admitting that existence is usually thought, argues that it is not stated in the universal judgment; so also Bosanquet. But in the judgment the point is not what we state, but what we think; and so long as the existence of A is added in thought, the judgment in question must contain the thought that A exists as well as that A is B, and therefore is a judgment that something is determined both as existing and in a particular manner. The statement only affects the proposition; and whenever we believe the existence of the thing, the belief in existence is part of the judgment thought, whether it is part of the proposition stated or not.

Here Sir William Hamilton did a real service to logic in pointing out that "Logic postulates to be allowed to state explicitly in language all that is implicitly contained in the thought." Not that men should or can carry this logical postulate out in ordinary life; but it is necessary in the logical analysis of judgments, and yet logicians neglect it. This is why they confuse the categorical and the universal with the hypothetical. Taking the carelessly expressed propositions of ordinary life, they do not perceive that similar judgments are often differently expressed, *e.g.*, "I, being a man, am mortal," and "If I am a man, I am mortal"; and conversely, that different judgments are often similarly expressed. In ordinary life we may say, "All men are mortal," "All centaurs are figments," "All square circles are impossibilities," "All candidates arriving five minutes late are fined" (the last proposition being an example of the identification of categorical with hypothetical in Keynes's *Formal Logic*). But of these universal propositions the first imperfectly expresses a categorical belief in existing things, the second in thinkable things, and the third in nameable things, while the fourth is a slipshod categorical expression of the hypothetical belief, "If any candidates arrive late they are fined." The four judgments are different, and therefore logically the propositions fully expressing them are also different. The judgment, then, is the measure of the proposition, not the proposition the measure of the judgment. On the other hand, we may go too far in the opposite direction, as Hamilton did in proposing the universal quantification of the predicate. If the quantity of the predicate were always thought, it ought logically to be always stated. But we only sometimes think it. Usually we leave the predicate indefinite, because, as long as the thing in question is (or is not) determined, it does not matter about other things, and it is vain for us to try to think all things at once. It is remarkable that in *Barbara*, and therefore in deducing lower from higher laws in science, to think the quantity of the predicate is not to the point either in the premisses or in the conclusion; so that to quantify the propositions, as Hamilton proposes, would be to express more than a rational man thinks and judges. In judgments, and therefore in propositions, indefinite predicates are the rule, quantified predicates the exception. It follows also that a normal judgment is not an equation. The symbol of equality (=) is not the same as the copula (is); it means "is equal to," where "equal to" is part of the predicate, leaving "is" as the copula. Now, in all judgment we think "is," but in few judgments predicate "equal to." In quantitative judgments we may think $x = y$, or, as Boole proposes, $x = vy = \frac{0}{0}y$, or, as Jevons proposes, $x = xy$, or, as Venn proposes, x which is not $y = 0$; and equational symbolic logic is useful whenever we think in this quantitative way. But it is a byway of thought. In most judgments all we believe is that x is (or is not) y, that a thing is (or is not) determined, and that the thing signified by the subject is a thing signified by the predicate, but not that it is the only thing, or equal to everything signified by the predicate. The symbolic logic, which confuses "is" with "is equal to," having introduced a particular kind of predicate into the copula, falls into the mistake of reducing all predication to the one category of the quantitative; whereas it is more often in the substantial, *e.g.*, "I am a man," not "I am equal to a man," or in the qualitative, *e.g.*, "I am white," not "I am equal to white," or in the relative, *e.g.*, "I am born in sin," not "I am equal to born in sin." Predication, as Aristotle saw, is as various as the categories of being. Finally, the great difficulty of the logic of judgment is to find the mental act behind the linguistic expression, to ascribe to it exactly what is thought, neither more nor less and to apply the judgment thought to the logical proposition, without expecting to find it in ordinary propositions. Beneath Hamilton's postulate there is a deeper principle of logic—*A rational being thinks only to the point, and speaks only to understand and be understood.*

§ 3. INFERENCE.

(1) *False Views of Syllogism arising from False Views of Judgment.*—The false views of judgment, which we have been examining, have led to false views of inference. On the one hand, having reduced categorical judgments to an existential form, Brentano proposes to reform the syllogism, with the results that it must contain four terms, of which two are opposed and two appear twice; that, when it is negative, both premisses are negative; and that, when it is affirmative, one premiss, at least, is negative. In order to infer the universal affirmative that every professor is mortal because he is a man, Brentano's existential syllogism would run as follows:—

There is not a not-mortal man.
There is not a not-human professor.
∴ There is not a not-mortal professor.

On the other hand, if on the plan of Sigwart categorical universals were reducible to hypotheticals, the same inference would be a pure hypothetical syllogism, thus:—

If anything is a man it is mortal.
If anything is a professor it is a man.
∴ If anything is a professor it is mortal.

But both these unnatural forms, which are certainly not analyses of any conscious process of categorical reasoning, break down at once, because they cannot explain those moods in the third figure, *e.g.*, *Darapti*, which reason from universal premisses to a particular conclusion. Thus, in order to infer that some wise men are good from the example of professors, Brentano's syllogism would be the following *non-sequitur*:—

There is not a not-good professor.
There is not a not-wise professor.
There is a wise good (*non-sequitur*).

So Sigwart's syllogism would be the following *non-sequitur*:—

If anything is a professor, it is good.
If anything is a professor, it is wise.
Something wise is good (*non-sequitur*).

But, as by the admission of both logicians these reconstructions of *Darapti* are illogical, it follows that their respective reductions of categorical universals to existentials and hypotheticals are false, because they do not explain an actual inference. Sigwart does not indeed shrink from this and greater absurdities; he reduces the first figure to the *modus ponens* and the second to the *modus tollens* of the hypothetical syllogism, and then, finding no place for the third figure, denies that it can infer necessity; whereas it really infers the necessary consequence of particular conclusions. But the greatest absurdity is that, if all universals were hypothetical, *Barbara* in the first figure would become a purely hypothetical syllogism—a consequence which seems innocent enough until we remember that all universal affirmative conclusions in all sciences would with their premisses dissolve into mere hypothesis. No logic can be sound which leads to the following analysis:—

If anything is a body it is extended.
If anything is a planet it is a body.
∴ If anything is a planet it is extended.

Sigwart, indeed, has missed the essential difference between the categorical and the hypothetical construction of syllogisms. In a categorical syllogism of the first figure, the major premiss, "Every M whatever is P," is a universal, which we believe on account of previous evidence without any condition about the thing signified by the subject M, which we simply believe sometimes to be existent (*e.g.*, "Every man existent"), and sometimes not (*e.g.*, "Every centaur conceivable"); and the minor premiss, "S is M," establishes no part of the major, but adds the evidence of a particular not thought of in the major at all. But in a hypothetical syllogism of the ordinary mixed type, the first or hypothetical premiss is a conditional belief, *e.g.*, "If anything is M it is P," containing a hypothetical antecedent, "If anything is M," which is sometimes a hypothesis of existence (*e.g.*, "If anything is an angel"), and sometimes a hypothesis of fact (*e.g.*, "If an existing man is wise"); and the second premiss or assumption, "Something is M," establishes part of the first, namely, the hypothetical antecedent, whether as regards existence (*e.g.*, "Something is an angel"), or as regards fact (*e.g.*, "This existing man is wise"). These very different relations of premisses are obliterated by Sigwart's false reduction of categorical universals to hypotheticals. But even Sigwart's errors are outdone by Lotze, who not only reduces "Every M is P" to "If S is M, S is P," but proceeds to reduce this hypothetical to the disjunctive, "If S is M, S is P^1 or P^2 or P^3," and finds fault with the Aristotelian syllogism because it contents itself with inferring "S is P" without showing what P. Now there are occasions when we want to reason in this disjunctive manner, to consider whether S is P^1 or P^2 or P^3, and to conclude that "S is a particular P"; but ordinarily all we want to know is that "S is P"; *e.g.*, in arithmetic, that 2+2 are 4, not any particular 4, and in life that all our contemporaries must die, without enumerating all their particular sorts of deaths. Lotze's mistake is the same as that of Hamilton about the quantification of the predicate, and that of those symbolists who held that reasoning ought always to exhaust all alternatives by equations. It is the mistake of exaggerating exceptional into normal forms of thought, and ignoring the principle that a rational being thinks only to the point.

(2) *Quasi-syllogisms.*—Besides reconstructions of the syllogistic fabric, we find in recent logic attempts to extend the figures of the syllogism beyond the syllogistic rules. An old error that we may have a valid syllogism from merely negative premisses (*ex omnibus negativis*), long ago answered by Alexander and Boethius, is now revived by Lotze, Jevons, and Bradley, who do not perceive that the supposed second negative is really an affirmative containing a "not" which can only be carried through the syllogism by separating it from the copula and attaching it to one of the extremes, thus:—

The just are not unhappy (*negative*).
The just are not-recognized (*affirmative*).
∴ Some not-recognized are not unhappy (*negative*).

Here the minor being the infinite term "not-recognized" in the conclusion, must be the same term also in the minor premiss. Schuppe, however, who is a fertile creator of quasi-syllogisms, has managed to invent some examples from two negative premisses of a different kind:—

(1)	(2)	(3)
No N is P.	No M is P.	No P is M.
S is not M.	S is not M.	S is not M.
∴ Neither S nor M is P.	∴ S may be P.	∴ S may be P.

But (1) concludes with a mere repetition, (2) and (3) with a contingent "may be," which, as Aristotle says, also "may not be," and therefore *nihil certo colligitur.* The same answer applies to Schuppe's supposed syllogisms from two particular premisses:—

(1)	(2)
Some M is P.	Some M is P.
Some S is M.	Some M is S.
∴ Some S may be P.	∴ Some S may be P.

The only difference between these and the previous examples (2) and (3) is that, while those break the rule against two negative premisses, these break that against undistributed middle. Equally fallacious are two other attempts of Schuppe to produce syllogisms from invalid moods:—

(1) 1st Fig.	(2) 2nd Fig.
All M is P.	P is M.
No S is M.	S is M.
∴ S may be P.	∴ S is partially identical with P.

In the first the fallacy is the indifferent contingency of the conclusion caused by the *non-sequitur* from a negative premiss to an affirmative conclusion; while the second is either a mere repetition of the premisses if the conclusion means "S is like P in being M," or, if it means "S is P," a *non-sequitur* on account of the undistributed middle. It must not be thought that this trifling with logical rules has no effect. The last supposed syllogism, namely, that having two affirmative premisses, and entailing an undistributed middle in the second figure, is accepted by Wundt under the title "Inference by Comparison" (*Vergleichungsschluss*), and is supposed by him to be useful for abstraction and subsidiary to induction, and by Bosanquet to be useful for analogy. Wundt, for example, proposes the following premisses:—

Gold is a shining, fusible, ductile, simple body.
Metals are shining, fusible, ductile, simple bodies.

But to say from these premisses, "Gold and metal are similar in what is signified by the middle term," is a mere repetition of the premisses; to say, further, that "Gold may be a metal" is a *non-sequitur,* because, the middle being undistributed, the logical conclusion is the contingent "Gold may or may not be a metal," which leaves the question quite open, and therefore there is no syllogism. Wundt, who is again followed by Bosanquet, also supposes another syllogism in the third figure, under the title of "Inference by Connexion" (*Verbindungsschluss*), to be useful for induction. He proposes, for example, the following premisses:—

Gold, silver, copper, lead, are fusible.
Gold, silver, copper, lead, are metals.

Here there is no syllogistic fallacy in the premisses; but the question is what syllogistic conclusion can be drawn, and there is only one which follows without an illicit process of the minor, namely, "Some metals are fusible." The moment we stir a step farther with Wundt in the direction of a more general conclusion (*ein allgemeinerer Satz*), we cannot infer from the premisses the conclusion desired by Wundt, "Metals and fusible are connected"; nor can we infer "All metals are fusible," nor "Metals are fusible," nor "Metals may be fusible," nor "All metals may be fusible," nor any assertory conclusion, determinate or indeterminate, but the indifferent contingent, "All metals may or may not be fusible," which leaves the question undecided, so that there is no syllogism. We do not mean that in Wundt's supposed "inferences of relation by comparison and connexion" the premisses are of no further use; but those of the first kind are of no syllogistic use in the second figure, and those of the second kind of no syllogistic use beyond particular conclusions in the third figure. What they really are in the inferences proposed by Wundt is not premisses for syllogism, but data for induction parading as syllogism. We must pass the same sentence on Lotze's attempt to extend the second figure of the syllogism for inductive purposes, thus:—

S is M.
Q is M.
R is M.
∴ Every Σ, which is common to S, Q, R, is M.

We could not have a more flagrant abuse of the rule *Ne esto plus minusque in conclusione quam in præmissis.* As we see from Lotze's own defence, the conclusion cannot be drawn without another premiss or premisses to the effect that "S, Q, R, are Σ, and Σ is the one real subject of M." But how is all this to be got into the second figure? Again, Wundt and B. Erdmann propose new moods of syllogism with convertible premisses, containing definitions and equations. Wundt's *Logic* has the following forms:—

(1) 1st Fig.	(2) 2nd Fig.	(3) 3rd Fig.
Only M is P.	$x=y$.	$y=x$.
No S is M.	$z=y$.	$y=z$.
∴ No S is P.	∴ $x=z$.	∴ $x=z$.

Now, there is no doubt that, especially in mathematical equations, universal conclusions are obtainable from convertible premisses expressed in these ways. But the question is how the premisses must be thought, and they must be thought in the converse way to produce a logical conclusion. Thus, we must think in (1) "All P is M" to avoid illicit process of the major, in (2) "All y is z" to avoid undistributed middle, in (3) "All x is y" to avoid illicit process of the minor. Indeed, it is the very essence of a convertible judgment to think it in both orders, and especially to think it in the order necessary to an inference from it. Accordingly, however expressed, the syllogisms quoted above are, as thought, ordinary syllogisms, (1) being *Camestres* in the second figure, (2) and (3) *Barbara* in the first figure. Aristotle, indeed, was as well aware as German logicians of the force of convertible premisses; but he was also aware that they require no special syllogisms, and made it a point that, in a syllogism from a definition, the definition is the middle, and the *definitum* the major in a convertible major premiss of *Barbara* in the first figure, *e.g.*:—

The interposition of an opaque body is (essentially) deprivation of light.
The moon suffers the interposition of the opaque earth.
∴ The moon suffers deprivation of light.

It is the same with all the recent attempts to extend the syllogism beyond its rules, which are not liable to exceptions, because they follow from the nature of syllogistic inference from universal to particular. To give the name of syllogism to inferences which infringe the general rules against undistributed middle, illicit process, two negative premisses, *non-sequitur* from negative to affirmative, and the introduction of what is not in the premisses into the conclusion, and which consequently infringe the special rules against affirmative conclusions in the second figure, and against universal conclusions in the third figure, is to open the door to fallacy, and at best to confuse the syllogism with other kinds of inference, without enabling us to understand any one kind.

(3) *Analytic and Synthetic Deduction.*—Alexander the Commentator defined synthesis as a progress from principles to consequences, analysis as a regress from consequences to principles; and Latin logicians preserved the same distinction between the *progressus a principiis ad principiata*, and the *regressus a principiatis ad principia*. No distinction is more vital in the logic of inference in general and of scientific inference in particular; and yet none has been so little understood, because, though analysis is the more usual order of discovery, synthesis is that of instruction, and therefore, by becoming more familiar, tends to replace and obscure the previous analysis. The distinction, however, did not escape Aristotle, who saw that a progressive syllogism can be reversed thus:—

1. *Progression.*	2. *Regression.*	
	(1)	(2)
All M is P.	All P is M.	All S is P.
All S is M.	All S is P.	All M is S.
∴ All S is P.	∴ All S is M.	∴ All M is P.

Proceeding from one order to the other, by converting one of the premisses, and substituting the conclusion as premiss for the other premiss, so as to deduce the latter as conclusion, is what he calls circular inference; and he remarked that the process is fallacious unless it contains propositions which are convertible, as in mathematical equations. Further, he perceived that the difference between the progressive and regressive orders extends from mathematics to physics, and that there are two kinds of syllogism: one progressing *à priori* from real ground to consequent fact (ὁ τοῦ διότι συλλογισμός), and the other regressing *à posteriori* from consequent fact to real ground (ὁ τοῦ ὅτι συλλογισμός). For example, as he says, the sphericity of the moon is the real ground of the fact of its light waxing; but we can deduce either from the other, as follows:—

1. *Progression.*	2. *Regression.*
What is spherical waxes.	What waxes is spherical.
The moon is spherical.	The moon waxes.
∴ The moon waxes.	∴ The moon is spherical.

These two kinds of syllogism are synthesis and analysis in the ancient sense. Deduction is analysis when it is regressive from consequence to real ground, as when we start from the proposition that the angles of a triangle are equal to two right angles, and deduce analytically that therefore (1) they are equal to equal angles made by a straight line standing on another straight line, and (2) such equal angles are two right angles. Deduction is synthesis when it is progressive from real ground to consequence, as when we start from these two results of analysis as principles and deduce synthetically the proposition that therefore the angles of a triangle are equal to two right angles, in the order familiar to the student of Euclid. But the full value of the ancient theory of these processes cannot be appreciated until we recognize that as Aristotle planned them Newton used them. Much of the *Principia* consists of synthetical deductions from definitions and axioms. But the discovery of the centripetal force of the planets to the sun is an analytic deduction from the facts of their motion discovered by Kepler to their real ground, and is so stated by Newton in the first regressive order of Aristotle—P–M, S–P, S–M. Newton did indeed first show synthetically what kind of motions by mechanical laws have their ground in a centripetal force varying inversely as the square of the distance (all P is M); but his next step was, not to deduce synthetically the planetary motions, but to make a new start from the planetary motions as facts established by Kepler's laws and as examples of the kind of motions in question (all S is P); and then, by combining these two premisses, one mechanical and the other astronomical, he analytically deduced that these facts of planetary motion have their ground in a centripetal force varying inversely as the squares of the distances of the planets from the sun (all S is M). (See *Principia* I. prop. 2; 4 coroll. 6; III. Phænomena, 4–5; prop. 2.) What Newton did, in short, was to prove by analysis that the planets, revolving by Kepler's astronomical laws round the sun, have motions such as by mechanical laws are consequences of a centripetal force to the sun. This done, as the major is convertible, the analytic order—P–M, S–P, S–M—was easily inverted into the synthetic order—M–P, S–M, S–P; and in this progressive order the deduction as now taught begins with the centripetal force of the sun as real ground, and deduces the facts of planetary motion as consequences. Thereupon the Newtonian analysis, which preceded this synthesis, became forgotten; until at last Mill in his *Logic*, neglecting the *Principia*, had the temerity to distort Newton's discovery, which was really a pure example of analytic deduction, into a mere hypothetical deduction; as if the author of the saying "*Hypotheses non fingo*" started from the hypothesis of a centripetal force to the sun, and thence deductively explained the facts of planetary motion, which reciprocally verified the hypothesis. This gross misrepresentation has made hypothesis a kind of logical fashion. Worse still, Jevons proceeded to confuse analytic deduction from consequence to ground with hypothetical deduction from ground to consequence under the common term "inverse deduction." Wundt attempts, but in vain, to make a compromise between the old and the new. He re-defines analysis in the very opposite way to the ancients; whereas they defined it as a regressive process from consequence to ground, according to Wundt it is a progressive process of taking for granted a proposition and deducing a consequence, which being true verifies the proposition. He then divides it into two species: one categorical, the other hypothetical. By the categorical he means the ancient analysis from a given proposition to more general propositions. By the hypothetical he means the new-fangled analysis from a given proposition to more particular propositions, *i.e.*, from a hypothesis to consequent facts. But his account of the first is imperfect, because in ancient analysis the more general propositions, with which it concludes, are not mere consequences, but the real grounds of the given proposition; while his addition of the second reduces the nature of analysis to the utmost confusion, because hypothetical deduction is progressive from hypothesis to consequent facts, whereas analysis is regressive from consequent facts to real ground. There is indeed a sense in which all inference is from ground to consequence, because it is from logical ground (*principium cognoscendi*) to logical consequence. But in the sense in which deductive analysis is opposed to deductive synthesis, analysis is deduction from real consequence as logical ground (*principiatum* as *principium cognoscendi*) to real ground (*principium essendi*), *e.g.*, from the consequential facts of planetary motion to their real ground in centripetal force to the sun. Hence Sigwart is undoubtedly right in distinguishing analysis from hypothetical deduction, for which he proposes the name "reduction." We have only further to add that many scientific discoveries about sound, heat, light, colour, and so forth, which it is the fashion to represent as hypotheses to explain facts, are really analytical deductions from the facts to their real grounds in accordance with mechanical laws. Recent logic does scant justice to scientific analysis.

(4) *Induction.*—As induction is the process from particulars to universals, it might have been thought that it would always have been opposed to syllogism, in which one of the rules is against using particular premisses to draw universal conclusions. Yet such is the passion for one type that from Aristotle's time till now constant attempts have been made to reduce induction to syllogism. Aristotle himself invented an inductive syllogism in which the major (P) is to be referred to the middle (M) by means of the minor (S), thus:—

A, B, C magnets (S) attract iron (P).
A, B, C magnets (S) are all magnets whatever (M).
∴ All magnets whatever (M) attract iron (P).

As the second premiss is supposed to be convertible, he reduced the inductive to a deductive syllogism as follows:—

Every S is P.	Every S is P.
Every S is M (convertibly).	Every M is S.
∴ Every M is P.	∴ Every M is P.

In the reduced form the inductive syllogism was described by Aldrich as "*Syllogismus in Barbara cujus minor* (*i.e.*, every M is S) *reticetur*." Whately, on the other hand, proposed an inductive syllogism with the major suppressed, that is, instead of the minor premiss above, he supposed a major premiss, "Whatever belongs to A, B, C magnets belongs to all." Mill thereupon supposed a still more general premiss, an assumption of the uniformity of nature. Since Mill's time, however, the logic of induction tends to revert towards syllogisms more like that of Aristotle. Jevons supposed induction to be inverse deduction, distinguished from direct deduction as analysis from synthesis, *e.g.*, as division from multiplication; but he really meant that it is a deduction from a hypothesis of the law of a cause to particular effects which, being true, verify the hypothesis. Sigwart declares himself in agreement with Jevons; except that, being aware of the difference between hypothetical deduction and mathematical analysis, and seeing that, whereas analysis (*e.g.*, in division) leads to certain conclusions, hypothetical deduction is not certain of the hypothesis, he arrives at the more definite view that induction is not analysis proper but hypothetical deduction, or "reduction," as he proposes to call it. Reduction he defines as "the framing of possible premisses for given propositions, or the construction of a syllogism when the conclusion and one premiss is given." On this view induction becomes a reduction in the form: all M is P (hypothesis), S is M (given), ∴ S is P (given). The views of Jevons and Sigwart are in agreement in two main points. According to both, induction, instead of inferring from A, B, C magnets the conclusion "Therefore all magnets attract iron," infers from the hypothesis, "Let every magnet attract iron," to A, B, C magnets, whose given attraction verifies the hypothesis. According to both, again, the hypothesis of a law with which the process starts contains more than is present in the particular data: according to Jevons, it is the hypothesis of a law of a cause from which induction deduces particular effects; and according to Sigwart, it is a hypothesis of the ground from which the particular data necessarily follow according to universal laws. Lastly, Wundt's view is an interesting piece of eclecticism, for he supposes that induction begins in the form of Aristotle's inductive syllogism, S–P, S–M, M–P, and becomes an inductive method in the form of Jevons's inverse deduction, or hypothetical deduction, or analysis, M–P, S–M, S–P. In detail, he supposes that, while an "inference by comparison," which he erroneously calls an affirmative syllogism in the second figure, is preliminary to induction, a second "inference by combination," which he erroneously calls a syllogism in the third figure with an indeterminate conclusion, is the inductive syllogism itself. This is like Aristotle's inductive syllogism in the arrangement of terms; but, while on the one hand Aristotle did not, like Wundt, confuse it with the third figure, on the other hand Wundt does not, like Aristotle, suppose it to be practicable to get inductive data so wide as the convertible premiss, "All S is M, and all M is S," which would at once establish the conclusion, "All M is P." Wundt's point is that the conclusion of the inductive syllogism is neither so much as all, nor so little as some, but rather the indeterminate "M and P are connected." The question therefore arises, how we are to discover "All M is P," and this question Wundt answers by adding an inductive method, which involves inverting the inductive syllogism in the style of Aristotle into a deductive syllogism from a hypothesis in the style of Jevons, thus:—

(1)	(2)
S is P.	Every M is P.
S is M.	S is M.
∴ M and P are connected.	∴ S is P.

He agrees with Jevons in calling this second syllogism analytical deduction, and with Jevons and Sigwart in calling it hypothetical deduction. It is, in fact, a common point of Jevons, Sigwart, and Wundt that the universal is not really a conclusion inferred from given particulars, but a hypothetical major premiss from which given particulars are inferred, and that this major contains presuppositions of causation not contained in the particulars.

It is noticeable that Wundt quotes Newton's discovery of the centripetal force of the planets to the sun as an instance of this supposed hypothetical, analytic, inductive method; as if Newton's analysis were a hypothesis of the centripetal force to the sun, a deduction of the given facts of planetary motion, and a verification of the hypothesis by the given facts, and as if such a process of hypothetical deduction could be identical with either analysis or induction. The abuse of this instance of Newtonian analysis betrays the whole origin of the current confusion of induction with deduction. One confusion has led to another. Mill confused Newton's analytical deduction with hypothetical deduction; and thereupon Jevons confused induction with both. The result is that both Sigwart and Wundt transform the inductive process of adducing particular examples to induce a universal law into a deductive process of presupposing a universal law as a ground to deduce particular consequences. But we can easily extricate ourselves from these confusions by comparing induction with different kinds of deduction. The point about induction is that it starts from experience, and that, though in most classes we can experience only some particulars individually, yet we infer all. Hence induction cannot be reduced to Aristotle's inductive syllogism, because experience cannot give the convertible premiss, "Every S is M, and every M is S"; that "All A, B, C are magnets" is, but that "All magnets are A, B, C" is not, a fact of experience. For the same reason induction cannot be reduced to analytical deduction of the second kind in the form, S–P, M–S, ∴ M–P; because, though both end in a universal conclusion, the limits of experience prevent induction from such inference as—

Every experienced magnet attracts iron.
Every magnet whatever is every experienced magnet.
∴ Every magnet whatever attracts iron.

Still less can induction be reduced to analytical deduction of the first kind in the form—P–M, S–P, ∴ S–M, of which Newton has left so conspicuous an example in his *Principia*. As the example shows, that analytic process starts from the scientific knowledge of a universal and convertible law (every M is P, and every P is M), *e.g.*, a mechanical law of all centripetal force, and ends in a particular application, *e.g.*, this centripetal force of planets to the sun. But induction cannot start from a known law. Hence it is that Jevons, followed by Sigwart and Wundt, reduces it to deduction from a hypothesis in the form "Let every M be P, S is M, ∴ S is P." There is a superficial resemblance between induction and this hypothetical deduction. Both in a way use given particulars as evidence. But in induction the given particulars are the evidence by which we discover the universal, *e.g.*, particular magnets attracting iron are the origin of an inference that all do; in hypothetical deduction, the universal is the evidence by which we explain the given particulars, as when we suppose undulating æther to explain the facts of heat and light. In the former process, the given particulars are the data from which we infer the universal; in the latter, they are only the consequent facts by which we verify it. Or rather, there are two uses of induction: inductive discovery before deduction, and inductive verification after deduction. But neither use of induction is the same as the deduction itself: the former precedes, the latter follows it. Lastly, the theory of Mill, though frequently adopted, *e.g.*, by B. Erdmann, need not detain us long. Most inductions are made without any assumption of the uniformity of nature; for, whether it is itself induced, or *à priori*, or postulated, this like every assumption is a judgment, and most men are incapable of judgment on so universal a scale, when they are quite capable of induction. The fact is that the uniformity of nature stands to induction as the axioms of syllogism do to syllogism; they are not premisses, but conditions of inference, which ordinary men use spontaneously, as was pointed out in *Physical Realism*, and afterwards in Venn's *Empirical Logic*. The axiom of contradiction is not a major premiss of a judgment: the *dictum de omni et nullo* is not a major premiss of a syllogism: the principle of uniformity is not a major premiss of an induction. Induction, in fact, is no species of deduction; they are opposite processes, as Aristotle regarded them except in the one passage where he was reducing the former to the latter, and as Bacon always regarded them. But it is easy to confuse them by mistaking examples of deduction for inductions. Thus Whewell mistook Kepler's inference that Mars moves in an ellipse for an induction, though it required the combination of Tycho's and Kepler's observations, as a minor, with the laws of conic sections discovered by the Greeks, as a major, premiss. Jevons, in his *Principles of Science*, constantly makes the same sort of mistake. For example, the inference from the similarity between solar spectra and the spectra of various gases on the earth to the existence of similar gases in the sun, is called by him an induction; but it really is an analytical deduction from effect to cause, thus:—

Such and such spectra are effects of various gases.
Solar spectra are such spectra.
∴ Solar spectra are effects of those gases.

In the same way, to infer a machine from hearing the regular tick of a clock, to infer a player from finding a pack of cards arranged in suits, to infer a human origin of stone implements, and all such inferences from patent effects to latent causes, though they appear to Jevons to be typical inductions, are really deductions which, besides the minor premiss stating the particular effects, require a major premiss inducing the general kind of effects of a general kind of cause. B. Erdmann, again, has invented an induction from particular predicates to a totality of predicates which he calls "*ergänzende Induction*," giving as an example, "This body has the colour, extensibility, and specific gravity of magnesium; therefore it is magnesium." But this inference contains the tacit major, "What has a given colour, &c., is magnesium," and is a syllogism of recognition. A deduction is often like an induction, in inferring from particulars; the difference is that deduction combines a law in the major with the particulars in the minor premiss, and infers syllogistically that the particulars of the minor have the predicate of the major premiss, whereas induction uses the particulars simply as instances to generalize a law. An infallible sign of an induction is that the subject and predicate of the universal conclusion are merely those of the particular instances generalized; *e.g.*, "These magnets attract iron, ∴ all do."

This brings us to another source of error. As we have seen, Jevons, Sigwart, and Wundt all think that induction contains a belief in causation, in a cause, or ground, which is not present in the particular facts of experience, but is contributed by a hypothesis added as a major premiss to the particulars in order to explain them by the cause or ground. Not so; when an induction is causal, the particular instances are already beliefs in particular causes, *e.g.*, "My right hand is exerting pressure reciprocally with my left," "A, B, C magnets attract iron"; and the problem is to generalize these causes, not to introduce them. Induction is not introduction. It would make no difference to the form of induction, if, as Kant thought, the notion of causality is *à priori;* for even Kant thought that it is contained in experience. But whether Kant be right or wrong, Wundt and his school are decidedly wrong in supposing "supplementary notions which are not contained in experience itself, but are gained by a process of logical treatment of this experience"; as if our belief in causality could be neither *à posteriori* nor *à priori*, and beyond experience wake up in a hypothetical major premiss of induction. Really, we first experience that particular causes have particular effects; then induce that causes similar to those have effects similar to these; finally, deduce that when a particular cause of the kind occurs it has a particular effect of the kind by synthetic deduction, and that when a particular effect of the kind occurs it has a particular cause of the kind by analytic deduction with a convertible premiss, as when Newton from planetary motions, like terrestrial motions, analytically deduced a centripetal force to the sun like centripetal forces to the earth. Moreover, causal induction is itself both synthetic and analytic: according as experiment combines elements into a compound, or resolves a compound into elements, it is the origin of a synthetic or an analytic generalization. Not, however, that all induction is causal; but where it is not, there is still less reason for making it a deduction from hypothesis. When from the fact that the many crows in our experience are black, we induce the probability that all crows whatever are black, the belief in the particulars is quite independent of this universal. How then can this universal be called, as Sigwart, for example, calls it, the ground from which these particulars follow? I do not believe that the crows I have seen are black because all crows are black, but *vice versâ*. Sigwart simply inverts the order of our knowledge. In all induction, as Aristotle said, the particulars are the evidence, or ground of our knowledge (*principium cognoscendi*), of the universal. In causal induction, the particulars contain the cause, or ground of the being (*principium essendi*), of the effect, as well as the ground of our inducing the law. In all induction the universal is the conclusion, in none a major premiss, and in none the ground of either the being or the knowing of the particulars. Induction is simply generalization. It is not syllogism in the form of Aristotle's or Wundt's inductive syllogism, because, though starting only from some particulars, it concludes with a universal; it is not syllogism in the form called inverse deduction by Jevons, reduction by Sigwart, inductive method by Wundt, because it often uses particular facts of causation to infer universal laws of causation; it is not syllogism in the form of Mill's syllogism from a belief in uniformity of nature, because few men have believed in uniformity, but all have induced from particulars to universals. Bacon alone was right in altogether opposing induction to syllogism, and in finding inductive rules for the inductive process from particular instances of presence, absence in similar circumstances, and comparison. But how from some particulars of experience do we infer all universally? The answer to this question is still a *desideratum* of logic.

(5) *Inference in General.*—There are three types:—

(1) Syllogism.	(2) Induction.	(3) Analogy.
Every M is P.	S is P.	S^1 is P.
S is M.	Every M is similar to S.	S^2 is similar to S^1.
∴ S is P.	∴ Every M is P.	∴ S^2 is P.

Different as they are, the three kinds have something in common: they are all processes from similar to similar; they are all processes from judgment to judgment, whether expressed in propositions or not; and, as a judgment is a belief in being, they are all processes from one belief in being to another. Inference, in short, is any process from a given judgment, or belief that something is (or is not) determined, to a concluding judgment, or belief that something else which is similar in one or more respects is (or is not) similarly determined. Nevertheless, simple as this account appears, it is opposed in every point to recent logic. In the first place, the point of Bradley's logic is that "similarity is not a principle which works. What operates is identity, and that identity is a universal." This view makes inference easy: induction is all over before it begins; for, according to Bradley, "every one of the instances is already a universal proposition; and it is not a particular fact or phenomenon at all," so that the moment you observe that this magnet attracts iron, you *ipso facto* know that every magnet does so, and all that remains for deduction is to identify a second magnet as the same with the first, and conclude that it attracts iron. In dealing with Bradley's works we feel inclined to repeat what Aristotle says of the discourses of Socrates: they all exhibit excellence, cleverness, novelty, and inquiry, but their truth is a difficult matter; and the Socratic paradox that virtue is knowledge is not more difficult than the Bradleian paradox that as two different things are the same inference is identification. The basis of Bradley's logic is the fallacious dialectic of Hegel's metaphysics, founded on the supposition that two things, which are different, but have something in common, are the same. For example, according to Hegel, being and not-being are both indeterminate, and therefore the same. "If," says Bradley, "A and B, for instance, both have lungs or gills, they are so far the same." The answer to Hegel is that being and not-being are at most similarly indeterminate, and to Bradley that each animal has its own different lungs, whereby they are only similar. If they were the same, then in descending, two things, one of which has healthy and the other diseased lungs, would be the same; and in ascending, two things, one of which has lungs and the other has not, but both of which have life, *e.g.*, plants and animals, would be so far the same. There would be no limit to identity either downwards or upwards; so that a man would be the same as a man-of-war, and all things would be the same thing, and not different parts of one universe. But a thing which has healthy lungs and a thing which has diseased lungs are only similar individuals numerically different. Each individual thing is the same only with itself, although related to other things; and each individual of a class has its own individual, though similar, attributes. The consequence of this true metaphysics to logic is twofold: on the one hand, one singular or particular judgment, *e.g.*, "this magnet attracts iron," is not another, *e.g.*, "that magnet attracts iron, and neither is universal; on the other hand, a universal judgment, *e.g.*, "every magnet attracts iron," means, distributively, that each individual magnet exerts its individual attraction, though it is similar to other magnets exerting similar attractions. A universal is not "one identical point," but one distributive whole. Hence in a syllogism, a middle term, *e.g.*, magnets, is "absolutely the same," not in the sense of "one identical point" making each individual the same as any other, as Bradley supposes, but only in the sense of one whole class, or total of many similar individuals, *e.g.*, magnets, each of which is a magnet, not magnet in general. Hence also induction is a real process, because, when we know that this individual magnet attracts iron, we are very far from knowing that all alike do so similarly; and the question of inductive logic, how we get from some similars to all similars, remains, as before, a difficulty, but not to be solved by the fallacy that inference is identification.

Secondly, a subordinate point in Bradley's logic is that there are inferences which are not syllogisms; and this is true. But when he goes on to propose, as a complete independent inference, "A is to the right of B, B is to the right of C, therefore A is to the right of C," he confuses two different operations. When A, B, and C are objects of sense, their relative positions are matters, not of inference, but of observation; when they are not, there is an inference, but a syllogistic inference with a major premiss, induced from previous observations, "whenever of three things the first is to the right of the second, and the second to the right of the third, the first is to the right of the third." To reply that this universal judgment is not expressed, or that its expression is cumbrous, is no answer, because, whether expressed or not, it is required for the thought. As Aristotle puts it, the syllogism is directed "not to the outer, but to the inner discourse," or as we should say, not to the expression but to the thought, not to the proposition but to the judgment, and to the inference not verbally but mentally. Bradley seems to suppose that the major premiss of a syllogism must be explicit, or else is nothing at all. But it is often thought without being expressed, and to judge the syllogism by its mere explicit expression is to commit an *ignoratio elenchi ;* for it has been known all along that we express less than we think, and the very purpose of syllogistic logic is to analyse the whole thought necessary to the conclusion. In this syllogistic analysis two points must always be considered: one, that we usually use premisses in thought which we do not express; and the other, that we sometimes use them unconsciously, and therefore infer and reason unconsciously, in the manner excellently described by Zeller in his *Vorträge*, iii. pp. 249–55. Inference is a deeper thinking process from judgment to judgment, which only occasionally and partially emerges in the linguistic process from proposition to proposition. We may now then reassert two points about inference against Bradley's logic: the first, that it is a process from similar to similar, and not a process of identification, because two different things are not at all the same thing; the second, that it is the mental process from judgment to judgment rather than the linguistic process from proposition to proposition, because, besides the judgments expressed in propositions, it requires judgments which are not always expressed, and are sometimes even unconscious.

Our third point is, that as a process of judgments inference is a process from one belief in being to another, and not an ideal construction, because a judgment does not always require ideas, but is always a belief about things, existing or not. This point is challenged by all the many ideal theories of judgment already quoted. If, for example, judgment were an analysis of an aggregate idea as Wundt supposes, it would certainly be true with him to conclude that "as judgment is an *immediate*, inference is a *mediate*, reference of the members of an aggregate of ideas to one another." But really a judgment is a belief that something, existing, or thinkable, or nameable, or what not, is (or is not) determined; and inference is a process from one to another of such beliefs in being. Hence the fallacy of those who, like Bosanquet, or like Paulsen in his *Einleitung in die Philosophie*, represent the realistic theory of inference as if it meant that knowledge starts from ideas and then infers that ideas are copies of things, and who then object, rightly enough, that we could not in that case compare the copy with the original, but only be able to infer from idea to idea. But there is another realism which holds that inference is a process neither from ideas to ideas, nor from ideas to things, but from beliefs to beliefs, from judgments about things in the premisses to judgments about similar things in the conclusion. Logical inference never goes through the impossible process of premising nothing but ideas, and concluding that ideas are copies of things. Moreover, as we have shown, our primary judgments of sense are beliefs founded on sensations without requiring ideas, and are beliefs, not merely that something is determined, but that it is determined as existing; and, accordingly, our primary inferences from these sensory judgments of existence are inferences that other things beyond sense are similarly determined as existing. First press your lips together and then press a pen between them: you will not be conscious of perceiving any ideas: you will be conscious first of perceiving one existing lip exerting pressure reciprocally with the other existing lip; then, on putting the pen between your lips, of perceiving each lip similarly exerting pressure, but not with the other; and consequently of inferring that each existing lip is exerting pressure reciprocally with another existing body, the pen. Inference then, though it is accompanied by ideas, is not an ideal construction, nor a process from idea to idea, nor a process from idea to thing, but a process from direct to indirect beliefs in things, and sometimes in existing things. Logic cannot, it is true, decide what these things are, nor what the senses know about them, without appealing to metaphysics and psychology. But, as the science of inference, it can make sure that inference, on the one hand, starts from sensory judgments about sensible things and logically proceeds to inferential judgments about similar things beyond sense, and, on the other hand, cannot logically go beyond the similar. These are the limits within which logical inference works, because its nature essentially consists in proceeding from one judgment to another about similar things, existing or not.

Finally, though sensory judgment is always true of its sensible object, inferential judgments are not always true, but are true so far as they are logically inferred, however indirectly, from sense; and knowledge consists of sense, memory after sense, and logical inference from sense, which, we must remember, is not merely the outer sense of our five senses, but also the inner sense of ourselves as conscious thinking persons. We come then, finally, to the old question—What is truth? It will be said that Kant has proved that real truth, in the sense of the "agreement of knowledge with the object," is unattainable, because we could compare knowledge with the object only by knowing both. Sigwart, indeed, adopting Kant's argument, concludes that we must be satisfied with consistency among the thoughts which presuppose an existent; this, too, is the reason why he thinks that induction is reduction, on the theory that we can show the necessary consequence of the given particular, but that truth of fact is unattainable. But Kant's criticism and Sigwart's corollary only derive plausibility from a false definition of truth. Truth is not the agreement of knowledge with an object beyond itself, and therefore *ex hypothesi* unknowable, but the agreement of our judgments with the objects of our knowledge. A judgment is true, whenever it is a belief that a thing is determined as it is known to be by sense, or by memory after sense, or by inference from sense, however indirect the inference may be, and even when in the form of inference of non-existence it extends consequentially from primary to secondary judgments. Thus the judgments "this sensible pressure exists," "that sensible pressure existed," "other similar pressures exist," "a conceivable centaur does not exist but is a figment," are all equally true, because they are in accordance with one or other of these kinds of knowledge. Consequently, as knowledge is attainable by sense, memory, and reason, truth is also attainable, because, though we cannot test what we know by something else, we can test what we judge by what we know. Not that all inference is knowledge, but it is sometimes. The aim of logic in general is to find the laws of all inference, which, so far as it obeys those laws, is always consistent, but is true or false according to its data as well as its consistency; and the aim of the special logic of knowledge is to find the laws of direct and indirect inferences from sense, because, as sense produces sensory judgments which are always true of the sensible things actually perceived, inference from sense produces inferential judgments which, so far as they are consequent on sensory judgments, are always true of things similar to sensible things, by the very consistency of inference, or, as we say, by parity of reasoning. We return then to the old view of Aristotle's Analytics that logic analyses inference as a means to knowledge, and to the old definition of logic, *Logica est ars ratiocinandi, ut discernatur verum a falso.*

In conclusion, the logic of the last quarter of the 19th century may be said to be animated by a spirit of inquiry, marred by a love of paradox and a corresponding hatred of tradition. But we have found, on the whole, that logical tradition rises superior to logical innovation. There are two old logics which still remain indispensable, Aristotle's *Organon* and Bacon's *Novum Organum.* If, and only if, the study of deductive logic begins with Aristotle, and the study of inductive logic with Aristotle and Bacon, it will be profitable to add the works of the following recent German and English authors :—

Authorities.—J. Bergmann. *Reine Logik*, Berlin, 1879; *Die Grundprobleme der Logik*, 2nd ed. Berlin, 1895.—B. Bosanquet. *Logic.* Oxford, 1888; *The Essentials of Logic.* London, 1895.—F. H. Bradley. *The Principles of Logic.* London, 1883.—F. Brentano. *Psychologie vom empirischen Standpunkte.* Vienna, 1874.—R. F. Clarke. *Logic.* London, 1889.—W. L. Davidson. *The Logic of Definition.* London, 1885.—E. Dühring. *Logik und Wissenschaftstheorie.* Leipzig, 1878.—B. Erdmann. *Logik.* Halle, 1892.—T. Fowler. *Bacon's Novum Organum*, edited, with introduction, notes, &c., 2nd ed. Oxford, 1889.—T. H. Green. *Lectures on Logic*, in *Works*, vol. iii. London, 1886.—J. G. Hibben. *Inductive Logic.* Edinburgh and London, 1896.—F. Hillebrand. *Die neuen Theorien der Kategorischen Schlüsse.* Vienna, 1891.—L. T. Hobhouse. *The Theory of Knowledge.* London, 1896.—H. Hughes. *The Theory of Inference.* London, 1894.—E. Husserl. *Logische Untersuchungen.* Halle, 1891, 1901.—W. Jerusalem. *Die Urtheilsfunction.* Vienna and Leipzig, 1895.—W. Stanley Jevons.—*The Principles of Science*, 3rd ed. London, 1879; *Studies in Deductive Logic.* London, 1880.—E. E. Constance Jones. *Elements of Logic.* Edinburgh, 1890.—J. N. Keynes. *Studies and Exercises in Formal Logic*, 2nd ed. London, 1887.—F. A. Lange. *Logische Studien*, 2nd ed. Leipzig, 1894.—T. Lipps. *Grundzüge der Logik.* Hamburg and Leipzig, 1893.—R. H. Lotze. *Logik*, 2nd ed. Leipzig, 1881 (English translation edited by B. Bosanquet. Oxford, 1884); *Grundzüge der Logik* (*Diktate*), 3rd ed. Leipzig, 1891 (English translation by G. T. Ladd. Boston, 1887).—Werner Luthe. *Beiträge zur Logik.* Berlin, 1872, 1877.—Members of Johns Hopkins University. *Studies in Logic* (edited by C. S. Peirce). Boston, 1883.—J. B. Meyer. *Ueberweg's System der Logik*, fünfte vermehrte Auflag. Bonn, 1882.—Max Müller. *Science of Thought.* London, 1887.—Carveth Read. *On the Theory of Logic.* London, 1878; *Logic, Deductive and Inductive*, 2nd ed. London, 1901.—E. Schröder. *Vorlesungen über die Algebra der Logik.* Leipzig, 1890, 1891, 1895.—W. Schuppe. *Erkenntnistheoretische Logik.* Bonn, 1878; *Grundriss der Erkenntnistheorie und Logik.* Berlin, 1894.—R. Shute. *A Discourse on Truth.* London, 1877.—Alfred Sidgwick. *Fallacies.* London, 1883; *The Use of Words in Reasoning.* London, 1901.—C. Sigwart. *Logik*, 2nd ed. Freiburg-i.-Br. and Leipzig, 1889–93 (English translation by Helen Dendy. London, 1895).—K. Uphues. *Grundlehren der Logik.* Breslau, 1883.—J. Veitch. *Institutes of Logic.* Edinburgh and London, 1885.—J. Venn. *Symbolic Logic*, 2nd ed. London, 1894; *The Principles of Empirical or Inductive Logic.* London, 1889.—J. Volkelt. *Erfahren und Denken.* Hamburg and Leipzig, 1886.—T. Welton. *A Manual of Logic.* London, 1891, 1896.—W. Windelband. *Präludien.* Freiburg-i.-Br., 1884.—W. Wundt. *Logik*, 2nd ed. Stuttgart, 1893–95.—Text-books are not comprised in this list.

(T. CA.)

Logroño, an inland province of northern Spain. With an area of 1945 square miles, it is divided into nine administrative districts and 184 parishes. The population was 181,465 in 1887, and 186,223 in 1897, when the birth-rate was 4·10 per cent., the death-rate 3·78 per cent., and illegitimacy 2·49 per cent. A railway line along the right bank of the Ebro connects the province with Saragossa, and from Miranda there is railway communication with Madrid, Bilbao, and France. Public education is in a somewhat unsatisfactory condition, except in the larger towns. The industries and commerce grew considerably in importance during the last twenty years of the 19th century. Wine is the principal export, much as it has been reduced in consequence of the French imports of Spanish wine falling off, since 1892, by about 75 per cent. Great efforts have been made to keep a hold upon French and English markets with light red and white Rioja wines. No less than 128,000 acres are covered with vines, and 21,000 with olive groves. About 72,000 acres are devoted to wheat, 88,877 acres to barley, rye, oats, maize, and 4000 to pod fruit. The mines, almost without exception, are unproductive, but many of them (chiefly iron) could be worked profitably if the means of communication were improved.

Logroño, the capital of the above province, stands on the right bank of the Ebro, and had a population in 1897 of 19,475. The squares and public promenades have fine trees and are fringed with handsome modern houses and new buildings, contrasting with the older and narrow streets. The bull-ring holds 11,000 spectators. The see of Calahorra was transferred to Logroño in 1890.

Lohardaga, or Ranchi, a district of British India, in the Chota Nagpur division of Bengal. Area, 7140 square miles; population (1881), 1,058,169; (1891), 1,128,885, showing an increase of 7 per cent.; average density, 155 persons per square mile. In 1901 the population was 1,188,562, showing a further increase of 5 per cent. The land revenue and rates are Rs.1,02,442; number of police, 419; number of boys at school (1896–97), 18,132, being 21·9 per cent. of the male population of school-going age; registered death-rate (1897), 46·48 per thousand, this high mortality being due to drought and high prices of grain, which also seriously affected the attendance at school. In addition to relief works, the Government sanctioned a bounty on the importation of grain. The administrative headquarters are at Ranchi (20,306), where there is a lac factory, employing 60 hands, with an out-turn valued at Rs.25,000. There is a small military cantonment at Doranda. The German Evangelical Lutheran mission maintains several schools and a printing-press. The S.P.G. mission is also active. Tea cultivation has been introduced, but does not flourish. In 1897 there were 21 gardens, with 2438 acres under tea, employing 1132 persons, and producing an out-turn of nearly one million pounds. There is no railway in the district, though surveys have been made to connect with the Bengal-Nagpur line. In January 1900 some of the aboriginal tribe of Mundas rose and committed several murders, chiefly of native Christians and policemen; but the rising was promptly suppressed by military force.

Loharu, a native state of India, within the Punjab, situated in the south-east corner of the province, between Hissar district and Rajputana. Area, 226 square miles; population (1881), 13,754; (1891), 20,139; (1901), 15,233; average density, 67 persons per square mile; estimated gross revenue, Rs.66,077; military force, 94 men. The chief, whose title is nawab, is a Mahommedan, of Afghan descent. The nawab Amir-ud-din Ahmad Khan, K.C.I.E., who is a member of the Viceroy's Legislative Council, is also administrator of the state of Maler Kotla. The town of Loharu is situated in 28° 24′ N. and 75° 52′ E.; population, 2038.

Loire, a river of France, rising in the department of Ardèche, and flowing north, north-west, and west to the Bay of Biscay, which it enters below Nantes. The total area drained is 207,060 square miles. The river is navigable only in a very limited sense, and, except in the two last sections of its course, by small boats only.

Below the confluence of the Maine facilities for navigation are increased, and the channel is capable of improvement. The disabilities do not apply to the Loire Maritime, as the section below Nantes is called. Great improvements have been effected by dredging and dyking operations, extending over several series of years between 1859 and 1892, resulting in the deepening of the channel, 82 yards wide, to about 15 feet. The most important work, however, was the construction of the MARITIME CANAL OF THE LOIRE. This work, decided on in 1879, was begun in 1881, and on 1st September 1892 the canal was opened for traffic, the undertaking having been successfully completed at a cost of about £1,000,000. The canal begins at Martinière, 1·2 mile below Nantes, and extends to Paimbœuf. At each end is a lock, 180 yards long by 19·6 yards wide. The canal has a total length of 9½ miles, width at surface 24½ yards, depth 19½ feet, capable of being increased to 24 feet. Since the opening of the canal, large ships can ascend to Nantes. Navigation is interrupted by ice on the average ten days in the year. The Loire is classed as flottable from Vorey (Haute Loire) to Noirie (Loire), 35 miles, and as navigable from Noirie to the sea, 513 miles; but in the upper course, for about 96 miles, there is neither flottage nor navigation.

Loire, a department in Central France, traversed by the mountains of Forez and of Lyonnais, and watered by the Loire, running through the middle of the department from south to north, and on its south-eastern boundary by the Rhône.

Area, 1853 square miles, divided among 30 cantons and 332 communes. The population, 603,384 in 1886, had increased to 644,532 in 1901. Births in 1899, 14,592, of which 771 were illegitimate; deaths, 12,955. The chief towns are St Étienne, with 146,671 inhabitants in 1901, Montbrison (7520), Roanne (34,568), Rive-de-Gier (16,087), and St Chamond (15,469). In 1896 there were 1130 primary schools, with 95,000 pupils, and 3 per cent. of the population were illiterate. The land under cultivation in 1896 amounted to over 1,028,000 acres; but the plough-land occupied only 573,000 acres, and the vineyards 44,480 acres. The wheat crop in 1899 produced the value of £582,000; rye, £400,000. Loire is one of the departments distinguished for the production of potatoes, yielding in 1899 a value of £520,000, and for natural pastures and grass lands, in which in 1899 the department returned the value of £880,000. Its vineyards produced the value of £216,000 in 1899. The live stock in 1899 included 14,800 horses, 158,810 cattle, 86,510 sheep, 63,360 pigs, and 47,890 goats. The coal basin of the Loire covers over 54,000 acres, divided among 28 companies. Its production in 1898 exceeded 3,850,000 metric tons, of the value of £2,200,000. During that year the industry in metals yielded 23,000 metric tons of cast-iron, 314,000 tons of iron, and 74,000 tons of steel, of a total value altogether of £2,200,000. St Étienne, St Chamond, and Rive-de-Gier are the centres of the mining and metallurgy. The manufacture of ribbons at St Étienne and its environs is carried on on a large scale, giving a yearly return of not less than 6 millions sterling. The weaving of muslins employs many hands in the zone of the Loire. According to the amount of horse-power it engages, Loire ranks as the third department in France. Its annual revenue is estimated at £14,000,000.

Loire, Haute, a department of Central France, traversed by the mountains of Velay (Mont Mézenc), and containing the upper waters of the Loire.

Area, 1931 square miles. From 320,063 in 1886 the population decreased to 306,671 in 1901. Births in 1899, 7561, of which 244 were illegitimate; deaths, 6672; marriages, 2317. In 1896 there were 987 schools, with 50,000 pupils, and not more than 3 per cent. of the population were illiterate. The land under cultivation was in 1896 estimated at 1,027,900 acres, but of this about 494,000 acres were covered with grass and forest, the plough-land occupying only 526,000 acres and the vineyards 17,300 acres. Wheat yielded in 1899 only £184,000; but the rye crop of the same year exceeded £693,000, while barley returned more than £159,000. Potatoes in 1899 produced the value of £357,000, and the natural pastures £1,180,000. The live stock is also relatively considerable, including (1899) 14,810 horses, 186,740 cattle, 306,750 sheep, 81,140 pigs, and 10,860 goats. The milk of the department yields a revenue of over £700,000 per annum. Haute-Loire possesses coal-pits, from which in 1898 it extracted 224,000 metric tons. It has also various metalliferous deposits, such as copper and lead, but the industry in metals is not correspondingly extensive. The manufacture of lace occupies a number of hands. Le Puy, the capital, had 20,570 inhabitants in 1901.

Loire-Inférieure, a department of the west of France, at the mouth of the Loire.

Area, 2695 square miles. The population increased from 643,884 in 1886 to 656,998 in 1901. Births in 1899, 13,771, of which 649 were illegitimate; deaths, 11,638; marriages, 4848. The schools numbered in 1896, 789, with 89,000 pupils, and the illiterate formed 5 per cent. of the population. The land under cultivation amounts to 1,575,272 acres, of which 961,274 acres are plough-land, 308,890 acres natural pastures and grass lands, and 69,291 acres vineyards. Wheat, oats, and buckwheat are the only cereals largely cultivated. Their total produce in 1899 reached the value of £1,910,000. The vines reached the value of £1,582,000; mangold-wurzel, £224,000; natural pastures, £1,080,000. Hemp, yielding in 1899 a value of £24,000, and linen £15,500, supply the raw material to considerable industries. Apples, besides, gave a revenue of £240,000. The live stock includes 47,850 horses, 319,240 cattle, 91,700 sheep, and 113,500 pigs. The value of milk products in 1899 was £1,040,000. Loire-Inférieure in 1898 produced 20,000 metric tons of coal, 15,000 tons of peat, 10,530 tons of iron, and 48,000 tons of sea-salt, of a value altogether of £40,000. Metallurgy is in an advanced state around Nantes and St Nazaire, in the making of machines and ship engineering. In 1898 it produced 55,000 metric tons of cast-iron, 9500 tons of iron, and 49,000 tons of steel, to the value altogether, inclusive of industries in other metals, of £760,000. Industries connected with alimentation are in a thriving state along the course of the Loire, as is spinning in the interior. Distillation produces little more than 33,000 gallons a year. Nantes, the capital, had 128,349 inhabitants in 1901.

Loiret, a department of Central France, watered by the Loire, the Loing, and the Loiret.

Area, 2630 square miles. The population, 374,875 in 1886, only numbered 363,812 in 1901. Births in 1899, 7204, of which 606 were illegitimate; deaths, 6943; marriages, 2557. With 724 schools in 1896, attended by 53,000 pupils, 3 per cent. of the population were illiterate. The area under cultivation in 1896 amounted to 1,571,646 acres; 1,116,956 acres arable, 252,050 acres under wood, and only 49,422 acres under vines. The wheat crop was in 1899 estimated at £1,204,000; oats, £780,000; rye, £180,000; meslin, £112,000; barley, £128,000. The vintage of 1899 was valued at £212,000; mangold-wurzel at £144,000; natural pastures at £104,000. In 1899 the yield of beetroot was valued at £88,000, the department thus standing in 1899 the eleventh in France in this respect. In 1899 the live stock included 44,340 horses, 142,590 cattle, 320,790 sheep, and 37,750 pigs. Poor in minerals, Loiret has no extensive industry in metals. Much more important are its distilleries, sugar-refineries, and textile industries, more particularly hosiery. Orleans, the capital, in 1901 had 67,539 inhabitants.

Loir-et-Cher, a department of Central France, watered by the Loire, the Loir, and the Cher.

Area, 2479 square miles. The population decreased from 279,214 in 1886 to 274,836 in 1901. Births in 1899, 5334, of which 358 were illegitimate; deaths, 5229; marriages, 2121. There were in 1896, 658 primary schools, with 41,000 pupils, and 5 per cent. of the population were illiterate. The area under cultivation in 1896 comprised 1,462,916 acres, of which 916,790 were plough-land and 93,903 acres vineyards. In 1899 the produce of wheat was valued at £970,000; rye, £112,000; barley, £72,000; oats, £580,000; vines, £680,000. The green crop and grass lands give but a moderate return, as do also colza, rape, oil-poppy, hemp, flax, &c. The live stock included (1899) 37,770 horses, 91,050 cattle, 234,190 sheep, 47,580 pigs, and 20,900 goats. Mining and metallurgy are not advanced. Distillation hardly produces more than a thousand hectolitres. Blois, the capital (23,793), has important hosiery manufactures.

Lolos, the name given by the Chinese to a large tribe of aborigines who inhabit the greater part of southern Szechuen. Under this heading we give a short account of the various non-Chinese races scattered over south-western China.

Exclusive of Tibetans, there are three principal ethnological varieties: the Miaotze of Kweichow, the Lolos of Szechuen, the Shans of Yunnan. The Miaotze or Miautze were described in the earlier volumes (xv. 223) of this Encyclopædia (ninth edition), and need not further be referred to, save to say that they still maintain a semi-independence in their mountain homes, but appear to be a decaying race, gradually giving way before the more vigorous Chinese. The Lolos are a more numerous and more important race. Their home is in the mountainous country called Taliang shan, which lies between the Yangtse river on the east and the Kien ch'ang valley on the west, in south Szechuen, but they are to be found in scattered communities as far south as the Burmese frontier, and west to the Mekong. The origin of the Lolos is not known, but there seems no reason to doubt that they were, like the Miaotze, one of the aboriginal tribes of China, driven southwards by the advancing flood of Chinese. The name is said to be a Chinese corruption of Lulu, the name of a former chieftain of a tribe who called themselves Nersu. They possess a written language which, like the Chinese, is monosyllabic and probably ideographic, and the characters employed bear a certain resemblance to Chinese. No literature, however, worthy of the name is known to exist, and the art of reading and writing is confined to a few. Politically they are divided into tribes, each under the government of a hereditary chieftain. The community consists of three classes, the "blackbones" or nobles, the "whitebones" or plebeians, and the *watze* or slaves. The last are mostly Chinese who have been captured in forays, or the descendants of such captives. Within the confines of Lolo-land proper, which extends to some 11,000 square miles, the Chinese Government exercises no jurisdiction. The people are independent and even aggressive, making frequent raids on their unarmed Chinese neighbours. They cultivate wheat, barley, and millet, but little rice. They have some knowledge of metals, making their own tools and weapons. Women are said to be held in respect, and may become chief of the tribe. They do not intermarry with Chinese. The Shans, the third race mentioned, are to be found all over the province of Yunnan and in the borderland between China and Burma. Shan is the Burmese name by which these tribes are known, and it has been generally adopted by Europeans, but they call themselves Tai, Punong, &c. The Chinese designate them usually Pai or Pai-yi. They are the descendants of a once powerful nation known in Chinese history as Yueh chang. They were masters at one time of a large part of what are now the provinces of Kwangsi and Yunnan, and were expelled only during the Yuan dynasty (1260–1368). The Examination Hall at Kweilin is said to be built on the ruins of an old Shan palace. Politically the Shan tribes, where not under the direct control of Chinese magistrates, are organized under their own chiefs, who are recognized by the Chinese Government and endowed with official rank and title. In Burmese such native chiefs are termed "Tsaubwa." Besides the three races just described, there are to be found in western Szechuen other native tribes who are variously termed by the Chinese Mantze, Sifan, and Kutsung. All these are in language, dress, and physique akin to the Tibetans, and may be regarded as offshoots of that race. They do not, as a rule, mix with the Chinese, but form semi-independent communities under tribal chiefs of their own choosing, whose authority is recognized by the Chinese officials.

See E. C. Baber. *Royal Geog. Society Sup. Papers*, vol. i. London, 1882.—F. S. A. Bourne. Blue Book, China, No. 1. 1888.—A. Hosie. *Three Years in Western China.* London, 1897. (G. J.)

Lombardy, a territorial division of northern Italy, embracing the middle portion of the valley of the Po, viz., the region contained between that river and the Swiss frontier, the lakes, and the Alps. It includes the provinces of Bergamo, Brescia, Como, Cremona, Mantua, Milan, Pavia, and Sondrio, and has an area of 9386 square miles, and a population of 3,680,615 (1881), and 4,278,188 (1901). Its principal crops are maize, wheat, rice, flax, hemp, wine, chestnuts, and potatoes. The only metals mined are zinc and iron. Lombardy is one of the busiest industrial regions in Italy. In parts of the region the peasantry suffer much from pellagra. The principal towns are Milan, Brescia, Bergamo, Pavia, Cremona, Como, Mantua, Lodi, and Monza. Pavia is the seat of a university. On the shores of the Alpine lakes and in the Alpine valleys there are a number of summer resorts, such as Trescore Balneario, Sondrio, Bormio, Varese, Gardone, Salò, and San Pellegrino. For the history see Milan, Mantua, and Italy.

Lombok, by the natives called Sassak, one of the Lesser Sunda islands, in the East Indian Archipelago, east of Java, between 8° 12′ and 9° 1′ S. and 115° 46′ and 116° 40′ E., with an area of 3136 square miles. Since the war of 1894 the island has been placed under the direct government of the Dutch, the people being, however, left in undisturbed exercise of their own laws, religions, customs, and institutions. Lombok is now a division of the residency of Bali and Lombok, and since 1898 has been divided into West, Middle, and East Lombok. Its chief towns are Mataram, Praya, and Sisi. On the west coast the harbour of Ampanam is the most frequented, though, on account of heavy breakers, it is often difficult of approach. The island is traversed by two mountain chains. The northern chain is of volcanic formation, and contains the peak of Lombok, 11,810 feet high, one of the highest volcanoes in the Archipelago. It is surrounded by a plateau (with lower summits, and a magnificent lake, Segara Anak) 8200 feet high. The southern chain is only a little over 3000 feet high. Between the two chains is a broad valley or terrace with a range of low volcanic hills. The small rivers serve only for irrigation and the growing of rice. The mountains are covered with forest. The plains grow rice of superior quality; also, for export, coffee, indigo, maize, and sugar, katyang (native beans), cotton, and tobacco. The Balinese and Sassaks profess respectively Hinduism and Islamism, and their conflicts resulted in the war referred to below. The Sassaks are estimated at 320,000; the Balinese at 50,000; the Europeans (1897) at 39; the Chinese at 305; the Arabs at 172. The residency of Bali and Lombok has an area of 4063 square miles, and population (1896) of 1,044,757.

For geography and statistics see Van Eck, "Schets van het Eiland Lombok," in *Tijdschrift Bat. Gen.* xxii.—Jacobs, *Eenigen Tijd onder de Baliers*, 1883.—Bijvanck, in *De Gids*, 1894–95.—Neeb and Asbeck Brusse. *Naar Lombok*, 1898. (C. M. K.)

History.—In July 1894 a Dutch expedition landed at Ampanam, and advanced towards Mataram, the capital of the Balinese sultan, who had defied Dutch authority and refused to send the usual delegation to Batavia. The objects of that expedition were twofold, to punish Mataram and to redress the grievances of the Sassaks, the aborigines of Lombok, whom the Balinese held in cruel subjection. The first Dutch expedition met with various reverses, and ultimately the invaders were forced back upon Ampanam, with the loss of several guns, and 9 officers and 90 men killed, 17 officers and 255 men wounded. The Dutch at once despatched a much stronger expedition, which landed at Ampanam in September. Mataram was bombarded by the fleet which had transported the troops, and these stormed the Sultan's stronghold, and Tjakra Negara, another chieftain's citadel, both after a desperate resistance. The old sultan of Mataram was captured, and he and other Balinese chiefs were exiled to different parts of the Malay Archipelago, whilst the sultan's heir fell at the hands of his warriors. Thus ended the Balinese domination of Lombok, and the island was placed under direct Dutch-Indian control, an assistant resident being appointed, who resides with a staff and a small garrison at Ampanam. Lombok is now administered from Bali by the Dutch resident on that island. The Sassaks, who are Mahommedans and distinct in many other respects from the Balinese Hindus, who vanquished but could not convert them, had their native rulers restored to them. They are far more numerous than the Balinese invaders, and disturbances between them and the Lombok Balinese frequently occur.

For recent history consult Wallace's *Malay Archipelago*, in whose famous "Dividing Line" Lombok plays an important part; Zollinger's *Travels* (in Dutch), published by the Dutch-Indian Government; Guillemard's *Cruise of the Marchesa* (2nd volume), and Captain W. Cool's *Lombok Expedition*, a narrative of the events sketched above, and published in 1896, in Dutch and English (Amsterdam and London). Wallace stayed some time at Ampanam, and gives many curious details, also a description of Mataram. Cool's book also contains many particulars about the folklore and dual religions of Lombok, which, with the adjacent Bali, forms the last stronghold of Hinduism east of Java. (H. Ti.)

Lombroso, Cesare (1836-——), Italian criminologist, was born in November 1836 at Venice. After making himself known by his medical and anthropological studies, he was in 1862 appointed professor at Pavia, then director of the lunatic asylum at Pesaro, and finally professor at Turin. His works include *L'Uomo delinquente* (1876), *La Pellagra in Italia* (1880), *Lezioni di medicina legale* (1886), *L'Uomo di genio* (1888), translated into English, and, in collaboration with G. Ferrero, *La Donna delinquente* (1893), also translated. Lombroso, like Bovio, Ferri, and Colajanni, well-known Italian criminologists, has been strongly influenced by Auguste Comte, and owes to him an exaggerated tendency to refer all mental facts to biological causes. In spite of this, however, and a serious want of accuracy and discrimination in handling evidence, his work has made an epoch in criminology; for he has surpassed all his predecessors by the wide scope and systematic character of his researches, and by the practical conclusions he draws from them. Their net theoretical result is that the criminal population exhibits a higher percentage of physical, nervous, and mental anomalies than non-criminals; and that these anomalies are due partly to degeneration, partly to atavism. The criminal is a special type of the human race, standing midway between the lunatic and the savage. This doctrine of a "criminal type" has been gravely criticized, but is admitted by all to contain a substratum of truth. The practical reform to which it points is a classification of offenders, so that the born criminal may receive a different kind of punishment from the offender who is tempted into crime by circumstances. Lombroso's biological principles are much less successful in his work on Genius, which he explains as a morbid, degenerative condition, presenting analogies to insanity, and not altogether alien to crime.

Lomond, Loch, the largest of Scottish lakes, is situated in the counties of Stirling and Dumbarton. It is 20¾ miles long in a straight line, and its greatest width is a mile, the area about 27 square miles, and the greatest depth 105 fathoms. It contains 30 islands, the largest of which is Inchmurrin, a deer park belonging to the duke of Montrose. The level of the loch is 23 feet above sea; it forms part of the route of one of two projected Forth and Clyde ship canals. The fish are sea-trout, lake-trout, pike, and perch. Part of the shore is skirted by the West Highland railway, opened in 1894, which has stations at Tarbet and Ardlui on the loch. There is a graceful waterfall at Inversnaid, which is also the point of arrival and departure for the Trossachs coaches. The country surrounding Inversnaid teems with Rob Roy memories. The ascent of Ben Lomond is made from Rowardennan. (See also TROSSACHS.)

Łomzha (*Łomźa* in Polish), a government of Russian Poland, to the north-east of Warsaw. Its population in 1897 was 585,781, of whom 279,279 were women, and 69,834 lived in towns. Out of a population of 626,582 on 1st January 1895 (including 15,940 military and 30,978 temporary inhabitants), there were 505,016 Catholics, 111,526 Jews, 6270 Protestants, and 3770 Orthodox Greeks. The industries are limited to a few breweries and potteries. The province is divided into seven districts, of which the chief towns are: Łomźa, capital of the province (26,075), Kolno (4941), Maków (7232), Mazowiec (4931), Ostrolenka (8679), Ostrów (11,264), and Szczuczyn (5725).

LONDON.

Area.

LONDON, the capital of England and of the British Empire, is situated on both banks of the river Thames, about 50 miles from its mouth, St Paul's Cathedral being 51° 30′ 48″ N. and 0° 5′ 48″ W. The name "London," strictly speaking, belongs only to the City and liberties, and up to the end of the 18th century the distinction was always made between London and Westminster and Southwark, although a larger London included in the "Bills of Mortality" was also officially acknowledged. By Act of Parliament in 1888 the administrative county of London was formed, so that since that date it is legally correct to describe all places included in the county as parts of London. The area of the administrative county (including the City—673 acres) consists of 74,839 acres. This area includes 31,652 acres taken from the geographical county of Middlesex, 23,123 acres from Surrey, and 20,064 acres from Kent. No portion of Essex is included in the county. As the City of London is of greater antiquity than the county of Middlesex, it really never formed a part of Middlesex. The boundary divisions of the administrative county of London are: on the north—Hampstead, St Pancras (including portion of Highgate), Islington, Stoke Newington, and Hackney; on the east—Bow, Bromley, and Poplar; on the south-east—Greenwich, Charlton, Woolwich, and Plumstead; on the south—Eltham, Lee, Lewisham, Camberwell, Lambeth, Streatham, Tooting, Wandsworth, and Putney; on the west—Fulham, Hammersmith, Kensington, and Paddington. The registration county, the area of the School Board, and the metropolitan poor-law area are the same as the administrative county. The Central Criminal Court district contains 269,148 acres. Greater London (consisting of the Metropolitan Police and City Police districts) contains 443,420 acres. The Metropolitan Police district contains the county of London, the whole of the county of Middlesex, and parts of the counties of Surrey, Kent, Essex, and Hertfordshire. The limits of the postal district are regulated by the Postmaster-General.

Parliamentary boroughs.

London is divided for parliamentary purposes into thirty parliamentary boroughs. Those on the *north of the Thames* are—Bethnal Green, Chelsea, City, Finsbury, Fulham, Hackney, Hammersmith, Hampstead, Islington, Kensington, part of Hornsey division of Middlesex, Paddington, St George's Hanover Square, St Marylebone, St Pancras, Shoreditch, Strand, Tower Hamlets, Westminster. Those on the *south of the Thames* are Battersea and Clapham, Camberwell, Deptford, Greenwich, Lambeth, Lewisham, Newington, Southwark part of north-eastern division of Wimbledon district of Surrey, Wandsworth, Woolwich.

The table on the following page gives the population of the parliamentary boroughs for the decennial periods 1881, 1891, and 1901, and the number of houses in 1901, divided between inhabited, uninhabited, and in course of building.

In accordance with the provisions of the London Government Act of 1899, vestries disappeared, and were replaced by borough councils. The first election of borough councils took place on 9th November 1900.

There are twenty-eight metropolitan boroughs in the administrative county of London, including the City of Westminster, but excluding the City of London. The new boroughs, although to a great extent the same as the parliamentary boroughs, are somewhat differently bounded.

Parliamentary Boroughs.	Area in Acres.	Population.			Houses, 1901.		
		1881.	1891.	1901.	Inhabited.	Uninhabited.	Building.
North of the Thames—							
1. City of London . .	673	50,569	37,702	26,923	3,865	6,199	166
2. Bethnal Green . . .	755	126,961	129,132	129,727	14,124	663	61
3. Chelsea	805	88,128	96,253	95,086	11,710	784	18
4. Finsbury (part of) (*a*) .	996	198,077	182,139	164,675	14,233	3,208	122
5. Fulham	1,702	42,900	91,639	137,249	18,521	827	299
6. Hackney . . .	3,929	186,462	229,542	253,291	35,960	1,172	90
7. Hammersmith . .	2,289	71,939	97,239	111,970	15,198	642	91
8. Hampstead . . .	2,247	45,452	68,416	82,329	11,359	787	116
9. Islington	3,108	282,865	319,143	335,238	38,675	1,518	45
10. Kensington . . .	2,188	163,151	166,308	173,073	21,784	1,891	35
11. Middlesex (part of Hornsey division of) (*a*) . .	230	...	16,892	16,703	2,319	62	...
12. Paddington (part of) (*a*) .	1,255	107,058	177,846	127,328	14,995	963	32
13. St George's, Hanover Sq. .	1,121	89,573	78,364	76,734	9,017	1,095	24
14. St Marylebone . . .	1,506	154,910	142,404	132,295	13,466	1,457	131
15. St Pancras . . .	2,672	236,363	234,379	234,912	23,636	1,516	22
16. Shoreditch . . .	648	126,591	124,009	117,706	12,647	1,426	35
17. Strand	613	80,036	64,733	53,297	4,827	1,923	88
18. Tower Hamlets . .	4,092	439,186	451,931	467,259	53,973	2,302	113
19. Westminster . . .	824	60,175	55,774	50,790	4,457	450	42
South of the Thames—							
20. Battersea and Clapham .	3,309	143,642	194,256	223,230	32,125	1,080	328
21. Camberwell (part of) (*b*) .	4,449	205,243	255,344	259,425	36,557	1,279	194
22. Deptford	1,574	76,752	101,286	110,122	15,763	423	91
23. Greenwich . . .	3,842	65,411	78,167	95,578	14,216	439	182
24. Lambeth	3,938	253,699	275,203	298,951	41,192	1,813	146
25. Lewisham . . .	7,006	67,500	88,653	128,346	22,977	1,602	598
26. Newington . . .	631	107,850	115,804	122,172	13,225	487	19
27. Southwark . . .	1,998	221,946	223,549	215,085	23,455	1,789	41
28. Surrey (part of north-eastern division of Wimbledon district of) (*c*) .	...	...	...	...	...	...	...
29. Wandsworth . . .	8,136	66,792	113,244	179,877	29,409	1,862	978
30. Woolwich . . .	8,299	74,963	98,966	117,170	18,083	410	517
Total . . .	74,835	3,833,194	4,308,317	4,536,541	571,768	40,069	4,624

(*a*) Remainder of the parliamentary borough is in the administrative county of Middlesex.
(*b*) ,, ,, ,, Kent.
(*c*) Formerly a detached part of Mitcham civil parish, now part of Tooting Graveney civil parish.

Metropolitan boroughs.

The parliamentary boroughs of the Strand and St George's, Hanover Square, are in the metropolitan borough of Westminster; the one parliamentary borough of Southwark is divided into two metropolitan boroughs—Southwark and Bermondsey; the parliamentary borough of Newington is included in the metropolitan borough of Southwark. The metropolitan borough of Stoke Newington is included in the parliamentary borough of Hackney; the metropolitan boroughs of Poplar and Stepney are included in the parliamentary borough of Tower Hamlets. The average area of the boroughs is a little over 4 square miles, but the areas are very unequal. The smallest metropolitan borough is Holborn, with an area of 409 acres, and the largest, Wandsworth, which consists of 9130 acres. The following is a table of the metropolitan boroughs, with their size in acres and population in 1891 and 1901 :—

North of the Thames.

	Area.	Population 1891.	Population 1901.
City of Westminster .	2502 acres	201,969	183,011
*Bethnal Green . .	759 ,,	128,929	129,680
*Chelsea . . .	660 ,,	72,954	73,842
Finsbury . . .	589 ,,	109,981	101,463
*Fulham	1703 ,,	91,790	137,289
*Hackney .	3289 ,,	199,606	219,272
*Hammersmith .	2286 ,,	97,283	112,239
*Hampstead . .	2265 ,,	68,126	81,942
Holborn . . .	405 ,,	66,781	59,405
*Islington . . .	3091 ,,	319,155	334,991
*Kensington . . .	2291 ,,	170,071	176,628
*Paddington . .	1356 ,,	135,955	143,976
Poplar . . .	2328 ,,	166,880	168,822
*St Marylebone . .	1473 ,,	144,083	133,301
*St Pancras . .	2694 ,,	234,749	235,317
*Shoreditch . .	658 ,,	124,727	118,637
Stepney	1765 ,,	285,116	298,600
Stoke Newington . .	863 ,,	47,988	51,247

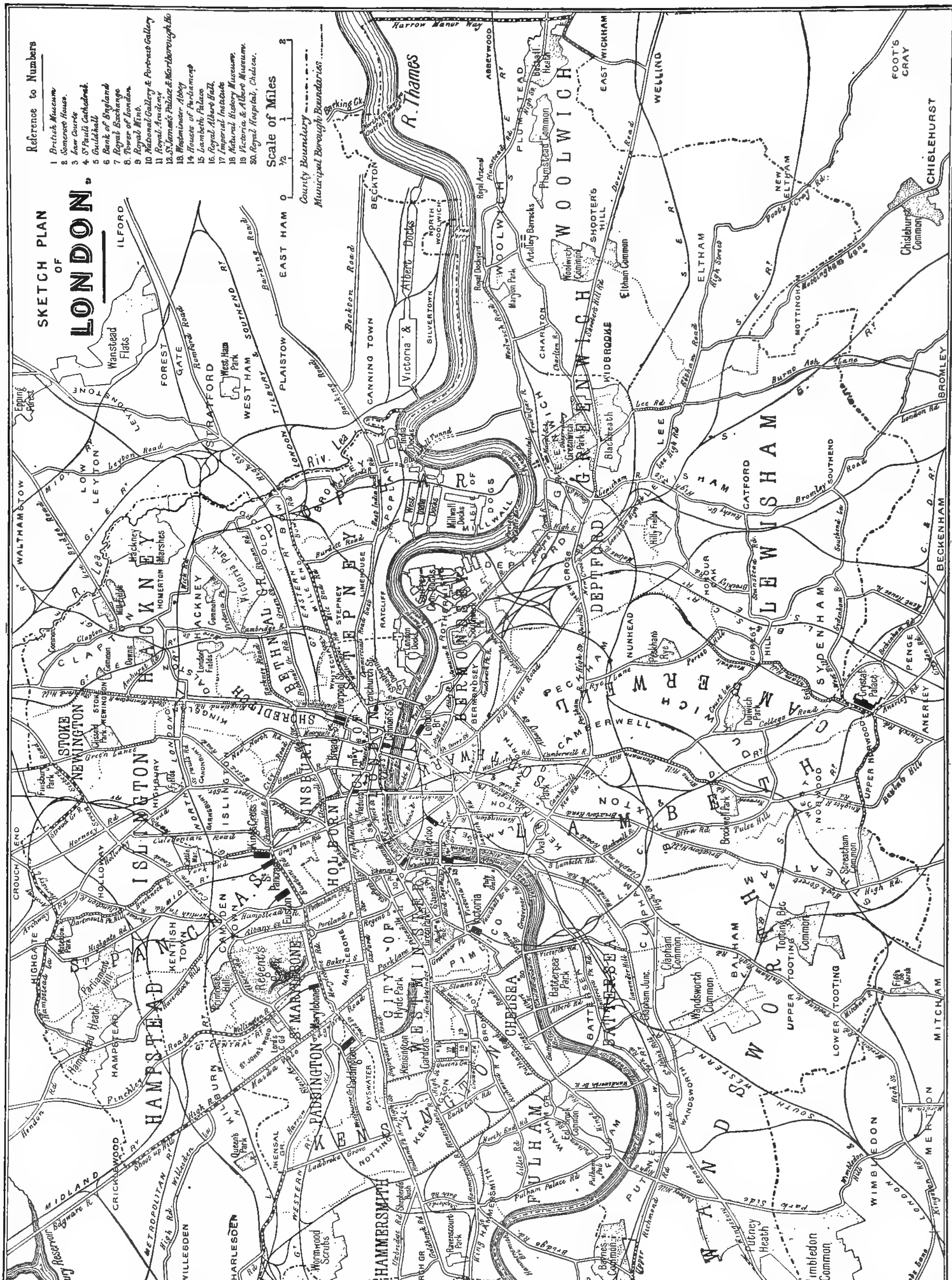
South of the Thames.

	Area.	Population 1891.	Population 1901.
*Battersea . . .	2160 acres	150,166	168,907
Bermondsey . . .	1499 ,,	136,014	130,760
*Camberwell . . .	4480 ,,	233,706	259,339
*Deptford . . .	1563 ,,	101,770	110,398
Greenwich . .	3852 ,,	78,493	95,770
*Lambeth . . .	4080 ,,	278,393	301,895
Lewisham . . .	7014 ,,	88,933	127,495
Southwark . . .	1131 ,,	202,479	206,180
Wandsworth . . .	9130 ,,	155,524	232,034
Woolwich . .	8277 ,,	98,994	117,178

The boroughs to the names of which an asterisk (*) is prefixed consist of single parishes.

Postal districts.

For purposes of convenience the Post Office divided London into eight districts, to which the following letters have been attached :—E.C. (East Central), W.C. (West Central), W. (West), S.W. (South-West), S.E. (South-East), E. (East), N. (North), N.W. (North-West). The following table shows the number of letters delivered and registered, telegrams handed in, and the number of persons employed in the London postal districts for the four years 1896–97 to 1900–01 :—



Sketch Plan of the Administrative County of London, showing the Metropolitan Boroughs.

Year.	Letters Delivered.	Letters Registered.	Telegrams.	Persons Employed.		Total.
				Males.	Females.	
1896–1897	555,200,000	4,999,428	26,645,407	29,688	5013	34,701
1897–1898	590,900,000	4,789,067	27,419,241	30,842	5293	36,135
1898–1899	617,700,000	5,174,092	28,468,242	31,891	5652	37,543
1899–1900	632,600,000	5,555,544	29,971,334	32,185	5956	38,141
1900–1901	664,300,000	5,921,288	29,355,734	33,875	6299	40,174

Telephones.

Up to the year 1901 the National Telephone Company was practically the sole owner of telephone exchange communication in London, although the Post Office owned all the trunk lines connecting the various telephone areas of the company, and also worked a few exchanges outside London. The Select Committee on Telephones, appointed in 1898, reported the same year that "general immediate and effective" competition by either the Government or local authority was necessary. The result of this was that the Post Office was entrusted with the work, and most of the Post Office exchanges are now in working order. The area of the competitive telephone service is about 630 square miles, extending to Romford, Enfield, Harrow, &c. on the north, and to Epsom, Reigate, and Dartford on the south. The service is divided under three headings: A, exclusive lines; B, party lines; C, public call office. The charge under A is for (1) unlimited user and (2) limited user. In the first class £17 per annum for one line and £14 extra for each additional line; in the second class the charge is £4 or £5 per annum, with a charge of 1d. or 2d. a message. Under B the charge is £2 or £3 per subscriber, with the same charge per message as in A. In C the charge is 2d. per message to subscribers on any exchange.

Agriculture.

The total area in London under crops and grass in 1899 was 12,548 acres, and in 1900, 12,054 acres. It was divided as follows:—

Year.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Small Fruit.	Fallow.
1899	629	2456	148	8922	350	43
1900	481	2201	142	8775	351	104

The following figures show the live stock for the same years:—

Year.	Horses.[1]	Cattle.	Cows and Heifers.	Sheep.	Pigs.
1899	805	5866	5467	5846	2607
1900	806	5409	...	2462	2518

In 1870 the value of the land not used for buildings was set down at £118,836, while in 1894 it was estimated at £67,560.

Population.

The population of the area now included in the administrative county of London in 1831 was 1,655,099, but in 1901 the number had risen to 4,536,541. This increase has taken place chiefly in the outer districts, as the central districts have decreased in population. The population of the City in 1801 was 128,129; in 1831 it was 122,491; in 1851, 127,819. Since 1851 the number has uniformly decreased, and in 1901 it stood at 26,923. The decrease in the other central districts between 1851 and 1896 was as follows:—

Holborn	47,000	to	31,000
St Giles's	54,000	,,	38,000
St James's	36,000	,,	23,000
St Martin's	25,000	,,	13,000
St Marylebone	158,000	,,	141,000
Strand	44,000	,,	24,000
Westminster	65,000	,,	53,000

The increase of population in the outer districts between 1851 and 1896 was as follows:—

Battersea	11,000	to	165,000
Camberwell	55,000	,,	253,000
Fulham	12,000	,,	114,000
Greenwich	67,000	,,	176,000
Hackney	54,000	,,	213,000
Hammersmith	18,000	,,	104,000
Hampstead	12,000	,,	75,000
Islington	95,000	,,	337,000
Kensington	44,000	,,	170,000
Lambeth	139,000	,,	295,000
Lewisham	16,000	,,	270,000

These figures are those given by Sir John Wolfe Barry in November 1898, before the creation of the metropolitan boroughs (*Journal Society of Arts*, vol. xlvii. p. 10).

Births, Deaths, and Marriages.

The registration of births, deaths, and marriages is under the direction of the Registrar-General, but is directly carried out by the several boards of guardians, and the figures relating to this subject are to be found in the annual report of the Registrar-General.

The following table shows the marriage-, birth-, and death-rate per thousand of the population, with the percentage of illegitimate births, for a series of years:—

	1870–79.	1880.	1880–89.	1890.	1889–98.	1899.
Marriage-rate	19·2	18·1	17·6	17·6	17·6	18·4
Birth-rate	35·4	35·3	33·7	30·7	30·7	29·3
Death-rate	22·8	21·7	20·5	21·0	19·3	19·4
Percentage of illegitimacy	3·9	3·9	3·9	3·8	3·7	3·6

The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, in 1880, 1890, 1899:—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				Males.	Females.
1880	34,144	133,310	81,832	2627	2546
1890	36,752	128,161	87,689	2492	2410
1899	41,876	133,134	88,063	2495	2254

Emigration and Immigration.

	1891.	1899.	1900.	1901.
Emigrants embarking at the Port of London	29,140	23,329	26,236	25,010
Alien immigrants arriving at the Port of London	17,476	26,840	33,039	29,729

"Emigrants" comprise passengers leaving London for places outside Europe.

Nationality of Aliens arriving at the Port of London.

	1900.	1901.
Russians and Poles	17,939	15,958
Norwegians, Swedes, and Danes	1,226	1,143
Germans	2,818	3,593
Dutch	1,617	1,685
French	468	549
Austrians and Hungarians	2,174	1,724
Italians	241	143
Other nationalities	4,110	2,275
	30,593	27,070
Add seamen	2,441	2,655
	33,034	29,725

The number of foreigners in London in 1891 was 95,063, and in 1901, 135,377.

Poor law.

The total expenditure in London for the relief of the poor, exclusive of the operation of the poor fund, was, according to the return of the Local Government Board, in 1899–1900, £3,446,132. There are thirty-one boards of guardians, five boards of managers of school districts, and two boards of managers of sick asylum districts. The parishes and unions which favour outdoor relief, and which have a majority of paupers in receipt of outdoor relief on their books, are Poplar, Lewisham, Woolwich, Camberwell, Wandsworth and Clapham, St Olave's, Hackney, and Islington. The following have more indoor than outdoor paupers: Whitechapel, St George's-in-the-East, Stepney, Strand, Kensington, Chelsea, and St George's, Hanover Square.

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[1] By horses is meant horses used solely for agricultural purposes, and unbroken horses.

The following table gives the number of paupers:—

	1897–98.	1898–99.	1899–1900.
Indoor paupers . .	58,089	59,259	59,359
Outdoor paupers . .	39,039	38,907	38,987
Vagrants . . .	1,322	1,302	1,297
Pauper lunatics . .	13,784	14,387	14,887
Paupers of all classes .	118,647	120,265	120,912
	1897.	1898.	1899.
Admission to casual wards	181,728	183,138	174,362
Average number on Friday nights—			
Men	815	825	789
Women. . . .	210	216	199
Children . . .	20	23	21
Total . .	1045	1064	1009

The amount spent in London in 1899–1900 on in-maintenance was £920,936; outdoor relief, £223,624; maintenance of lunatics in asylums and licensed houses, £414,963; salaries and superannuation allowances, £767,262; loans repaid and interest, £524,099. The remainder is described as "other expenses of, or immediately connected with, relief." The Metropolitan Asylums Board is a central authority created by the Metropolitan Poor Act of 1867, to provide accommodation for the infectious sick and the harmless insane. There are seventy-three managers, fifty-five of whom are elected by the boards of guardians, and eighteen are nominated by the Local Government Board.

Health. The County Council, as the central health authority of London, is entrusted by the Legislature with important powers of action in default of local sanitary authorities. The death-rate per thousand living in 1900 was 18·6, as against 19·3 in 1899. Of the sanitary districts showing a rate below this there were:—Battersea (17·8), Camberwell (17·0), Chelsea (18·5), Fulham (17·7), Greenwich (18·1), Hackney (16·7), Hammersmith (17·1), Hampstead (11·4), Islington (17·1), Kensington (15·8), Lambeth (18·2), Lee (13·4), Lewisham (14·1), Paddington (16·3), Plumstead (16·0), St George's, Hanover Square (14·5), St James's (15·8), St Martin's-in-the-Fields (17·7), Stoke Newington (13·2), and Wandsworth (14·2). The sanitary districts having the highest death-rates were:—Bermondsey (23·6), Bethnal Green (21·8), Clerkenwell (22·0), Holborn (25·7), Limehouse (26·4), City of London (21·6), Newington (22·4), Poplar (22·6), Rotherhithe (22·9), St George's-in-the-East (24·4), St George's, Southwark (27·3), St Luke's (28·6), St Olave's (21·6), St Saviour's, Southwark (25·6), Shoreditch (22·0), Strand (22·4), and Woolwich (22·1).

The death-rate per thousand living from 1881 to 1900 was as follows:—

1881	21·3	1886	20·6	1891	21·0	1896	18·1
1882	21·5	1887	20·3	1892	20·3	1897	17·7
1883	20·8	1888	19·3	1893	21·0	1898	18·2
1884	20·9	1889	18·4	1894	17·4	1899	19·3
1885	20·4	1890	21·4	1895	19·5	1900	18·6

The following table gives the total births and deaths, and the deaths from zymotic diseases, 1881 to 1900:—

Deaths from Zymotic Diseases and from all Causes, 1881–1900.

Year.	Total Births.	Total Deaths.	Deaths of Infants under One Year.	Deaths from Principal Zymotic Diseases.									Percentage of Deaths from Principal Zymotic Diseases.
				Total.	Smallpox.	Measles.	Scarlet Fever.	Diphtheria.	Whooping Cough.	Fever.	Diarrhœa.	Cholera.	
1881	132,904	81,120	20,907	13,681	475	1501	3073	541	3438	886	3767	...	16·9
1891	134,484	90,595	20,776	9,839	8	1807	598	1435	2872	613	2435	71	10·8
1896	133,833	82,390	21,615	14,046	9	3662	916	2657	2904	598	3207	93	17·0
1897	134,187	81,119	21,286	11,674	16	1909	782	2273	1839	594	4146	115	14·4
1898	132,849	84,154	22,192	12,700	1	3073	582	1766	2160	602	4385	131	15·09
1899	133,134	89,705	22,287	11,394	3	2134	398	1951	1720	811	4225	152	12·70
1900	130,868	86,007	20,927	10,302	4	1936	361	1558	1948	765	3654	76	11·98

Streets. Various attempts to improve the thoroughfares of London have been made since the formation of Regent Street in 1813–20, but they have proved to be quite inadequate to relieve the constantly increasing congestion. The greatest improvement was the construction of the Thames Embankment, which at once restored the river to its proper position as the prominent feature of the town that originally grew up by its shores. The Victoria Embankment, on the north bank, from Blackfriars to Westminster, and the Albert Embankment on the south bank, from Westminster Bridge to Vauxhall, were both opened in 1870. The Chelsea Embankment, on the north bank, from Battersea Bridge to Chelsea Bridge, was finished in 1874. The dates of the chief improvements in the thoroughfares of London during the latter half of the 19th century are as follows:—1854, Cannon Street; 1864, Southwark Street; 1870, Holborn Viaduct; 1871, Hamilton Place, Queen Victoria Street; 1876, Northumberland Avenue; 1882, Tooley Street; 1883, Hyde Park Corner; 1884, Eastcheap; 1886, Shaftesbury Avenue; 1887, Charing Cross Road; 1890–92, Rosebery Avenue. The great improvement of a new road running north to south from Holborn to the Strand is under construction. The chief streets are all too narrow, especially the Strand and Fleet Street. These are being widened, but there seems to be little hope of any adequate relief of the congestion until a drastic system of readjustment is carried out. One of the chief causes of obstruction is due to the crossing of main thoroughfares. Sir John Wolfe Barry, when chairman of the Council of the Society of Arts, proposed in his opening address to the Society in 1899 a series of crossings of east and west, and north and south traffic, by means of bridges over and tunnels under the streets at six of the important places of intersection:—1, Hyde Park Corner; 2, Piccadilly Circus; 3, Ludgate Circus; 4, Oxford Street and Tottenham Court Road; 5, Wellington Street and Strand; 6, Southwark Bridge and Upper Thames Street.

BRIDGES ACROSS THE THAMES.

Property of the Corporation of the City of London.

Tower Bridge (opened 1894).
London Bridge (opened 1831).
Southwark Bridge (opened 1819).
Blackfriars Bridge (opened 1869).

Property of the London County Council.

Waterloo Bridge (opened 1817).
Charing Cross footbridge (opened 1878); the railway bridge is the property of the South-Eastern Railway Company.
Westminster Bridge (opened 1860–62).
Lambeth Bridge (completed 1862).
Vauxhall Bridge (opened 1816; new bridge in course of erection).
Victoria or Chelsea Bridge (opened 1858).
Albert Bridge (completed 1873).
Battersea Bridge (opened 1890).
Wandsworth Bridge (opened 1880).
Putney Bridge (opened 1886).
Hammersmith Bridge (opened 1887).

The bridges referred to as the property of the Metropolitan Board of Works became so under the terms of the Metropolis Toll Bridge Act, 1877 (40 and 41 Vict. c. 99), and on the passing of the Local Government Act, 1888, they were transferred to the London County Council, which expends a sum of £10,000 per annum on their maintenance. Besides bridges, there are several tunnels under the Thames.

Thames Tunnel (2 miles below London Bridge) was commenced in 1825, and opened for public traffic in 1843. It was sold in 1865 to the East London Railway for £200,000. The original cost was over £600,000.

Tower Subway, a tunnel from Tower Hill to Tooley Street, was constructed in 1869–70 at a cost of £16,000. The tunnel is reached at each end by a shaft about 60 feet deep.

Blackwall Tunnel, connecting Poplar with Greenwich, was constructed by the London County Council, in accordance with an Act passed in 1887, at a total cost of £869,476. The tunnel was opened by the prince of Wales, 22nd May 1897. In addition to the cost of making the tunnel, the Council has spent a sum of £350,000 in the acquisition of property, £70,000 in erecting dwellings for persons of the working classes who have been displaced in the carrying out of the scheme, and £64,000 in making the approach roads from Lower Woolwich road to the tunnel. With other minor works and incidental expenses the Blackwall Tunnel Scheme necessitated an expenditure approximating to £1,383,502. The annual cost of maintenance is about £6300.

Greenwich Tunnel (from Greenwich to Millwall). An Act was passed in 1897 authorizing the County Council to construct a subway for the use of pedestrians only, to connect the Isle of Dogs and Greenwich. It was opened in 1902.

Rotherhithe Tunnel (between Rotherhithe and Ratcliff), authorized under local act 1900, was in 1902 under construction.

Woolwich free ferry was constructed under the powers of the Metropolitan Board of Works (Various Powers) Act, 1885, and was opened by the earl of Rosebery on 23rd March 1889. The total cost incurred by the Council in forming and improving the ferry (including the formation of approach roads, river walls, piers, acquisition of land, &c.) and building the ferry-boats was £182,775, and the annual working expenses are £18,405. The number of passengers using the ferry in 1900 was 5,319,070, and the number of vehicles 437,961.

Means of communication.

The chief means of communication from place to place in London are supplied by omnibuses, tramways, railways, and steamboats, the statistics of which are given in the following tables. The average number of omnibuses running during the first half of 1900 belonging to the London General Omnibus Company was 1372, and 480 to the Road Car Company. The number of passengers carried by the London General Omnibus Company in 1900 was 199,575,529; by the Road Car Company in the same year, 64,948,339.

Omnibuses.

	Receipts.	Expenditure.	Gross Profits.
London General Omnibus Company, 1899 . .	£1,205,644	£1,116,357	£89,287
London General Omnibus Company, 1900 . .	1,245,174	1,157,918	87,256
London Road Car Company, 1899 . . .	381,784	337,053	44,731
London Road Car Company, 1900 . . .	383,575	351,364	32,211

Tramways.—When the County Council was formed, there were thirteen tramway companies in existence. The Council set to work to secure possession of these undertakings in virtue of its powers under the Tramways Act of 1870, and will ultimately be in possession of all the tramways of London. There are twelve companies having running powers in the county, with a total length of line—115 miles within, and 33 miles outside the county. The County Council owns 48 miles of line, at present worked by the North Metropolitan Tramways Company, the standard gauge being 4 feet 8½ inches.

The gross receipts and expenditure for the year 1898–99 were as follows:—

Gross receipts	£1,376,148
Total working expenditure . . .	1,086,386
Gross profits	£289,762
Number of passengers in the same year .	294,002,749
Number of miles run by cars ,,	28,699,059
Number of horses	14,114
Number of cars	1,489
Number of omnibuses . . .	111

Electrical tramways and light railways (1901) operated or authorized:—

Barking Town	9 miles
East Ham	10 ,,
London United Tramways . . .	82 ,,

Railways (Metropolitan), 31st December 1899.

	Length of Line in Miles open on 31st Dec. 1899.	Passengers (exclusive of Season and Periodical Tickets).				Holders of Season and Periodical Tickets.	Total Receipts from Passengers.	Receipts (gross) from Goods Traffic.
		1st Class.	2nd Class.	3rd Class.	Total.			
Metropolitan	73	2,877,431	8,151,866	68,943 147	79,972,444	36,594	£743,648	£99,430
Metropolitan District (including Richmond, Ealing, and Fulham Extensions, and Hounslow and Metropolitan) (*a*) .	19	2,838,090	5,961,376	32,712,130(*b*)	41,511,596	26,503	428,402	4,361
Metropolitan and Metropolitan District (City lines and extensions)	2	20,913	111,722	1,274,308	1,406,943	93	35,005	...
North London.	12	660,766	3,248,900	34,429,078	38,338,744	88,505	33,423	35,741

(*a*) The Whitechapel and Bow Railway (2¼ miles), built jointly by, and connecting, the Metropolitan District and the London, Tilbury, and Southend Railways, was opened in June 1902.

(*b*) Including 6,528,701 workmen conveyed at reduced fares.

Electrical Railways in Operation.

City and South London (commenced 1890), 5½ miles; number of passengers (exclusive of season ticket holders) for half-year ended June 1900, 4,169,717.

Waterloo and City (commenced 1898), 1½ miles; number of passengers for half-year ended June 1900, 1,868,737.

Central London (commenced 1900), 6½ miles.

Electrical Railways under Construction or Authorized.

Baker Street and Waterloo .	about 6 miles	constructing
Charing Cross, Euston, and Hampstead	6 ,,	,,
Great Northern and City .	3½ ,,	,,
Brompton and Piccadilly .	2½ ,,	authorized
City and Brixton . . .	4 miles	authorized
Great Northern and Strand .	6¼ ,,	,,
North-West London . .	4¼ ,,	,,

Steamboats.—From various causes, pier dues being the chief, the steamboat service on the Thames has greatly declined. It has been proposed that the service should be undertaken by the London County Council. The London, Westminster, and Vauxhall Steamboat Company established in 1840 a service of seven steamboats between London Bridge and Vauxhall. This company was bought up by the Citizen and Iron Steamboat Companies in 1865. The City Steamboat Company, established in 1848, began with eight boats, and by 1865 had increased their fleet to seventeen, running from London Bridge to Chelsea. This company was taken over by the London Steamboat Company in 1875. The sinking of the *Princess Alice* in 1878 was a serious blow to the London Steamboat

Company, which collapsed, and was succeeded by the River Thames Steamboat Navigation Company, which went into liquidation in 1887. The fleet of thirty-three vessels was bought by a syndicate and sold to the Victoria Steamboat Association. In recent years the service has been run by the Thames Steamboat Company with a fleet of 36 boats, but early in 1902 the Company announced that their service of boats would be discontinued. The County Council in 1902 promoted a Bill in Parliament to empower them to run a service of boats on the Thames, but the Bill was thrown out.

Port of London.

The inadequacy of the dock accommodation for modern ships has long been realized, and London is losing its share of the carrying trade of the country largely from this cause. In 1901 a Royal Commission was appointed "to inquire into the present administration of the Port of London and the water approaches thereto; the inadequacy of the accommodation provided for vessels, and the loading and unloading thereof; the system of charge for such accommodation, and the arrangements for warehousing dutiable goods; and to report whether any change or improvement in regard to any of these matters is necessary for the promotion of trade in the public interest."

The chief authorities concerned in the government of the Port of London are :—

1. *Thames Conservancy.*—For conservancy purposes, regulation of navigation, removal of obstruction, dredging, &c. The area of its jurisdiction differs in limits for various purposes.

2. *City Corporation.*—Port sanitary purposes from Teddington Lock seawards.

3. *Trinity House.*—Pilotage, lighting, and buoying from London Bridge seawards.

4. *The Watermen's and Lightermen's Company.*—The licensing authority for watermen and lightermen.

Besides these authorities, the London County Council, the Board of Trade, the Admiralty, the Metropolitan and City Police, police of riparian boroughs, Kent and Essex Fisheries Commissioners, all the dock companies, and others, play some part in the government and public services of the port.

The Thames Conservancy receipts and expenditure for the year 1900 were as follows :—

Receipts, Lower Navigation	£104,388
,, Upper Navigation	33,640
Expenditure, Lower Navigation	88,806
,, Upper Navigation	38,535

The dock companies are partly consolidated, and the revenues and expenditure for 1899 were :—

Total revenue	£2,311,302
,, expenditure	1,644,999
Balance carried forward towards interest and dividends	£666,303

The Rivers Committee of the London County Council reported in January 1901 on the need of improvement in the Port of London, and recommended (*a*) the deepening and improvement of the Thames on the lines indicated in the report of the Lower Thames Navigation Commission and in the evidence given before the Royal Commission by Sir Alexander Binnie (then the Council's engineer, who estimated the cost at less than £2,000,000 spread over several years); (*b*) the improvement of the docks, their equipment and approaches. The committee further recommended that all administrative control should be absolutely left to a statutory authority to be called "The Port of London Committee," of not more than thirty members, of whom ten should be from the Council, two from the City Corporation, ten should be representatives of the shipowners and merchants, and the other members to be appointed by Government departments.

Food supply.

The wholesale supply of food to London is chiefly carried on through the authorized markets. There are a few retail markets, but these are little more than the informal markets established by costermongers in the public streets. These were formerly more common than at present.

The principal markets are under the administration of the Corporation of the City of London. They are—

London Central Markets at Smithfield (meat, poultry, provisions, fruit, vegetables, flowers, and fish).
Leadenhall Market (meat and poultry).
Billingsgate Market (fish).
Smithfield Hay Market (hay).
Metropolitan Cattle Market at Islington (cattle).
Deptford Cattle Market (foreign cattle).
Coal Market (coal).

The total debt on the City markets on 31st December 1898 was as follows :—

London Central Markets	£1,758,500
Leadenhall Market	247,800
Billingsgate Market	274,500
Metropolitan Cattle Market	396,600
Deptford Cattle Market	21,000
	£2,698,400

There are also three markets either directly or indirectly controlled by local authorities. They are—

Whitechapel Hay Market, under control of trustees; Borough Market, under control of trustees, including the overseers of St. Saviour's, Southwark; Woolwich Market, under control of Woolwich Local Board, now the metropolitan borough of Woolwich.

There are also a few markets in the hands of private owners, namely, Covent Garden and Spitalfields Markets (fruit, vegetables, and flowers); Cumberland Market (hay); and Shadwell Market (fish).

There are also informal and street markets held in various parts of London.

Fish delivered in London.

	1899. Tons.	1900. Tons.
Billingsgate (*a*)	179,983	187,684
Shadwell	11,387	4,004
Total	191,370	191,688
Fish seized and condemned	870	780

(*a*) Farringdon Market is supplied through Billingsgate.

Table of Cattle, Sheep, and Pigs in the London Markets.

Year.	Cattle.					Sheep.					Pigs.				
	Home Supply, Metropolitan Cattle Market.	Foreign Supply.			Total.	Home Supply, Metropolitan Cattle Market.	Foreign Supply.			Total.	Home Supply, Metropolitan Cattle Market.	Foreign Supply.			Total.
		Metropolitan Cattle Market.	Foreign Cattle Market.	Total.			Metropolitan Cattle Market.	Foreign Cattle Market.	Total.			Metropolitan Cattle Market.	Foreign Cattle Market.	Total.	
1880	173,290	50,170	120,196	170,366	343,656	789,010	77,860	658,899	736,759	1,525,769	940	30	23,864	23,894	24,834
1890	119,866	27,039	185,117	212,156	332,022	639,195	38,860	120,802	159,662	798,857	4,728	..	1,169	1,169	5,897
1891	107,188	14,222	154,127	168,349	275,537	727,370	48,960	196,570	245,530	972,900	6,176	..	..	..	6,176
1892	94,244	8,181	140,168	148,349	242,593	735,584	8,230	975	9,205	744,789	4,011	..	..	..	4,011
1893	114,512	..	117,063	117,063	231,575	877,170	..	10,508	10,508	887,678	3,408	..	..	..	3,408
1894	105,332	..	174,884	174,884	280,216	772,310	73,120	62,835	135,955	908,265	625	..	..	..	625
1895	102,645	40	150,928	150,968	253,613	610,470	132,270	230,202	362,472	972,942	2,972	..	2	2	2,974
1896	82,195	.	211,551	211,551	293,746	639,110	890	284,537	285,427	924,537	5,642	..	..	..	5,642
1897	80,413	.	224,831	224,831	305,214	594,585	..	288,560	288,560	883,145	4,550	..	..	..	4,550
1898	80,245	..	222,853	222.853	303,098	538,160	..	351,204	351,204	889,364	1,535	..	450	450	1,985
1899	86,701	..	168,069	168,069	254,770	546,960	..	297,200	297,200	844,160	20	..	..	..	20
1900	81.570	..	170,752	170,752	252,322	494,410	..	159,786	159,786	654,196	6,670		..	..	6,670

Open spaces.

London has always been famous for its squares and open spaces, but with the immense increase in the area it has been difficult to keep pace with the needs of the enormous population, and large districts are deficient in open spaces. In the county of London the area of commons consists of 2162 acres, of parks and gardens 1654 acres, and of royal parks 1249 acres. The royal parks are St James's Park and Green Park; Hyde Park and Kensington Gardens; and Regent's Park. Among the chief open spaces under the control of the London County Council may be mentioned Battersea Park (opened 1858); Blackheath (transferred 1871); Bostal Heath, &c. (purchased 1877–94); Brockwell Park (purchased 1890); Clapham Common (rights purchased 1877); Clissold Park (purchased 1889); Dulwich Park (presented to the Metropolitan Board of Works by Dulwich College); Finsbury Park (1857); Hampstead Heath, Golder's Hill, and Parliament Hill (1871–99); Lee, open space (1902); Peckham Rye Park, Plumstead Common (1878); Southwark Park (1864); Streatham Common, Tooting Bec, and Tooting Graveney Common (1873–75); Victoria Park (1842); Wandsworth Common (1871); Waterlow Park, Highgate (1892); Wormwood Scrubbs (1879).

Besides these parks, commons, &c., there are the gardens of the Thames embankments, playgrounds, disused churchyards, &c. The London County Council are anxious to preserve wild birds in London, and in January 1900 they obtained from the then Home Secretary (Sir M. W. Ridley, afterwards Viscount Ridley) an order for wild birds' protection (county of London), which was given in pursuance of powers conferred upon the Home Secretary by the Wild Birds' Protection Acts, 1880–96. The order protects birds and their eggs in the various London pastures under penalties.

Cemeteries within the County of London.

	Size in Acres.	Date of first Interment.
Abney Park, Stoke Newington	32	1840
Battersea (St Mary's)	8½	1860
Brompton or West London	38	1840
Camberwell, Peckham Rye	29½	1856
Charlton, S.E.	8	1855
City of London and Tower Hamlets	33	1841
Deptford (St Paul's) Mile End, Lewisham	17	1858
Fulham	12½	1865
Greenwich	15	...
Greenwich Hospital, Westcombe, S.E.	6	1857
Hammersmith	16½	1869
Hampstead (Fortune Green)	19¼	1876
Highgate (St James's)	38	1839
Kensal Green (All Souls')	69¾	1833
,, St Mary's Roman Catholic	30	1858
Lambeth (Tooting Graveney)	41	1854
Lee, Hither Green, S.E.	10	1873
Lewisham	15½	1858
Norwood (South Metropolitan)	40	1838
Nunhead (All Saints')	50	1840
Plumstead, S.E.	32¼	1890
Putney (St Mary's)	3	1855
Wandsworth	12	1878
Woolwich	32	1856

The total acreage of London cemeteries is 608¾.

Buildings.

The most important change made in the heart of London has been caused by the destruction of a large district in order to form the new road north of the Strand to Holborn. The destruction of Holywell Street has made the widening of the Strand a possibility, and the north side of that thoroughfare from the courts of law to Wellington Street has been entirely altered. The chief of the newly-constructed buildings have been hotels and theatres. No feature of London life has undergone so radical change of late years as that connected with the improvement of hotels and the supply of palatial buildings such as the Cecil, the Carlton, and the Hotel Russell in Russell Square. The rebuilding of Her Majesty's Theatre and the construction of the Carlton Hotel to form one architectural whole has made a great change in the Haymarket and Pall Mall. In these alterations the well-known opera colonnade has disappeared. The increase of comfort in the newest London theatres has been very marked, and Her Majesty's Theatre stands at the head of the theatres of London on account of the improved arrangements for the accommodation of the public. Another marked change in the appearance of the streets has been caused by the building of flats in all parts of London.

Public baths.

Twenty-five boroughs have adopted the Baths and Wash-houses Acts. In seventeen of these boroughs the Acts are in force throughout the whole borough, and in eight the Acts are only in force in parts of the borough.

The number of bathers and washers at the public baths and wash-houses during 1897–98 reached a total of 5,090,990; of these, 4,463,109 were bathers, and the remaining 627,881 were women who used the wash-houses. The number of bathers was made up as follows:—

Bathers in private baths—		
1st class	650,338	
2nd class	1,697,620	
		2,347,958
Bathers in swimming baths—		
1st class	705,456	
2nd class	1,409,695	
		2,115,151
		4,463,109

The expenditure on water forms a considerable item in the accounts of baths and wash-houses authorities. The total cost of water supplied at twenty-six establishments which were open during the year 1897–98, and which were supplied wholly by one or other of the eight companies, was £12,522. In no case in London is an establishment carried on so as to produce a surplus, though there are many instances where the actual deficit is less than the charge in respect of the repayment and interest on debt. Prior to the rebuilding of the Marylebone Baths in 1895, there was a surplus for several years, which was paid over to the relief of the rates. There was no actual charge on the rates for the year 1897–98 in respect of either St James's, Westminster, or St George's-in-the-East establishments, but there were deficits to the extent of £660 and £184 respectively, which were met by corresponding decreases in balances.

The following is a summary of the receipts and expenditure for 1897–98 of the thirty-four authorities administering the Baths and Wash-houses Acts in London:—

Expenditure.

Interest and repayment of loans	£62,563
Buildings—Repairs, rents, rates, and taxes, &c.	16,881
Working Expenses—Coals, gas, water, salaries, &c.	78,927
Total expenditure	£158,371

Receipts in Aid.

Tickets sold—Baths, £55,991; Laundries, £14,027	£70,018
Various—Soap, soda, towels, &c.	5,293
Total receipts in aid of expenditure	£75,311
Resulting charge falling on rates	£83,060

The public and domestic lighting of London has been

Lighting.

long in the hands of the Gas Companies, but since 1886 a large number of electric light companies have come into existence. At the end of 1901, 15 local authorities and 16 companies possessed statutory powers to supply electricity. The following table gives some statistics of the electricity supplies of the various local authorities and companies which were in working order in 1900–01; that is to say, in the case of the borough councils up to 31st March 1901 and the companies till 31st December 1900:—

	Number of Customers.	Supply commenced.	Number of Units sold.			Amount of Loans outstanding.
			Public.	Private.	Total.	
Borough Councils—						
Fulham (1901)	170	June 1901	...	...	...	...
Hammersmith	847	June 1897	288,524	914,259	1,202,783	£139,456
Hampstead	2060	Oct. 1894	179,562	1,579,585	1,759,147	119,884
Islington	578	Jan. 1896	1,135,236	1,188,821	2,324,057	322,600
Poplar	176	Oct. 1900	130,200	74,119	204,319	99,058
St. Pancras	1438	Nov. 1891	712,095	2,296,386	3,008,481	239,913
Shoreditch	676	June 1897	561,751	1,695,258	2,257,009	202,208
Southwark	179	July 1899	175,047	309,384	484,431	55,500
Stepney	Information not available	Dec. 1899	202,759	360,321	563,080	78,831
Companies—						Capital raised.
Blackheath and Greenwich	342	Feb. 1900	...	...	161,778	£158,972
Brompton and Kensington	2395	Jan. 1889	...	...	1,494,106	208,305
Charing Cross and Strand	3049	1891	139,921	4,857,260	4,997,181	500,000
Chelsea	2241	Sept. 1889	...	...	1,672,026	370,968
City of London	9855	Dec. 1891	1,200,000	11,272,968	12,472,968	1,666,453
County of London and Brush Provincial—						
County of London (North)	Information not available	Sept. 1897	...	...	...	900,000
,, ,, (Northern Extensions)		Mar. 1898	...	...	1,976,651	
Holborn and St Giles's		1899	...	...	...	
Camberwell	Information not available	July 1899	...	...	...	
Southwark		July 1899	...	...	1,013,487	
Wandsworth		Jan. 1897	...	...	...	
Crystal Palace District	250	Feb. 1893	...	...	268,657	103,519
Kensington and Knightsbridge	2324	Jan. 1887	...	...	2,630,482	265,000
London	Information not available	1885	...	...	3,546,461	832,200
Metropolitan	Information not available	1889	...	...	9,855,175	1,397,185
Notting Hill	1191	May 1891	...	...	782,215	172,000
St James's and Pall Mall	2137	April 1889	143,027	4,984,748	5,127,775	450,000
South London	751	Nov. 1899	...	...	928,131	325,000
Westminster	5572	Nov. 1890	...	...	7,281,109	797,600
Woolwich District	150	Sept. 1893	...	...	253,651	35,000

Electric lighting is also carried out by companies and local authorities in districts immediately around the county of London, as Acton, Barking, Ealing, Harrow, West Ham, Wimbledon, &c.

Mr A. H. Preece's paper on "The Electricity Supply of London" read before the Institution of Civil Engineers in 1898 (*Proceedings*, vol. cxxxiv. pp. 121–205) contains a large amount of information up to the date of its publication, but the years 1900 and 1901 are specially memorable for the large increase in the supply of electrical power.

Gas.—Gas is supplied mainly by three companies—the Gas Light and Coke Company, the South Metropolitan Company, and the Commercial Company. Some other companies supply the outer districts of the county. Gas has to be supplied at sixteen-candle illuminating power, and is officially tested by the Chemists' department of the County Council.

Gas Companies, 1899.

Company.	Capital paid up at end of Year.		Price per 1000 Cubic Feet.		Length of Mains.	Number of Consumers on 31st Dec.	Profits.
	Share.	Loan.					
	£	£	s.	d.	Miles.		£
Gas Light and Coke	22,685,840(*a*)	4,434,175(*a*)	3 2	0 (*b*) 1 (*c*)	2044	353,740	1,262,895
South Metropolitan	6,072,971(*a*)	1,795,160(*a*)	2	1	930	189,618	353,181
Commercial	813,441(*a*)	238,287(*a*)	2	6	279	34,823	109,130
Brentford	848,880(*a*)	162,300(*a*)	2	11	312	39,959	91,797
Crystal Palace	621,931(*a*)	97,651(*a*)	2	6	144¾	24,654	38,478
Hornsey	145,206(*a*)	36,301	3	0	63	6,517	14,743
Mitcham and Wimbledon	116,567(*a*)	25,000	3	8	85	4,267	14,518
Wandsworth and Putney	198,222(*a*)	22,674	2	2	75	12,626	19,708
Total	31,503,058	6,811,548	...		3,932¾	666,204	1,904,450

(*a*) Including premiums. (*b*) North of Thames. (*c*) South of Thames.

Crime.

The chief courts for the trial of criminal cases are, in London, the Central Criminal Court (which takes the place of the Assizes in the provinces) and the Court of Quarter Sessions. There are twelve sessions of the central criminal court in the year, while the sittings of the court of quarter sessions are held thirty-six times in the year. The inferior criminal courts are the courts of summary jurisdiction or police courts.

The following table shows the number of crimes known to the police, 1893–99, and the number of persons apprehended for indictable and non-indictable offences:—

Year.	Average Daily Strength of Police.	Crime known to Police.	Indictable Offences.			Non-indictable Offences.			Persons apprehended.						Total Number apprehended.
			Persons summoned.	Persons apprehended.	Total.	Persons summoned.	Persons apprehended.	Total.	Offences Summarily determined.			Persons committed			
									Convicted or held to bail.	Discharged.	Total.	Convicted.	Acquitted and Bills ignored.	Total (*a*)	
1893	14,074	23,294	243	15,172	15,415	60,534	72,592	133,126	57,770	23,747	81,517	2758	486	3244	84,761
1894	14,099	23,480	208	15,045	15,253	60,701	76,534	137,235	59,718	25,196	84,914	2654	519	3180	88,107
1895	14,260	22,115	208	14,049	14,257	58,669	75,083	133,752	58,222	24,329	82,551	2636	528	3183	85,763
1896	14,282	20,817	241	13,729	13,970	70,498	80,109	150,607	60,965	26,459	87,424	2396	518	2920	90,423
1897	14,336	21,081	218	13,973	14,191	71,154	91,860	163,014	71,727	27,696	99,423	2454	578	3035	102,525
1898	14,412	22,060	196	15,162	15,358	81,756	105,195	186,951	83,854	29,617	113,471	2659	569	3234	116,778
1899	14,647	20,502	171	14,192	14,363	88,966	105,254	194,220	85,054	27,249	112,303	2522	541	3072	115,550

(*a*) The difference is made up of persons who absconded or died while awaiting trial.

Police.—The following table shows the condition of the metropolitan police force on 31st December 1899, as compared with the previous year:—

	Employed on Special Duties.		Employed on Ordinary Duties.		Total Force.	
	1898.	1899.	1898.	1899.	1898.	1899.
Superintendents	4	5	27	27	31	32
Inspectors	54	52	524	519	578	571
Sergeants	203	210	1,727	1,739	1,930	1,949
Constables	1600	1662	11,555	11,551	13,155	13,213
Total	1861	1929	13,833	13,836	15,694	15,765

Accounts for the Year 1900–01.

	Metropolitan.	City.
Expenditure	£2,159,641	£157,689
Receipts in aid.	398,272	10,577
Amount borne by Corporation estates	...	42,091
Net expenditure falling on taxation .	1,761,369	105,021
Expenditure falling on the rates .	840,932	105,018
Rates raised	914,344[1]	113,105

Education. The total number of *elementary* day schools on the 31st August 1900 was 975, of which 484 were board and 491 voluntary, made up of 342 National Church of England, 16 Wesleyan, 101 Roman Catholic, 32 British and others. The average number of attendances was 616,918.

The expenditure of the School Board for London, for the year ended 25th March 1900, was £3,387,666 (an increase on the previous year of £182,554), leaving a balance for the year of £312,182. The rate levied was 13·37d. for the entire year.

The Board of Education was formed under the provisions of the Board of Education Act, 1899. On the 6th of April 1900 the Board issued a minute, which was approved by Parliament, enabling the Board to recognize a new class of public elementary schools termed "higher elementary schools."

The report of the Board of Education, 1900–01, deals with *secondary* education, which is divided under technical instruction and science and art instruction. The Board is authorized to inspect any school supplying secondary education and desiring to be so inspected.

Considerable changes have been made in the foundation schools of London. St Paul's School has been removed to Hammersmith, Charterhouse School to Godalming (Merchant Taylors' School taking its place at Charterhouse), King's College School to Wimbledon, Christ's Hospital to Horsham, and the City of London School to Victoria Embankment.

Examinations in technology have been conducted by the City and Guilds of London Institute for the Advancement of Technical Education for several years. In 1880 the number of subjects was 24; the number of centres of examination, 89; and the number of candidates, 816. In 1899 the number of subjects had increased to 63; the number of centres to 397; and number of candidates to 14,004. The number of registered classes in 1899 was 1764, and of students in attendance, 34,176. The gross expenditure in 1899 was £33,720, of which £12,229 was expended on the Central Technical College; £9835 on the Technical College, Finsbury; £7272 on the Leather Trades School; and £1204 on administration. The net cost, after deducting students' fees, was £22,373.

The University of London was first incorporated by Royal Letters Patent, dated 28th November 1836. It had hitherto been an examining body for conferring degrees, but was reorganized in 1900 in accordance with statutes and regulations drawn up by the Royal Commission appointed under the University of London Act, 1898. It now undertakes teaching as well as examination, and is divided into the faculties of theology, arts, law, music, medicine, engineering, and economics and political science. The governing body consists of the senate (including chancellor, vice-chancellor, and chairman of convocation), and 54 appointed members. The University has been removed from Burlington Gardens to the Imperial Institute, South Kensington, the eastern wing and central portion of which have been transferred to the University. Accommodation for examinations in physics and chemistry will be found in the new buildings of the Royal College of Science.

Museums, &c.—The Victoria and Albert (late South Kensington) Museum, and Bethnal Green Branch Museum; the Museum of Practical Geology, Jermyn Street; the Geological Survey of the United Kingdom; and the committee of Solar Physics, are dealt with in the Report of the Board of Education, 1899–1900, in connexion with secondary education.

British Museum and Natural History Museum, South Kensington. The Parliamentary vote for 1901–02 was for the Bloomsbury establishment, £151,686; and for Natural History Museum, £62,121.

The Royal United Service Institution has been removed from Whitehall Yard to the Banqueting House, Whitehall.

Art.—National Gallery and Tate Gallery, Parliamentary vote, 1901–02, £24,808. The Tate Gallery or National Gallery of British Art, Millbank, was opened in 1897, and extended in 1899. Wallace Gallery, Hertford House, Manchester Square, was opened 1900; the Parliamentary vote, 1901–02, was £32,313. The National Portrait Gallery in St Martin's Place was opened in 1896; the Parliamentary vote, 1901–02, was £7760. Leighton House, 2 Holland Park Road, Melbury Road, Kensington, presented to the nation by Lord Leighton's sisters, contains 370 original drawings, paintings, and studies by Lord Leighton; open daily. Exhibitions of pictures are held at the Royal Academy, Burlington House, Piccadilly; the New Gallery, 121 Regent Street (established 1888); the Grafton Gallery, Grafton Street, built 1893; the Fine Art Society, 148 New Bond Street; the Art Gallery of the Corporation of London, Guildhall, established in 1885, &c., &c. There are also a large number of Art Societies which hold exhibitions.

Statues erected in London since 1882.

Anne (Queen), St Paul's Churchyard, after Bird by Boehm.
Boadicea, Victoria Embankment, Westminster.
Burns (Robert), Victoria Embankment Gardens.
Carlyle (Thomas), Chelsea Embankment Gardens.
Cromwell (Oliver), Old Palace Yard.

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[1] Including Government contribution under the Agricultural Rates Act.

Forster (Rt. Hon. W. E.), M.P., Victoria Embankment Gardens.
Frere (Sir Bartle), Victoria Embankment Gardens.
Gordon (General), Trafalgar Square.
Strathnairn (Field-Marshal Lord), Knightsbridge.
Raikes (Robert), Victoria Embankment Gardens.
Tyndale (William), Victoria Embankment Gardens.
Victoria (Queen), Blackfriars Bridge.
Wellington (Duke of), Hyde Park Corner.
Wesley (John), graveyard of the City Road Chapel.

(For *London Fire Brigade*, see FIRE.)

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GOVERNMENT AND ADMINISTRATION.

The revolution effected in London administration by the legislation of 1888 and 1899 is intelligible only in the light of the history of the local government of the district now known as the county of London before the year 1888. Until 1855 there can hardly be said to have been a system of local government for London outside the City (as to the City, see the earlier volumes of the *Encyclopædia Britannica*, 9th ed., xiv. 818). For a distance of many miles outside the City there was a belt of very thickly populated country, governed, as in the most rural and most sparsely populated districts, by the inhabitants of the parish in vestry assembled, except where the parishes had availed themselves of the provisions of Hobhouse's Act (1 and 2 Will. IV. c. 60), and had elected a select vestry. The vestry (whether open or select) had, however, no powers of what is known as town management. To meet the needs of particular localities, commissioners or trustees having powers of town management were from time to time created by local Acts. The chaos resulting from this piecemeal legislation is summarized in Sir B. Hall's speech on introducing the Metropolis Management Bill in 1855 (*Hansard*, vol. cxxxvii. pp. 705, 899). From his speech it appears that in 1855 the number of local Acts in force in the metropolis was 250, administered by not less than 300 different bodies; the number of persons serving on these bodies was computed at 10,448. These persons were either self-elected, or elected for life, or both, and therefore in no degree responsible to the ratepayers. In addition there were two bodies having jurisdiction over the whole metropolis except the City,—the one being the officers appointed under the Metropolitan Building Act of 1844, and the other the Metropolitan Commissioners of Sewers, appointed under the Commissioners of Sewers Act, 1848. Neither body was responsible to the ratepayers. To remedy this chaotic state of affairs, the Metropolis Management Act, 1855, was passed. Under that Act a vestry elected by the ratepayers of the parish was established for each parish in the metropolis outside the City. The vestries so elected for the twenty-two larger parishes were constituted the local authorities. The fifty-six smaller parishes were grouped together in fifteen districts, each under a district board, the members of which were elected by the vestries of the constituent parishes. Woolwich, which had previously become a local government district under a local board, was left untouched, and therefore not subject to the law applicable to the rest of the metropolis. A central body, styled the Metropolitan Board of Works, having jurisdiction over the whole metropolis (including the City) was also established, the members of which were elected by the Common Council of the City, the vestries and district boards, and the local board of Woolwich. Further, the area of the metropolis for local government purposes was for the first time defined, the area adopted being the same as that included in the Commissioners of Sewers Act, 1848, which in its turn had been taken from the area of the weekly bills of mortality. To the Metropolitan Board of Works was assigned the duty of constructing and maintaining the main drainage of London, in which work they superseded the old Commissioners of Sewers; the Board was also given certain powers of supervision over the vestries and district boards, and by an Act of the same session was constituted the central authority for the administration of the Building Acts. The vestries and district boards became the authorities for sewering (except so far as related to main drainage), and for paving, lighting, repairing, and maintaining streets and highways, and for the removal of nuisances, superseding the commissioners and trustees created by local Acts, the surveyors of highways, and (by an amending Act 19 and 20 Vict. c. 112) all existing vestries, whether open or select. The City of London remained as before a county of a city governed by an unreformed Corporation. Between 1855 and 1888 many additional powers and duties were conferred on the Metropolitan Board of Works and on the vestries and district boards. The constitution of the Board of Works, however, was open to objection on the ground that the system of election was indirect in the case of all its members and doubly indirect in the case of those elected by the district boards, and the sense of responsibility was proportionately weakened. Some of its acts were open to such suspicion that a Royal Commission was appointed to inquire into certain matters connected with the working of the Board.

Act of 1888.

An attempt was made in 1884 by Sir William Harcourt to constitute the metropolis a municipal borough under the government of a single council, to which it was proposed to transfer the existing powers of the Metropolitan Board of Works and of the vestries and district boards, and the administrative powers of justices. But it was not until 1888 that the next step in advance towards the solution of the problem of London local government was definitely taken. The Local Government Act of that year dealt with the area of the metropolis as if it were a separate county, both for administrative and for non-administrative purposes. For non-administrative purposes—quarter sessions, justices, militia, coroners, sheriffs, &c.—so much of the counties of Middlesex, Surrey, and Kent as lay within the metropolis (or in other words, the whole of London exclusive of the City) was constituted a county at large, with an organization corresponding to that of other counties in England, except so far as that organization is modified by the existence of the central criminal court, the metropolitan police, the metropolitan police courts and their magistrates, and a paid chairman of quarter sessions. The position of the City as a county of a city was left almost untouched, except that the right of appointing a sheriff for Middlesex was taken away. For administrative purposes the whole of the metropolis, including the City, was constituted an administrative county, having, as in other counties, a county council as the central administrative body, differing only from other county councils in that the number of councillors and the electoral divisions were fixed by the Act, and that the aldermen number not less than one-sixth, instead of one-third, of the councillors. The total number of councillors is 118, four members being elected for the City, and two for each of the other parliamentary boroughs and divisions in London. The City for administrative purposes was treated as quarter sessions boroughs with a population exceeding 10,000 were treated elsewhere in England, the powers of the council of a borough of that class being either transferred or reserved to the Common Council. To the County Council, in addition to the administrative powers conferred on it as on the councils of other counties, there were transferred the extensive powers of town government previously vested in the Metropolitan Board of Works, including not only direct administrative functions, but also various powers of control over the action of the subordinate local authorities. Most of the powers so transferred were exercisable only outside the City, but some (for example, main drainage) extended to the area of the City. How great these powers were may be appreciated from the following summary of what the defunct Board had effected. It had "constructed a main drainage system at a cost of more than six millions and a half; embanked the Thames; freed most of the bridges from toll; constructed vast arteries of street communication; established and maintained a metropolitan fire brigade; provided and maintained 2603 acres of parks and open spaces free to the public for ever; exercised a controlling jurisdiction over the half-million buildings of London; cleared vast insanitary areas; and in many other ways discharged under more than 120 Acts of Parliament important municipal functions in London." The County Council thus not only obtained large powers of town government over the whole area of the administrative county with the exception of the City, but also powers and functions within the City which no other county council exercises in a borough lying within its administrative area. On the other hand, the Corporation of the City retained rights and powers which by ancient privilege or special legislation extended beyond the area of the City and applied to or affected the whole of London, such, for instance, as market rights and powers as to foreign cattle and as port sanitary authority. The area within which these powers were exercisable was not curtailed, and their exercise connects the City with the administrative county of London in a way in which no ordinary borough is connected with the administrative county in which it lies. In spite of these anomalies, the broad fact remains that under the Act of 1888 the inhabitants of the metropolis acquired for the first time a direct control over the most important matters of municipal work. But in another direction the Act was confessedly incomplete in dealing both with the county of London and with the other counties of England. It contemplated the establishment by some future Act of subsidiary district councils in London and elsewhere. This intention was carried into effect as respects all places outside London by the Local Government Act, 1894. But the framers of that Act were content, in respect of London, with abolishing the property qualification of vestrymen, extending the franchise to all parochial electors, and removing the right of the incumbents of parishes to be *ex officio* chairmen of vestries.

Act of 1899.

The larger and more wealthy parishes became discontented with the form of local government to which they remained subject. The evil associations which still cling to the terms "vestry" and "vestryman" perhaps deterred the persons best qualified from seeking seats on the governing body. Accordingly in 1897 Kensington and Westminster petitioned to be created boroughs by the grant of charters under the Municipal Corporations Acts. But these Acts are inapplicable to London, and to make them applicable special legislation would have been required. It was then decided that, in constituting new local authorities in London, it would be advisable to follow the lines indicated by the report of the Commissioners appointed in 1893 to inquire into the conditions under which the amalgamation of the county and City could be effected, and that the form of local government should be homogeneous throughout London outside the City, and that it would be inexpedient to have boroughs dotted about here and there in London, as would have been the result of the grant of charters under the Municipal Corporations Acts. The result of this decision is embodied in the London Government Act, 1899. This Act divided London into twenty-eight districts of very various sizes, ranging, at the date of the passing of the Act, in population between 336,764 and 50,377, in area between 9106 acres and 409 acres, in rateable value between £4,977,802 and £320,089. Each of these districts is called a metropolitan borough—a terminology which may cause difficulties and misconceptions in the future, the term "borough" having hitherto been (in reference to local government) a term of art, meaning a borough under the Municipal Corporations Acts. One of the most notable features of the Act is the revival of the old city and liberties of Westminster, embracing the parishes of St Margaret and St John, St George Hanover Square, St James's, St Martin-in-the-Fields, the district of the Strand Board of Works, and the close of the Collegiate Church of Westminster. This large area, with a rateable value exceeding that of the City, is formed into a single metropolitan borough. Each borough is governed by a council consisting of a mayor, aldermen, and councillors, the number of aldermen being one-sixth of that of the councillors. The qualifications and mode of election of the mayor and aldermen are assimilated to those of the chairman and aldermen of county councils. The franchise is left unaltered, and in other respects the law relating to the vestries is applied to the new councils (except that women are disqualified for holding office either as mayors, aldermen, or councillors). Woolwich is brought into line with the other districts in London. The accounts of the new councils are made subject to Government audit. To the new councils are transferred all the powers of the old vestries and district boards, of the commissioners of public libraries and baths and wash-houses, and of burial boards, and certain minor powers of the London County Council. A few additional powers and duties, including a power to promote and oppose Bills in Parliament, are given to and imposed on the new councils. Power is also given to the Local Government Board to transfer in the future, by provisional orders, powers and duties from the County Council to the borough councils and from the borough councils to the County Council, but the consent of the County Council and of a majority of borough councils is necessary in every case. A similar power of transfer similarly exercisable is given with respect to the powers and duties of the County Council and the Common Council of the City.

The Act leaves the City practically untouched, but a local Act passed in 1897 abolished the old Commissioners of Sewers for the City and vested their powers and duties in the Corporation of the City, acting through the Common Council. The Common Council thus became the sanitary authority for the City. The coal duties leviable by the Corporation were abolished in 1889 by 52 and 53 Vict. c. 17.

Much has been done to simplify and systematize the local government of London, but it remains anomalous, and perhaps from the nature of the case it must be anomalous. As the supreme authority there is a County Council which exercises, in addition to the powers of an ordinary county council, various powers of town government exercisable elsewhere by the councils of boroughs; in the centre is the City, an area governed by an unreformed Corporation exercising the powers exercisable elsewhere by the councils of quarter sessions boroughs of over 10,000 inhabitants, but also having some powers which extend far beyond the City area; the rest of the county is divided into boroughs, which are not boroughs in the ordinary acceptation of the word, and whose constitution resembles in some respects municipal boroughs, in others county councils, and in others urban district councils.

Powers.—In distributing powers between the central and local authorities the principle observed has been to give all powers and duties which require uniformity of action throughout the whole of London to the County Council, and powers and duties that can be locally administered to the local authorities, uniformity in some cases being secured by giving the County Council power to regulate the administration by by-laws. Of late the tendency has perhaps been to give to the County Council powers which might with advantage have been given to the local authorities. However, the conference of representatives of the local authorities which was held in 1895–96 to discuss what powers might be transferred from the County Council to the local authorities, found but few, and these comparatively unimportant, which could be so transferred. The Act of 1899 carried into effect such of the recommendations of this conference as were approved by the County Council. The result is that the County Council is the authority to deal with the following matters:—main sewers, tramways, embankments and the prevention of floods, fire brigade, metropolitan commons, parks and open spaces (with a few exceptions), the naming and numbering of streets, the formation and width of new streets, the line of frontage in streets, the pollution of rivers (except the Thames and the Lea), the licensing of theatres (except those within the jurisdiction of the Lord Chamberlain), music halls and racecourses, technical instruction, the making of by-laws as to the rule and good government of London as to overhead wires, &c., *bridges, *locomotive traffic, *street improvements, *constant water supply, *infant life protection, *storage &c. of petroleum and explosives, *contagious diseases of animals, *coroners, *gas testing, *asylums, *reformatory and industrial schools, *shop hours, *weights and measures testing, *dangerous and neglected structures, *the housing of the working classes, *common lodging houses, *licensing of offensive trades and slaughter-houses. This list does not pretend to be complete. A useful summary of the powers of the County Council will be found in Appendices VII. and IX. of the report of the Unification Commission in 1894 (C. 7493 II.), and in the report of the conference of local authorities referred to above. The matters marked with an asterisk are in the City under the control of the Common Council. The Common Council of the City and the new metropolitan borough councils are the authorities for paving, lighting, cleansing, and watering streets, for making and maintaining the local sewers, for removing nuisances, for providing and maintaining public libraries, baths and wash-houses, and burial grounds, and for acting generally as the sanitary authorities; they can also exercise concurrently with the County Council some of the powers of that Council.

Expenditure.—The performance of such numerous and important functions involves heavy expenditure. The following table shows the sums expended by the various authorities on the municipal administration of London in 1898–99, and the manner in which such expenditure was met:—

Authority.	Expenditure.	Receipts in Aid from			Amounts Raised by Rates.
		Imperial Taxation.	Indirect Local Taxation.	Other Sources.	
	£	£	£	£	£
County Council . . .	2,511,315	130,895	520,505	341,648	1,519,303
Metropolitan Asylums Board	603,686	*nil*	*nil*	1,810	635,450
Metropolitan Police (London proportion) . . .	1,588,714	653,223	31,769	281,633	671,630
City Corporation . . .	732,421	*nil*	153,365	503,054	125,914
Sanitary Authorities (including the Common Council of the City)	3,533,188	*nil*	7,451	554,386	*a* 2,831,191
Commissioners of Baths and Wash-houses and Public Libraries and Burial Authorities	206,463	*nil*	36,667	69,629	100,175
Total . . .	9,175,787	748,118	749,757	1,752,160	5,883,663

(*a*) Of this sum £947,075 was defrayed out of the county rate.

Besides the annual expenditure, large sums have been borrowed to defray the cost of works of a permanent nature. The debt of London, like that of other municipalities, has considerably increased, and shows a tendency to go on increasing. Of the tables in the next column, the first shows the total amounts raised for various purposes by the Metropolitan Board of Works and the London County Council, and the second, the state of indebtedness of those authorities at the time when the powers of the former were transferred to the latter and at the close of the financial year 1898–99.

The net liabilities of the County Council, after deducting assets, on 31st March 1899 were £21,562,018; of this amount the sum of £2,131,576 represented remunerative expenditure. In 1899 the indebtedness of the Corporation of the City was £5,750,983; of the vestries and district boards, and of the local board of Woolwich, and of burial boards and commissioners of baths and wash-houses and public libraries, £4,802,519.

Amounts Raised.

	Main Drainage.	Street Improvements and Embankments.	Bridges, Subways, &c.	Housing of Working-Classes.	Parks and Open Spaces.	Fire Brigade.
	£	£	£	£	£	£
Metropolitan Board of Works, 1856–88	6,779,525	15,363,374	2,351,305	1,549,176	650,646	487,606
London County Council, 1889–98	1,188,755	1,292,423	1,640,406	1,029,600	765,476	471,368
Total . .	7,968,280	16,655,797	3,991,711	2,578,776	1,416,122	958,974

State of Indebtedness.

Date	Total Amount raised.	Loans to Other Authorities outstanding.	Amount Applied to repay Debt.	Net Liability after deducting Assets.
	£	£	£	£
31st Dec. 1888	37,449,728	8,723,986	9,659,806	16,972,469
31st Mar. 1899	51,617,488	16,760,480	10,784,750	21,562,018

Rates.

In addition to the provisions already noticed, the London Government Act, 1899, simplifies administration in two respects. The duties of overseers in London have been performed by most diverse bodies. In some parishes overseers were appointed in the ordinary manner; in others the vestry was, by local Acts and by orders under the Local Government Act, 1894, appointed to act as, or empowered to appoint, overseers; in others local Acts constituted various statutory bodies to perform the functions of overseers, whilst in Chelsea the guardians acted as overseers. The Act of 1899 swept away all these distinctions, and constituted the new borough councils in every case the overseers for every parish within their respective boroughs, except that the town clerk of each borough performs the duties of overseers with respect to the registration of electors.[1] Again, with regard to rates, there were in all cases three different rates leviable in each parish—the poor rate, the general rate, and the sewers rate—whilst in many parishes in addition there was a separate lighting rate. From the sewers rate and lighting rate, land, as opposed to buildings, was entitled to certain exemptions. Under the Act of 1899 all these rates are consolidated into a single rate, called the general rate, which is assessed, made, collected, and levied as the poor rate, but the interests of persons previously entitled to exemptions are safeguarded. Further, every precept sent by an authority in London for the purpose of obtaining money which has ultimately to be raised out of a rate within a borough is sent direct to the council of the borough instead of filtering through other authorities before reaching the overseers. The only exceptions to this rule are (1) precepts issued by the Local Government Board for raising the sums to be contributed to the metropolitan common poor fund; and (2) precepts issued by poor-law authorities representing two or more poor-law unions: in both these cases the precept has of necessity to be first sent to the guardians. With the object of equalizing rates in different parts of London, the richer parts are required under various enactments to contribute towards the expenses of the administration of the poorer parts. By the Metropolitan Poor Act, 1867, the metropolitan common poor fund, to which each union in London contributes in proportion to its rateable value, was established. Out of this fund certain expenses of guardians in connexion with the maintenance of indoor paupers and lunatics, the salaries of officers, the maintenance of children in poor-law schools, valuation, vaccination, registration, &c., are paid. The payments amounted in 1898–99 to £1,336,986. Under the Local Government Act, 1888, the County Council makes grants to boards of guardians, sanitary authorities, and overseers in London in respect of certain services. This grant is in lieu of the grants formerly made out of the Exchequer grant in aid of local rates, and amounted in 1898–99 to £566,738. Finally, in 1894, the fund called the Equalization Fund was established. This fund is raised by a rate of 6d. in the £ levied annually on the whole county of London, and redistributed amongst the sanitary authorities on the basis of population. It amounted in 1898–99 to £915,118. The amount of parish, union, and district expenses so paid out of rates levied on the whole of London (including a small grant by the Metropolitan Asylums Board) was in 1898–99 £2,822,735, equal to about 27·2 per cent. of the local expenditure raised by rates; and out of a total of £10,401,441 raised by rates, £7,363,829 was raised by rates levied over the whole county. But, in spite of these attempts at equalization, rates remain very unequal in London, and varied in 1899 between 5s. 3d. in St James's, Westminster, and 8s. 8d. in Rotherhithe.

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[1] Over 200 local Acts have been repealed by schemes made under the Act of 1899.

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SANITATION.

Special conditions in London.

The original statutes relating to public health applied to London equally with the rest of England, but when in 1875 these statutes were consolidated and amended, London was expressly excluded from the scope of the new Act, and remained under the old law. The law applicable to London was consolidated and amended in 1891, and differs from that in force elsewhere mainly in three directions:—(1) The London County Council is a central sanitary authority, and as such deals with main drainage, the housing of the working classes, infant life protection, contagious diseases of animals, common lodging-houses and shelters, and other matters where uniformity of administration is essential or desirable. (2) The County Council to a certain extent controls and supervises the work of the local sanitary authorities for the purpose of promoting uniformity and efficiency of administration. Uniformity of administration is promoted by means of the by-law-making power of the Council. The Council may make by-laws regulating the construction of local sewers, and the construction, cleansing, and repair of all pipes, drains, &c.; as to sanitary conveniences, cesspools, and ashpits; prescribing the times for the removal of fæcal or offensive matter and refuse; regulating offensive businesses, slaughter-houses, and dairies; and for the prevention of nuisances not otherwise preventible by the local authorities. Efficiency of administration is promoted chiefly in two ways. The Council not only appoints a medical officer of health for the whole county, but pays half the salaries of the medical officers of health and the sanitary inspectors of the local authorities. The Council may also act where local sanitary authorities[1] make default with respect to the removal of any nuisance, the institution of any proceedings, or the enforcement of any by-laws, and may make representations to the Local Government Board as to the failure of the local authorities to perform their duties. Further, if the Local Government Board are satisfied that a local sanitary authority has failed to perform its duties, the Board may direct the County Council to withhold the whole or any part of any payment due to the authority under the Equalization of Rates Act, 1894. (3) The Metropolitan Asylums Board, though originally established in 1867 as a purely poor-law authority for the relief of sick, insane, and infirm paupers in London, has since become a central hospital authority for infectious diseases, having power to receive into its hospitals persons, who are not paupers, suffering from fever, smallpox, or diphtheria. The Metropolitan Asylums Board and the County Council have also, for the purpose of the epidemic regulations, such powers and duties of a sanitary authority as may be assigned to them by those regulations.

For the purpose of the local administration of the sanitary laws London is divided into sanitary districts, each district being under the jurisdiction of a local sanitary authority having, subject to the above-mentioned limitations, much the same powers as sanitary authorities elsewhere in England. The City and the various metropolitan boroughs are the sanitary districts, and the Corporation (acting through the Common Council) and the metropolitan borough councils constitute the local sanitary authorities.

Drainage.

The system of main drainage inaugurated by the Commissioners of Sewers in 1849, and carried out by the Metropolitan Board of Works from 1856 to 1888, has since 1889 been maintained, completed, and improved by the London County Council. The most important improvement effected by the latter body has been the erection of pumping machinery and stations in low-lying localities to prevent flooding in times of storm. The London main sewers receive, besides the sewage from London, that from West Ham, Penge, Tottenham, and Wood Green, and from parts of Beckenham, Hornsey, Croydon, Willesden, East Ham, and Acton. The length of the main intercepting sewers in London now exceeds 87 miles; their construction has cost nearly eight million pounds. The systems on the north and south of the Thames are distinct. The sewage on the north side is dealt with at the Barking outfall works, that on the south side at Crossness. The sewage at these outfall works is treated with lime and proto-sulphate of iron. By means of this treatment the sewage is transformed into a clear innocuous effluent and sludge. The effluent is allowed to flow into the Thames, the sludge is taken fifty miles out to sea, a service on which six sludge ships are constantly employed; the sludge so carried amounted to 2,344,000 tons in 1898–99. The total amount of sewage treated exceeds 76,876,250,000 gallons a year, and the annual cost of the maintenance of the main drainage system (exclusive of any charge for the payment of interest or repayment of capital) approaches £200,000. The sanitary authorities are concerned only with the supervision of house drainage and the construction and maintenance of local sewers discharging sewage into the County Council's main sewers.

The London County Council have pursued (as did their predecessors the Metropolitan Board of Works) an active policy under the Artisans' Dwellings and Housing of the Working Classes Acts, having from 1856 to 1898 incurred a capital expenditure of £2,578,776 for the purpose. Under Part I. of the Act of 1890 (which consolidated the previous enactments) large insanitary areas may be cleared and accommodation provided for the labouring classes displaced; Part II. makes similar provisions with respect to smaller areas; Part III. enables accommodation to be provided for the working classes irrespective of displacement. Schemes under Part I. are carried out by the County Council, schemes under Part II. by either the County Council or by the local sanitary authority, usually with a contribution from the Council to the local authority or *vice versâ*, as the case may be. Part III. may be adopted either by the County Council or the local sanitary authority. The following table gives the details as to the principal schemes carried out or in course of being carried out:—

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[1] This power may not be exercised in the case of the City.

Housing.

Improvement Schemes under the Artisans' and Labourers' Dwellings Improvement Acts and the Housing of the Working Classes Act in London.

Name of Scheme.	Commenced.	Estimated Net Cost.	Actual Net Expenditure to Date.	Persons displaced.	Persons for whom Accommodation is provided.
By Metropolitan Board of Works:—		£	£		
Whitechapel and Limehouse	1876	54,400	151,763	3,669	3,600
Goulston Street, and Flower and Dean Street	1877	147,773	279,491	4,004	3,702
St George-the-Martyr, Southwark	1877	33,353	52,443	1,266	1,906
Bedfordbury, St Martin's-in-the-Fields	1877	63,995	75,510	797	720
Great Wild Street, St Giles's	1877	49,540	105,650	1,903	1,620
Pear Tree Court, Clerkenwell	1877	5,050	20,869	410	1,362
Whitecross Street, St Luke's	1877	98,786	314,943	3,687	3,740
High Street, Islington	1877	7,960	38,187	547	800
Old Pye Street, Westminster	1877	5,830	49,896	1,333	1,700
Bowman's Buildings, Marylebone	1878	40,700	36,458	806	1,288
Essex Road, Islington	1878	77,100	97,899	1,796	3,866
Little Coram Street, St Giles's and St Pancras	1879	58,890	13,488	858	840
Wells Street, Poplar	1879	71,047	64,119	1,029	1,392
Great Peter Street, Westminster	1879	7,500	212	179	532
Windmill Row, Lambeth	1883	21,400	9,778	459	460
Tabard Street, Newington	1884	16,100	8,229	220	288
Totals	...	759,424	1,318,935	22,963	27,816
Begun by M.B.W., completed by L.C.C.:—					
Tench Street, St George's-in-the-East	1883	28,100	51,991	1284	(*a*)
Brook Street, Limehouse	1883	18,480	19,617	562	306
Trafalgar Road, Greenwich	1883	18,500	17,285	378	306
Hughes Fields, Deptford	1884	61,000	80,386	1786	906
Castle Street, Shadwell	1886	46,300	40,834	970	796
Shelton Street, St Giles's	1886	55,550	68,269	1208	616
Totals	...	227,930	278,382	6188	2930
By the L.C.C. under Part I. of the Housing of the Working Classes Act, 1890:—					
Boundary Street, Bethnal Green	1890	300,000	...	5,719	5,524
Churchway Street, St Pancras	1895	51,650	...	1,095	708
Clare Market, Strand	1895	216,500	...	3,172	2,250
Garden Row, &c., St Luke's	1899	144,850	...	1,193	1,296
Webber Row, &c., St George-the-Martyr, Southwark	1899	152,950	...	903	1,750
Aylesbury Place and Union Buildings, Clerkenwell, Holborn	1899	189,800	...	1,402	1,400
Barford's Court, &c., Poplar	1899	13,300	...	269	269
(*b*) Nightingale Street, Marylebone	1899	6,000	...	576	576
By the L.C.C. under Part II. of the Housing of the Working Classes Act, 1890:—					
Brooke's Market, Holborn	1891	(*c*) 5,950	...	55	60
Mill Lane, Deptford	1892	(*c*) 39,500	...	715	959
Ann Street, Poplar	1893	(*c*) 8,800	...	261	475
Falcon Court, Borough	1895	(*c*) 15,500	...	800	678
Totals	...	2,132,154	...	55,283	46,691

Note.—The above figures as to cost represent the net cost of clearing the land only, *i.e.*, the cost of the land less its value for housing purposes.
(*a*) Site devoted to purposes of an open space.
(*b*) To be carried out at the expense of Lord Portman.
(*c*) The local authority concerned contributes one-half the net cost.

The County Council in 1899 passed a resolution in favour of providing dwellings under Part III. of the Act apart from the re-housing required in connexion with clearance and improvement schemes, provided that no charge was placed on the county rate thereby. Seven schemes under this part of the Act have already been, or are in the course of being carried out by the County Council. Under the Totterdown Fields scheme it is proposed to provide accommodation for 11,000 persons, and under the Millbank Estate scheme for 4434. It is estimated that the rents received will be sufficient to repay the interest on the capital expended, and the sinking fund charges.

The provisions of the Infectious Diseases (Notification and Prevention) Acts, which for London are embodied in the Public Health (London) Act, 1891, are carried out by the local sanitary authorities, but the hospitals for the reception of infectious cases are provided and maintained by the Metropolitan Asylums Board. In the execution of this duty the Board has established eleven hospitals (including a convalescent hospital) with accommodation for 4500 patients, and two hospital ships and a convalescent hospital at Darenth for the treatment of 1500 smallpox cases. The admissions to the Board's hospitals in 1898 numbered 21,063. The Board also maintains an ambulance service for infectious diseases

Infectious diseases.

throughout London; the mileage run of this service in 1898 was 214,677 miles. The Board's expenditure on the common charges account was, in 1898–99, £603,686, in addition to the sums contributed by the various boards of guardians in London for the maintenance of patients chargeable to their several unions. It is impossible to distinguish what proportion of the sum of £603,686 should be classified as sanitary expenditure and what as expenditure on poor relief.

The other duties of sanitary authorities, such as the removal of nuisances, scavenging, the cleansing of streets, and the like, are performed by the local sanitary authorities. The efficiency with which these bodies have performed their duties varies enormously. It is difficult, however, to discover any criterion by which to gauge their respective efficiency, especially as their accounts have hitherto not been made up on any uniform principle. But, speaking broadly, the tendency has distinctly been towards a better administration of the law. The number of sanitary inspectors appointed has steadily grown, and in 1898 reached 256, an increase of thirty as compared with the previous year.

Conservancy.

The Thames Conservancy Board, originally constituted in 1857 and reconstituted in 1866, was further remodelled in 1894. The Board under the Act of 1894 (57 and 58 Vict. c. 187) now contains nominees or representatives of the Admiralty, the Board of Trade, the Trinity House, the Corporation of the City, the London County Council, the councils of the counties and chief boroughs through which the river flows, ship-owners, owners of barges, lighters, and tugs, dock-owners, wharfingers, and the metropolitan water companies. The Act of 1894 further enlarged the powers of the Board, chiefly by extending their control of pollution to the whole watershed of the river. Much has been done by the Board to purify the Thames by the detection and prohibition of sources of pollution. So far has the purification proceeded that a project has been initiated for the reintroduction of salmon into the river. The Lea has been similarly improved under the Lea Conservancy Board. The chief sources of impurity have been removed by the reception into the London sewers (under the Lea Purification Act, 1886, and the Wood Green Sewage Act, 1891) of the sewage from Tottenham and Wood Green.

See *Annual Reports of the Local Government Board.* London, annually since 1872.—*Annual Reports of the Proceedings of the London County Council.* London, annually since 1889.—*Annual Reports of the Medical Officer of Health of the Administrative County of London.* London, annually since 1889.

WATER SUPPLY.

In spite of the reports of many commissions and committees recommending that the water supply of London should be improved and vested in a body representative of the consumers, and in spite of various attempts to carry such recommendations into effect, the eight metropolitan water companies still maintain their position, and the Thames and the Lea remain the chief sources of supply.[1]

In the case of a provincial town the transfer of the water undertaking of a company to the corporation is a comparatively simple matter, even if the corporation is in consequence authorized to supply water to a small district outside their borough. In London the problem is complicated by the fact that of the area of 620 square miles within which the eight companies are authorized to supply water only 121 square miles are within the county of London, and of the 5,814,219 persons supplied by the companies in 1898 only some 4,526,500 resided in London. Consequently the efforts of the London County Council to purchase the undertakings of the companies have been opposed not only by the companies, but also by the councils of the surrounding counties, parts of which are within what is known as "Water London." These councils demand that, in the event of the purchase by the London County Council of the companies' undertakings, not only the means of distribution within their respective areas should be made over to them, but also that a portion of the sources of supply should be allotted to them, so that they should not be dependent on the London County Council for their water supply. The London County Council is pledged, in the event of the Council purchasing the undertakings of the companies, to make such an apportionment. But the Royal Commission presided over by Lord Llandaff reported that "although severance of the works and sources of supply of the several companies, and the division thereof between the councils of the six counties within the limits of supply, are not actually impracticable, they would be very difficult and highly undesirable." Many attempts have also been made to solve the difficulty by constituting a body representative of the various authorities interested, but such attempts have met with but little favour. Lord Llandaff's Commission proposed the creation of a Water Trust as the only method by which the purchase of the water companies could be effected. The price to be paid to the companies constitutes another obstacle to purchase. The companies contend that they should be bought out on the same terms as have almost invariably been given to water companies in the provinces, that is to say, that the price to be paid should be settled by agreement, and failing agreement, by compulsory arbitration under the Lands Clauses Acts. The London County Council, on the other hand, contend that the price so fixed would be exorbitant, and that in assessing the value of the undertakings regard should be had to the prospective liability of the companies to provide new works and new sources of supply, and that no allowance should be made for compulsory sale. To the present sources of supply objection is taken both on the ground of the quality and of the quantity of the water derived from those sources. By the construction of subsidence reservoirs and filter-beds much has of late years been done to improve the quality of the London water, and the Commission presided over by Lord Balfour of Burleigh in 1893 reported that, though not blind to the fact that the provisions as to filtration and subsidence differed enormously in different companies, and in some were quite inadequate, they considered that the water as supplied to the consumer in London was of a very high standard of excellence and purity. And this opinion was endorsed by Lord Llandaff's Commission. Both these Commissions also came to the conclusion that if the present sources of supply were utilized to their utmost by the construction of large storage reservoirs, 420,000,000 gallons daily might be drawn from them, whilst leaving a sufficient supply of water for the navigation of the Thames and Lea. This would supply 35 gallons a head to 12,000,000 persons, and would suffice till 1941. Doubt has been thrown on the conclusions of the Balfour Commission as to the capacity of the present sources, but the Llandaff Commission accepted their conclusions. Both Commissions pronounced in favour of a scheme for the construction of large storage reservoirs in the Thames valley at an estimated cost of from £9,000,000 to £10,000,000. This scheme has already been begun to be carried out by three of the companies, the New River Company, the West Middlesex Company, and the Grand Junction Company, which are jointly constructing large storage reservoirs at Staines. The London County Council, on the other hand, is in favour of bringing the necessary additional supply from Wales, and it has for the past few years yearly introduced Bills authorizing the Council to acquire two large catchment areas in Wales, and to impound the head-waters of the Wye, the Towy, and the Usk. The part of the County Council's scheme which would give approximately the same amount of water as the Thames valley scheme is estimated to cost something over £10,000,000, but if the accumulated interest during the construction of the works and for pumping charges is taken into account, it would bring the cost up to over £15,000,000. This cost, in the opinion of Lord Llandaff's Commission, was prohibitive.

The system of constant supply has been extended almost universally throughout "Water London," but the droughts in the summers of 1895 and 1898 compelled the East London Company to suspend the supply of water between certain hours during several months in each of those years. As during the same period some of the other companies had a surplus of water beyond their own requirements, an Act was passed in 1899 (62 and 63 Vict. c. 7) providing for the interconnexion of the systems of the various companies, and for the supply of water from one company to another.

Parliament has lately imposed stringent restrictions on the raising of new capital by the companies. Since 1878 the increase of share capital has in no case been authorized; further capital, if required, has to be raised by the issue of debenture stock, the debenture stock has to be sold by public auction, and the premiums, if any, realized by the sale applied as capital money. Again, since 1886 a clause, known as the sinking fund clause, has been inserted in all Bills authorizing the creation of new capital. Under this clause a certain percentage on the new capital has annually to be paid by the company to the Chamberlain of the

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[1] A Bill was introduced by the Government in 1902, in order to constitute a water board, and to transfer to the board the undertakings of the metropolitan water companies.

City, who accumulates the money so paid to him with a view to providing a fund for the ultimate purchase of the undertakings of the companies. The funds in the hands of the Chamberlain of the City from this source amounted in 1901 to over £70,000. A Committee of the House of Commons reported in 1896 that the insertion of such provisions in the Acts of the companies tended to weaken the enterprise of the companies as private concerns, whilst the consumer was left without that care of his interests which would be ensured by placing supply under a representative body.

Of the accompanying tables, the first shows the financial condition of the water companies in 1880, 1888, and 1898; the second affords a comparison between the supply, &c., of the companies in 1898, as compared with the figures given in vol. xiv. p. 825.

Finances of London Water Companies.

Date.	Ordinary Capital.	Preference and Loan Capital.	Total Capital.	Total Capital Expenditure.	Income.	Working Expenses.	Dividends.
	£	£	£	£	£	£	
1880–81	9,087,917	3,448,981	12,536,898	12,612,589	1,532,784	610,899	921,885
1888	10,042,915	4,101,408	14,144,323	14,488,464	1,743,171	647,682	903,144
1898	10,258,568 30,000*a*	6,453,716 3,492,464*a*	16,712,284 3,522,464*a*	17,507,838	2,248,974	974,290	982,164

(*a*) Authorized but not raised.

Details of Supply.

Date.	Authorized Daily Supply from Thames.	Average Daily Supply from Thames.	Other Sources.	Number of Houses supplied.	Houses on Constant Supply.	Estimated Population supplied.	Capacity of Subsidence Reservoirs.	Acreage of Filter Beds.	Miles of Mains in London.	Miles of Mains constantly supplied.
	Gallons.	Gallons.	Gallons.				Gallons.			
1880	110,000,000	68,000,000	72,000,000	622,000	186,000	4,600,000	1,264,350,000	46 (*a*)	2707	750
1898	185,500,000	117,382,448	86,671,507	871,949	799,782	5,814,219	2,548,600,000	131½	3480	1793 (*b*)

(*a*) Filtered storage. (*b*) Number of miles of streets in which mains constantly supplied are laid.

AUTHORITIES.—CRIPPS. *The Position of the London Water Companies.* London, 1892.—RICHARDS and PAYNE. *London Water Supply.* London, 1899.—CLIFFORD. *History of Private Bill Legislation.* London, 1885.—*Report* (*with Minutes of Evidence*) *of the Committee of the House of Commons on the Metropolis Water Supply Bills.* London, 1852.—*Report* (*with Minutes of Evidence and Appendices*) *of the Royal Commission on Water Supply.* London, 1869.—*Report* (*with Minutes of Evidence and Appendices*) *of the Royal Commission appointed to inquire into the Water Supply of the Metropolis.* London, 1893.—*Final Report* (*with Minutes of Evidence and Appendices*) *of the Commissioners appointed to inquire into the Water Supply within the Limits of the Metropolitan Water Companies.* London, 1899. (See also WESTMINSTER.) (F. F. L.)

London, a city and port of entry of Middlesex county, Ontario, Canada, situated 105 miles south-west of Toronto, on the river Thames and on the Grand Trunk, Canadian Pacific, and Lake Erie and Detroit River Railways. It has an electric street railway, and does a large wholesale trade in dry goods, groceries, &c., and export trade in manufactures, live stock, and farm produce. Two hospitals, a normal school, and collegiate institute are among the newer public buildings. The factories had in 1898 an output valued at $8,726,170, and employed 6000 hands. Total assessment in 1902, $18,350,360; acreage within the city limits, 4478 acres; exports in the year 1898–99, $1,490,989; imports, $3,883,805. Population (1881), 19,746; (1891), 31,977; (1901), 37,981, or, including suburbs of London Junction and Ealing, 45,000.

Londonderry, a maritime county of Ireland, province of Ulster.

Population.—The area of the administrative county in 1900 was 513,388 acres, of which 176,663 were tillage, 219,269 pasture, 367 fallow, 4484 plantation, 25,944 turf bog, 4232 marsh, 58,352 barren mountain, and 24,077 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, does not include the city of Londonderry, now a separate county. The population in 1881 was 164,991; in 1891, 152,009; and in 1901, 144,329, of whom 69,013 were males and 75,316 females, divided as follows among the different religions: Roman Catholics, 65,308; Presbyterians, 45,828; Protestant Episcopalians, 27,687; Methodists, 1440; and other denominations, 4066. The decrease of population between 1881 and 1891 was 7·87 per cent., and between 1891 and 1901, 5·1 per cent. The average number of persons to an acre in 1891 was ·29 of the total population, and 109,168 persons inhabited the rural districts, being an average of 187 persons to each square mile under crops and pasture. The following table gives the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R.C.	Pr.Ep.	Presb.	Meth.
Read and write	47,737	48,397	96,134	60·5	71·0	81·3	91·2
Read only .	8,567	12,546	21,113	17·6	16·9	12·5	5·0
Illiterate .	9,220	10,283	19,503	21·9	12·1	6·2	3·8

The percentage of illiterates among Roman Catholics in 1881 was 27·3. In 1891 there were 16 superior schools with 995 pupils (Roman Catholics, 174, and Protestants, 821), and 296 primary schools with 18,411 pupils (Roman Catholics, 7032, and Protestants, 11,379). The number of pupils on the rolls of the National schools on 31st December 1900 was 23,521, of whom 10,000 were Roman Catholics and 13,521 Protestants. The following table gives the births, deaths, and marriages:—

Year.	Births.	Deaths.	Marriages.
1881	4199	3106	800
1891	3574	2810	772
1900	3219	2828	797

In 1900 the birth-rate per thousand was 22·3, and the death-rate 19·6; the rate of illegitimacy was 3·8 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 102,776, of whom 57,926 were males and 44,850 females. The chief towns in the county are Londonderry (39,873 in 1901), Coleraine (6929 in 1901), Limavady (2692 in 1901).

Administration.—The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1901 being respectively 10,175 and 8922. The rateable value in 1899 was £414,755. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises two urban and four rural sanitary districts.

Agriculture.—The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900:—

Year.	Wheat.	Oats.	Barley, Beans, Rape, &c.	Potatoes.	Turnips.	Flax.	Other Green Crops.	Meadow and Clover.	Total.
1881	1817	74,668	3102	34,437	12,491	18,940	3389	38,047	186,891
1891	1114	69,090	1896	30,236	14,249	11,920	2535	43,829	174,869
1895	697	72,788	1809	30,370	14,743	13,621	1438	47,667	183,133
1900	1084	68,471	1838	28,681	15,153	8,284	3123	50,029	176,663

For 1900 the total value of the cereal and other crops was estimated at £1,403,629. The number of acres under pasture in 1881 was 203,483; in 1891, 202,986; and in 1900, 219,269.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	20,776	462	96,693	30,161	23,946	4666	368,436
1891	21,631	535	111,860	70,540	38,091	6694	459,452
1895	22,212	594	112,148	61,229	39,576	5664	526,122
1900	20,766	696	114,279	67,321	34,417	5736	588,349

The number of milch cows in 1891 was 42,077, and in 1900, 41,176. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £1,595,918. In 1900 the number of holdings not exceeding 1 acre was 1484; between 1 and 5, 1497; between 5 and 15, 5129; between 15 and 30, 4570; between 30 and 50, 2298;

between 50 and 100, 1459; between 100 and 200, 426; between 200 and 500, 124; and above 500, 32—total, 17,019. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901 was 5319, amounting to £1,282,266. The number of loans for agricultural improvements sanctioned under sec. 31 of the Land Act, 1881, between 1882 and 1901, was 147, and the amount issued £10,815. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1901 was £75,157.

Fisheries.—In the deep-sea and coast fishery districts of Moville (co. Donegal) 211 boats were registered in 1900, employing 891 hands. In the salmon fishery district of Coleraine, on the river Bann, 784 persons were employed in the same year. (W. H. PO.)

Londonderry, a maritime city, county and parliamentary borough (returning one member), on the river Foyle, 144 miles north-north-west of Dublin. It is an extensive railway centre, being served by the Great Northern, the Belfast and Northern Counties, and the Londonderry, Letterkenny, and Lough Swilly railways, all of which are in direct connexion with the harbour. The Protestant cathedral was enlarged and restored in 1887, and has now a length of 140 feet, exclusive of the tower and vestibule. Shirt-making is the chief industry, and it is estimated that £500,000 is annually expended in wages. The harbour, which is under the jurisdiction of the Irish Society, has now a depth of 33 feet of water at high tide and 12 feet at low tide. The number of vessels registered in the port in 1900 was 22 of 10,323 tons. In the same year the total number of vessels that entered was 1554 of 297,352 tons; 928 of 185,959 tons cleared. The total foreign and colonial imports, which included 1,102,300 cwts. of maize, amounted to £329,932. There are valuable salmon fisheries on the Foyle, which in 1900 employed 891 persons. In 1898 Londonderry was constituted one of the six county boroughs which have separate county councils. Population (1881), 29,162; (1891), 33,200; (1901), 39,873. The rateable value in 1900 was £99,887.

Long Branch, a city of Monmouth county, New Jersey, U.S.A. It is on the east coast, a short distance south of New York Bay, and is reached by lines of the Pennsylvania and the Central of New Jersey railways, and, in the summer, by steamboats from New York. It is a very popular seaside resort. The city lies back from the edge of a cliff, 25 to 30 feet high, at the foot of which extends a magnificent beach five miles in length. Most of the city is built on Ocean Avenue, which follows the edge of the cliff and forms a drive five miles long. The city contains many fine private residences, several large hotels, and multitudes of boarding-houses. Population (1880), 3833; (1890), 7231; (1900), 8872, of whom 1431 were foreign-born and 987 were negroes.

Longford, an inland county of Ireland, province of Leinster.

Population.—The area of the administrative county in 1900 was 257,770 acres, of which 62,953 were tillage, 140,427 pasture, 129 fallow, 3595 plantation, 30,642 turf bog, 4842 marsh, 1511 barren mountain, 13,671 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 61,009; in 1891, 52,647; and in 1901, 46,581, of whom 23,765 were males and 22,816 females, divided as follows among the different religions:—Roman Catholics, 42,669; Protestant Episcopalians, 3406; Presbyterians, 251; Methodists, 194; and other denominations, 61. The decrease of population between 1881 and 1891 was 13·70 per cent., and between 1891 and 1901, 11·5. The average number of persons to an acre in 1891 was 0·20, and of the total population, 48,820 inhabited the rural districts, being an average of 155 persons to each square mile under crops and pasture. The following table shows the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R. C.	Pr.Ep.	Presb.	Meth.
Read and write	16,938	15,991	32,929	67·0	89·0	92·7	96·3
Read only .	3,192	3,586	6,778	15·0	5·4	1·9	1·6
Illiterate . .	4,110	3,962	8,072	18·0	5·6	5·4	2·1

The percentage of illiterates among Roman Catholics in 1881 was 24·8. In 1891 there were 4 superior schools, with 92 pupils (all Roman Catholics), and 117 primary schools, with 7597 pupils (Roman Catholics, 6805, and Protestants, 792). The number of pupils on the rolls of National schools on 31st December 1900 was 7941, of whom 7198 were Roman Catholics and 743 Protestants.

The following table gives the number of births, deaths, and marriages in the years specified:—

Year.	Births.	Deaths.	Marriages.
1881	1734	1050	270
1891	1065	811	193
1900	929	963	186

In 1900 the birth-rate per 1000 was 19·9, and the death-rate 20·7; the rate of illegitimacy was ·3 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 56,305, of whom 28,597 were males and 27,708 females. The chief towns in the county, with their populations in 1901, were Longford, 3733; Granard, 1700.

Administration.—The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1901 being respectively 5043 and 5311. The rateable value in 1900 was £153,098. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises two urban and three rural sanitary districts.

Agriculture.—The following tables show the acreage under crops, including meadow and clover, and the amount of live stock, in 1881, 1891, 1895, and 1900:—

Year.	Wheat.	Oats.	Barley, Rape, Beans, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	307	18,670	469	13,102	2621	1688	37,899	74,756
1891	397	14,158	308	11,782	2666	2171	39,286	70,718
1895	164	12,605	208	10,449	2105	1670	37,582	64,783
1900	271	10,898	126	9,818	1840	2051	38,450	62,954

In 1900 the total value of the cereal and other crops was estimated at £390,288, the smallest amount of any Irish county. The number of acres under pasture in 1881 was 125,830; in 1891, 130,866; and in 1900, 140,427.

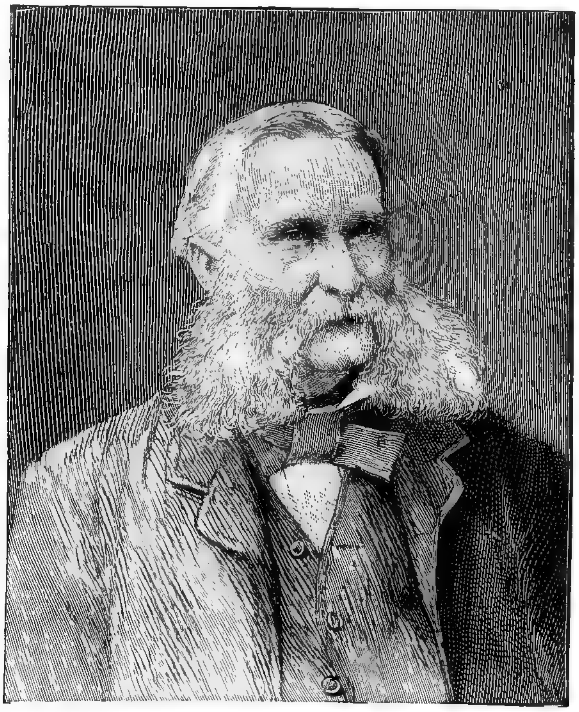
Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	7526	3066	51,557	24,140	17,900	7978	232,324
1891	8843	3668	68,189	38,380	22,660	9679	251,395
1895	8904	3854	58,404	27,068	21,371	7890	272,355
1900	8039	4198	66,225	31,621	22,781	8010	309,478

The number of milch cows in 1891 was 17,580, and in 1900, 17,024. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £917,502. In 1900 the number of holdings not exceeding 1 acre was 1172; between 1 and 5, 857; between 5 and 15, 2464; between 15 and 30, 2676; between 30 and 50, 1185; between 50 and 100, 588; between 100 and 200, 186; between 200 and 500, 72; and above 500, 7—total, 9207. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 1873, amounting to £416,903. The number of loans for agricultural improvements sanctioned under section 31 of the Land Act, 1881, between 1882 and 1901, was 334, and the amount issued was £25,133. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1901 was £184,151. (W. H. PO.)

Long Island City, formerly a city of New York state, U.S.A., capital of Queens county, now a part of the borough of Queens, one of the five boroughs which compose the city of New York. It is near the western end of Long Island, in the south-eastern part of the state. It was incorporated in the city of New York, 1st January 1898, and constitutes the first ward in Queens borough. With a water front of ten miles on East River and

Long Island Sound, it has some commerce, but it is known chiefly as a manufacturing place. In 1890 it contained 325 manufacturing establishments, with a capital of $12,823,594. They employed 4691 persons, and paid in wages $3,066,132, while the products had a total value of $16,200,226. The principal manufacturing industries are oil-refining, the making of chemicals, asphalt, and carpets. Population (1880), 17,129; (1890), 30,506; (1900), 48,272, of whom 15,899 were foreign-born.

Longstreet, James (1821-——), American general in the Confederate army, was born on 8th January 1821 in Edgefield district, South Carolina, and graduated at West Point in 1842. He served through the Mexican war with distinction, was twice breveted for conduct, and severely wounded at Churubusco. When the Southern States seceded he resigned, and became a brigadier-general in the Confederate army. His brigade fought in the battle of Bull Run (July 1861). Divisions were not formed in the Confederate army until that autumn, and corps not until a year later. Longstreet's division, already distinguished in many battles, became the nucleus of the 1st corps, which he commanded until the end of the war. At Gettysburg he disapproved of the attack because of the exceptionally strong position of the Federal forces. He has been charged with tardiness in getting into the action, but his delay was in part authorized by Lee to await an absent brigade, and in part was the result of instructions to conceal his movements, which caused circuitous marching. The most desperate and most conspicuous fighting in the battle was conducted by Longstreet. In September 1863 he took his corps to Georgia, where he made the successful assault upon Rosecrans at Chickamauga. In November he commanded the expedition against Knoxville, which proved a failure. In 1864 he rejoined Lee's army in Virginia, and on 6th May arrived upon the field of the Wilderness as the Confederate right had been turned and routed. His attack was a model of impetuosity and skill, and drove the enemy back until their entire force upon that flank was in confusion. At this critical moment, as Longstreet in person, at the head of fresh troops, was pushing the attack in the forest, he was fired upon by mistake by a flanking force of his own men, and desperately wounded by a shot through the neck. This mischance stayed the Confederate assault for four hours, and enabled the enemy to provide effective means to meet it. In October 1864 he resumed command of his corps, which he retained until the surrender, although paralysed in his right arm. During what is known as the Reconstruction Period, Longstreet advised acceptance of terms of readmission into the Union which disfranchised the leading men of the South, himself among them. He believed that if these were rejected harder terms would be enforced. In fact, the ballot was afterwards given to the recently emancipated slaves, and the state governments were turned over to them. For this advice Longstreet was bitterly assailed by most of the Southern press. But as time assuaged prejudice, he regained the respect and affection of former days, when his soldiers, proud of his record, called him "General Lee's War-horse." Longstreet's merit lay in sound strategic judgment, in instinctive appreciation of what it was possible for his soldiers to do, and in a stubborn courage rising highest when all seemed lost. After the war he held several important civil offices, among them those of minister to Turkey under President Grant, and Commissioner of Railways under Presidents McKinley and Roosevelt.



General Longstreet.

Longton, a municipal borough and market-town of Staffordshire, England, 2½ miles by rail south-east of Stoke-upon-Trent, within which parliamentary borough it is included. There are a town-hall, public baths, a theatre, a technical institute and public library, a public park, and a good secondary school; also an organized school of science and a school of art. The town is in the Potteries district, and in the neighbourhood of coal and iron mines. Area, 1934 acres. Population (1881), 29,915; (1891), 34,327; (1901), 35,825.

Longwy, a fortified town and railway station, arrondissement of Briey, department of Meurthe-et-Moselle, France, 63 miles in direct line west-north-west of Nancy on the railway from Longuyon to Arlon, and on a plateau overlooking the Chiers, a right-bank affluent of the Meuse, near the frontiers of Belgium and Luxemburg. It comprises an upper and a lower town; the former, a strong place on a hill, 390 feet above the Chiers valley, commands the Luxemburg road, and is strengthened by outlying fortifications. There is garrison accommodation for 5000 men and 800 horses. The lower town is the industrial centre. The 17th-century church has a lofty square tower, the Hôtel de Ville dates from 1730, and there is a fine hospital. Iron is extensively mined in the district, and supplies numerous blast furnaces. Several important iron and steel works are in operation, and metal utensils and porcelain are manufactured. Longwy (*Longus vicus*) has been fortified since the 17th century. It was the first border stronghold captured by the Prussians in 1792, and was again taken in the wars of 1815 and 1871. Population (1881), 3701; (1891), 4729; (1901), 9235.

Lönnrot, Elias (1802–1884), the Finnish philologist and discoverer of the *Kalevala*, was born at Nyland in Finland on 9th April 1802. He began life as an apothecary's assistant, but entered the university of Åbo in 1822, and after taking his successive degrees, became a physician in 1832. But before this, as early as 1827, he had begun to publish contributions to the study of the ancient Finnish language, and to collect the national ballads and folk-lore, a field which was at that time wholly uncultivated. In 1833 he settled as a doctor in the country district of Kajana, and began to travel throughout Finland and the adjoining Russian provinces in his leisure time, garnering the harvest of songs and legends. In this way he was able to put together, as described in vol. ix. pp. 219–220, the great epic of Finland, the *Kalevala*, the first edition of which he published in 1835; he continued to add to it, and in 1849 issued a much larger and completer text. In 1840 Lönnrot issued his very important collection of the *Kanteletar*, or folk-songs of ancient Finland, which he had taken down from oral tradition. The *Proverbs of Finland* followed in 1842. In 1853, on the death of Castrén, Lönnrot became professor of the Finnish language and literature at the high school of Helsingfors; he retired from this chair in 1862. His whole life, which closed on 19th March 1884, was dedicated to the study and the elucidation of the obscure and difficult native language of Finland, and his contributions to philology, and particularly to folk-lore, place Lönnrot in the first rank of modern European scholars. (E. G.)

Lorain, a city of Lorain county, Ohio, U.S.A., on Lake Erie, at the mouth of the Black river, and the Cleveland, Lorain, and Wheeling, and the New York, Chicago, and St Louis railways, at an altitude of 609 feet. It has a good harbour and considerable lake commerce, especially in coal. Population (1880), 1595; (1890), 4863; (1900), 16,028, of whom 4730 were foreign-born and 329 were negroes.

Lorca, a town of Spain, in the province of Murcia. The population in 1897 was 59,624. The old part of the town, with narrow, irregular streets, contrasts with the modern part, which has broad streets and squares, and many fine public buildings—the bishop's palace, theatre, town-house, hospitals, courts of justice, and a new bridge over the river Sangonera. There is an important trade in agricultural products and live stock, as well as manufactures of woollen stuffs, leather, and porcelain.

Lorenzo Marques, or LOURENÇO MARQUES, capital of Portuguese East Africa, or Mozambique, on Delagoa Bay, close to the mouth of the Espirito Santo or English river. Since the opening in 1888 of the railway to Pretoria the town has increased in commercial and material prosperity. Extensive harbour works, estimated to cost over a million of money, were begun at the end of the 19th century. Meanwhile vessels generally discharge into lighters, though there are three piers (two only small). The district of LORENZO MARQUES has a population of 3000 Europeans and 200,000 natives.

Loreto, a famous pilgrimage centre and episcopal see of the province of Ancona, the Marches, Italy, 15 miles south-south-east of Ancona by rail to Brindisi. The shrine of the Virgin's House (Casa Santa) is visited annually by some 50,000 pilgrims, the chief festival being held on 7th and 8th September. Population (1881), 5183; (1900), 5000.

Loreto, an interior department of northern Peru, with an area of 32,727 square miles, and in 1896 a population of 70,676. It contains four provinces—Alto-Amazonas, Bajo-Amazonas, Moyobamba, and Huallaga. The town of Moyobamba has a population of 10,000.

Lorient, chief town of arrondissement and railway station, department of Morbihan, France, 37 miles west by north of Vannes; a military port of the first class, a fortified place of the third class, and the first port for naval construction in France. The Government ship-building yards on the Caudan peninsula cover an area of about 38 acres, and contain nine slips for ships and frigates, and two others for smaller vessels, besides forges with twenty-eight furnaces, and workshops for iron ship-building; on the right bank of the river are the graving dock, called Clermont-Tonnerre, a covered slip 232 feet by 81, and three other slips. In all, eighty furnaces are connected with the dockyard. The roadstead is provided with eight lighthouses. In 1900, 98 vessels of 17,694 tons entered, and 111 vessels of 17,584 tons (British three-fourths) cleared, in addition to the coasting trade. Population (1881), 30,502; (1891), 34,620; (1901), 44,082.

Loris-Mélikof, Michael Tarielovitch, COUNT (1825 (?)–1888), Russian statesman, son of an Armenian merchant, was born at Tiflis in 1825 or 1826, and educated in St Petersburg, first in the Lazaref School of Oriental Languages, and afterwards in the Guards' Cadet Institute. He joined a hussar regiment, and four years afterwards (1847) he was sent to the Caucasus, where he remained for more than twenty years, and made for himself during troublous times the reputation of a distinguished cavalry officer and an able administrator. In the latter capacity, though a keen soldier, he aimed always at preparing the warlike and turbulent population committed to his charge for the transition from military to normal civil administration, and in this work his favourite instrument was the schoolmaster. In the Russo-Turkish war of 1877–78 he commanded a separate corps d'armée on the Turkish frontier in Asia Minor. After taking the fortress of Ardahan, he was repulsed by Mukhtar Pasha at Zevin, but subsequently defeated his opponent at Aladja Dagh, took Kars by storm, and laid siege to Erzerum. For these services he received the title of Count. In the following year he was appointed temporary governor-general of the region of the Lower Volga, to combat an outbreak of the plague, and the measures he adopted proved so effectual that he was transferred to the provinces of Central Russia to combat an epidemic of a still more dangerous kind, the revolutionary agitation of the Nihilists and Anarchists, who had adopted a policy of terrorism, and had succeeded in assassinating the governor of Kharkoff. His success in this struggle led to his being appointed chief of the Supreme Executive Commission which had been created in St Petersburg for the purpose of dealing with the revolutionary agitation in general. Here, as in the Caucasus, he showed a decided preference for the employment of ordinary legal methods rather than exceptional extra-legal measures, and an attempt on his own life soon after he assumed office did not shake his convictions. In his opinion the best policy was to strike at the root of the evil by removing the causes of popular discontent, and for this purpose he recommended to the Tsar a large scheme of administrative and economic reforms. Alexander II., who was beginning to lose faith in the efficacy of the simple method of police repression hitherto employed, lent a willing ear to the suggestion; and when the Supreme Commission was dissolved in August 1880, he appointed Count Loris-Mélikof Minister of the Interior with exceptional powers. The proposed scheme of reforms was at once taken in hand, but it was never carried out. On the very day in March 1881 that the emperor signed a ukaz creating several commissions, composed of officials and eminent private individuals, who should prepare reforms in various branches of the administration, he was assassinated by Nihilist conspirators; and his successor, Alexander III., at once adopted a strongly reactionary policy. Count Loris-Mélikof immediately resigned, and lived in retirement until his death, which took place at Nice on 22nd December 1888. (D. M. W.)

Lörrach, a town of Germany, grand-duchy of Baden, in the valley of the Wiese, 6 miles by rail north-east of Basel. It is the seat of considerable industry—calico and shawl printing, cloth, silk, chocolate, cotton, hardware, furniture, and dyeing, and a trade in wine, fruit, and timber. Population (1885), 6795; (1900), 10,347.

Lorraine. See ALSACE-LORRAINE, and the French departments MEUSE and MEURTHE-ET-MOSELLE.

Los Angeles, a city of California, U.S.A., capital of Los Angeles county, on Los Angeles river, near the foot of San Gabriel range, in the southern part of the state, at an altitude of 300 feet. It is the largest and most important city of southern California, and the second in size in the state. Its site is, in the main, level, and the plan is quite regular, with broad streets, well paved in the business section, and shaded with eucalyptus and pepper trees. The residential portions are in the main constructed in detached cottages and villas, and contain many fine houses, with ample grounds beautified with tropical vegetation. The city derives its water supply by gravity from Los Angeles river, and is well sewered. It is divided into nine wards. Situated only 14 miles from the Pacific coast, and under the influence of prevailing westerly winds from the ocean, the atmosphere is necessarily heavily charged with moisture, but the annual rainfall is small and occurs in the winter. On account of this slight rainfall and the balmy temperature Los Angeles and its neighbourhood enjoy a great reputation as a health resort, especially for consumptives. This has done much in the way of settling and developing the region. The death-rate in 1900 was 18·01; in 1890 it was 20. The city is situated upon the Southern Pacific and the Atchison, Topeka, and Santa Fé railways. The surrounding region is, when irrigated, extremely fertile, producing oranges, lemons, figs, and other semi-tropical fruits. As surface water for irrigation is scarce, thousands of artesian wells have been bored to secure a supply from the underlying gravels. Indeed, the region between San Bernardino and Los Angeles is the most important artesian well country in the world. Los Angeles had, in 1900, 1415 manufacturing establishments, with a total capital of $11,742,838. They employed 8044 hands, and 939 salaried officials and clerks, and their products were valued at $21,297,537. These products were very varied in character. Among the educational institutions of the city are Occidental College, a Presbyterian school, founded in 1887, and St Vincent's College, Roman Catholic, founded in 1865. The assessed valuation of real and personal property in 1900, on a basis of about 60 per cent. of the full value, was $67,599,920; the net debt of the city was $1,417,791, and the rate of taxation was $28·70 per $1000. Population (1880), 11,183; (1890), 50,395; (1900), 102,479, of whom 19,964 were foreign-born and 2131 were negroes. There were, in 1900, 28,508 persons of school age (5 to 20 years inclusive). Out of 33,049 males of voting age, 886 were illiterate (unable to write).

Losoncz, a corporate town of Upper Hungary, in the county of Nógrád, 101 miles by rail north-north-east of Budapest, with 8225 inhabitants in 1891 and 9530 in 1901. Its chief industries include enamelling, cloth, and glue factories, and a steam mill. It possesses an upper gymnasium, a normal school, a theatre, and a public library. It was almost totally destroyed in 1849 by the Russians, but is again flourishing. The first Hungarian state railway was laid from Budapest to Losoncz, and this is still the main line connecting central Hungary with Berlin.

Lossiemouth, a police burgh of Elginshire, Scotland, embracing the three villages of Lossiemouth, Branderburgh, and Stotfield, at the mouth of the Lossie river, 5½ miles by rail north-north-east of Elgin, of which it is the port. The harbour, which has an area of nearly 6 acres, and a depth varying from 8 to 20 feet, is accessible to vessels of 600 tons, having been deepened at a cost (by Government loan) of £20,000. There are a town-hall and swimming-baths. Water is supplied. The industries are boat-building and fishing; in 1898 the value of the fish caught was £14,275. The port is the leading one in the district. The churches are Established, United Free, Baptist, and Episcopal. A public school had an average attendance of 822 in 1898–99. There is an excellent golf-course. Population (1881), 3497; (1901), 3889.

Lossing, Benson John (1813–1891), American historical writer, was born in Beekman, New York, on 12th February 1813. After editing newspapers in Poughkeepsie he became an engraver on wood, and removed to New York in 1839 for the practice of his profession, to which he added that of drawing illustrations for books and periodicals. He likewise wrote or edited the text of numerous publications in a long and active career as a writer. His *Pictorial Field-Book of the Revolution* (first issued in 30 parts, 1850–52, and then in 2 volumes) was a pioneer work of value in American historical literature. In its preparation he travelled some 9000 miles during a period of nearly two years; made more than a thousand sketches of extant buildings, battlefields, &c.; conversed with local authorities; and presented his accumulated materials in a form serviceable to the topographer and interesting to the general reader. Similar but less characteristic and less valuable undertakings were a *Pictorial Field-Book of the War of 1812* (1868), and a *Pictorial History of the Civil War in the United States of America* (3 vols. 1866–69). His other books, between 1840 and his death, were numerous: an *Outline History of the Fine Arts;* many illustrated histories, large and small, of the United States; popular descriptions of Mount Vernon and other localities associated with famous names; and biographical sketches of celebrated Americans, of which *The Life and Times of Major-General Philip Schuyler* (2 vols. 1860–73) was the most considerable. He died at Dover Plains, New York, on 3rd June 1891. (C. F. R.)

Lot, a department of the south-west of France, watered by the Lot and the Dordogne.

Area, 2018 square miles. From 271,514 in 1886 the population decreased to 223,736 in 1901. In 1899 the births numbered only 3849 against 5630 deaths, 97 of the births being illegitimate; marriages numbered 1570. In 1896 there were 841 schools, with 31,000 pupils, and only 2 per cent. of the population was illiterate. The area under cultivation, confined by the rocks of the high plateaux, measured in 1896 only 1,023,052 acres, of which 588,132 acres were arable land and 69,190 acres vineyards. The land in wheat returned in 1899 a value of £643,000; rye, £83,000; oats, £86,000; vines, £189,000. The natural pastures yielded £215,900 in 1898. Chestnuts were then valued at £61,200, and walnuts at nearly as much. The rearing of sheep is carried on in a specially important degree. While the horses of the department in 1899 numbered only 9530, its asses 5220, and its cattle 72,630, its sheep amounted to 428,600—a number exceeded by only ten other departments of France. In 1898, 4000 tons of coal and 9200 tons of iron were mined. Metallurgy is in a backward state. Tanning and the manufacture of coarse cloths are more advanced. Cahors, the chief town, has a population of 13,981 (1901).

Lot-et-Garonne, a department of the south-west of France, watered by the two rivers naming it.

Area, 2079 square miles. The population declined from 307,437 in 1886 to 276,607 in 1901. In 1899 the births numbered 4143, of which 145 were illegitimate; deaths, 6132; marriages, 1987. The schools in 1896 numbered 747, with 31,000 pupils, and the illiterate constituted 5 per cent. of the population. In 1896, out of 1,181,206 acres of cultivated land, 733,929 acres were plough-land and 135,912 acres vineyards. The wheat crop of 1899 was valued at £883,000; the other cereals returned light values—potatoes, £448,000; natural pastures, £324,000; tobacco, £140,000. Lot-et-Garonne in 1899 yielded plums to the value of £198,000. Its vines in 1899 returned the value of £564,090. The live stock of that year included 21,950 horses, 269,220 cattle, 156,530 sheep, and 65,200 pigs. In 1898 there were mined 25,500 tons of iron, and 20,050 metric tons of cast-iron were produced, valued at £64,000. The alimentary industries, particularly the rearing of pigs, are in a very thriving state. Agen, the capital, had 22,482 inhabitants in 1901.

Loti, Pierre [the pen-name of LOUIS MARIE JULIEN VIAUD] (1850– ——), French author, was born at Rochefort on the 14th of January 1850. The Viauds are an old Protestant family, and Pierre Loti has consistently adhered, at least nominally, to the faith of his fathers. Of the picturesque and touching incidents of his childhood he has given a very vivid account in *Le Roman d'un Enfant* (1890). His education began in Rochefort, but at the age of seventeen, being destined for the navy, he entered the great French naval school, Le Borda, and gradually rose in his profession. His pseudonym is said to be due to his extreme shyness and reserve in early life, which made his comrades call him after *le Loti*, an Indian flower which loves to blush unseen. He was never given to books or study (when he was received at the French Academy, he had the courage to say, "Loti ne sait pas lire"), and it was not until his thirtieth year that he was persuaded to write down and publish some curious experiences at Constantinople, in *Aziyadé*, a book which, like so many of Loti's, seems half a romance, half an autobiography. He proceeded to the South Seas, and on leaving Tahiti published the Polynesian idyl, originally called *Rarahu*, which was reprinted as *Le Mariage de Loti* (1880), and which first introduced to the wider public an author of remarkable originality and charm. He now became extremely prolific, and in a succession of volumes chronicled old exotic memories or edited the journal of new travels. *Le Roman d'un Spahi*, a record of the melancholy adventures of a soldier in Senegambia, belongs to 1881. In 1882 Loti issued a collection of short studies under the general title of *Fleurs d'Ennui.* In 1883 he achieved the widest celebrity, for not only did he publish *Mon Frère Yves*, a novel describing the life of a French bluejacket in all parts of the world—perhaps, on the whole, to this day his most characteristic production—but he was involved in a public discussion in a manner which did him great credit. While taking part as a naval officer in the Tongking war, Loti had exposed in a Parisian newspaper a series of scandals which followed on the capture of Hué, and, being recalled, was suspended from the service for more than a year. He continued for some time nearly silent, but in 1886 he published a novel of life among the Breton fisher-folk, called *Pêcheur d'Islande*, which has been the most popular of all his writings. In 1887 he brought out a volume of extraordinary merit, which has never received the attention it deserves; this is *Propos d'Exil*, a series of short studies of exotic places, in his peculiar semi-autobiographic style. The fantastic novel of Japanese manners, *Madame Chrysanthème*, belongs to the same year. Passing over one or two slighter productions, we come in 1890 to *Au Maroc*, the record of a journey to Fez in company with a French embassy. A collection of strangely confidential and sentimental reminiscences, called *Le Livre de la Pitié et de là Mort*, belongs to 1891. Loti was on board his ship at the port of Algiers when news was brought to him of his election, on the 21st of May 1891, to the French Academy. After he became an Immortal the literary activity of Pierre Loti somewhat declined. In 1892 he published *Fantôme d'Orient*, another dreamy study of life in Constantinople, a sort of continuation of *Aziyadé*. He has described a visit to the Holy Land, somewhat too copiously, in three volumes (1895–96), and has written a novel, *Ramuntcho* (1897), a story of manners in the Basque province, which is quite on a level with his best writings. In 1900 he visited British India, with the view of describing what he saw, but it was understood that he was disappointed; in 1901 he was writing from Peking his impressions of China after the war. At his best, Pierre Loti is unquestionably the finest descriptive writer of the day. In the delicate exactitude with which he reproduces the impression given to his own alert nerves by unfamiliar forms, colours, sounds, and perfumes, he is without a rival. But he is not satisfied with this exterior charm; he desires to blend with it a moral sensibility of the extremest refinement, at once sensual and ethereal. Many of his best books are long sobs of remorseful memory, so personal, so intimate, that an English reader is amazed to find such depth of feeling compatible with the power of minutely and publicly recording what is felt. In spite of the beauty and melody and fragrance of Loti's books, it is not to be denied that his mannerisms are apt to pall upon the reader, and that his more recent books of pure description have been rather empty. His greatest successes were gained in the species of confession, half-way between fact and fiction, which he essayed in his earlier books. When all his limitations, however, have been rehearsed, Pierre Loti remains, in the mechanism of style and cadence, one of the most original and most perfect writers of the second half of the 19th century. Whether his matter is worthy of the form in which he sets it is a question which must be left to the temperament of the individual reader.

Loubet, Émile (1838– ——), President of the French Republic, son of a peasant proprietor at Marsanne, in the department of the Drôme, was born on 31st December 1838. He studied law, and established himself at the small town of Montélimar, of which he was mayor in 1870 and parliamentary representative in 1876. He steadily supported the Moderate Republican party; in 1885 he was elected to the Senate, and in 1887 received the portfolio of public works in the Tirard cabinet, but resigned in the following year. In 1892 he himself formed a ministry at the request of President Carnot, but the excitement of the Panama scandals overthrew his administration in the winter of the same year—a circumstance which his political opponents used against him when he was elected President. That no imputation rested upon M. Loubet personally was shown by his election to the highly honourable office of President of the Senate in 1895; and the prestige thus acquired contributed to his elevation to the presidency of the Republic on the sudden death of President Faure in February 1899. Coming to office at a very difficult period, when the nation was rent by the Dreyfus controversy, and the upper classes of Society seemed united with large sections of the Church and the Army in opposition to the Republic, M. Loubet underwent severe trials, and was exposed to unexampled insults, over which he gradually triumphed by dint of patience, fortitude, and the exhibition of a perfect simplicity of life. He retained his predecessor's advisers as long as possible; but when a reconstruction eventually became necessary, he called upon Republicans of all shades to concentrate for the salvation of the Republic, and for the first time Moderates and Socialists were seen sharing in the same Administration. The cabinet thus formed by M. Waldeck-Rousseau displayed unexpected vitality, though no doubt much assisted by the general aversion from disturbance during the great Exhibition of 1900. M. Loubet had the satisfaction of seeing "l'affaire Dreyfus" at last driven into the background, and the Nationalist and anti-Semite agitation discomfited by a resolute vindication of republican institutions. On 22nd September 1900 a successful monster banquet in Paris to the provincial mayors gave occasion for a great demonstration of loyalty of the country as a whole to its Government; and in

September 1901 M. Loubet's triumph was signalized by the visit to France of the Tsar and Tsarina of Russia, on which occasion the alliance of the two countries was once more proclaimed.

Loughborough, a municipal borough (incorporated 1888) and market-town, in the Loughborough parliamentary division of Leicestershire, England, on the Soar, 11 miles north by west of Leicester by rail. Modern erections are a free library, a philharmonic hall, a theatre, Queen's memorial baths, and a drill hall. The infirmary has been enlarged. Area, 3045 acres. Population (1881), 14,552; (1891), 18,196; (1901), 21,508.

Louisiade Archipelago. See MELANESIA and NEW GUINEA.

Louisiana, one of the southern states of the American Union. It is composed of 59 parishes or counties. In 1880 the population was 939,946; in 1890 it was 1,118,587. In 1900 it was 1,381,625. The increase between 1890 and 1900 was 23·5 per cent. The density of population in 1890 was 24·6; in 1900 it was 30·4. In 1890 there were 559,350 males and 559,237 females; 558,395 white and 560,192 coloured; 1,068,840 native-born and 49,747 foreign-born. There are 104 incorporated cities, towns, and villages in the state, of which only 7 had in 1900 more than 5000 inhabitants, and 3 more than 10,000. These three were New Orleans, with 287,104 inhabitants; Shreveport, with 16,013; and Baton Rouge, with 11,269.

Education.—The number of children enrolled in public schools in 1896 was 169,947. In 1899 the number was 196,169. Of these 121,936, or 62 per cent., were white, and 74,233, or 38 per cent., were coloured. The number of pupils reported as attending private schools in 1899 was 14,694, of whom 11,896 were white and 2798 were coloured. To these may be added 10,000 children not reported. The number of children of school age in 1900 was 404,757. Thus the percentage of children educated was 54. The average attendance in the public schools was, whites, 90,187; coloured, 56,136; total, 146,323. The number of public school teachers employed was 4157; the number of private teachers was 645. The average length of school session was six months. Of the state tax of six mills on the dollar, $1\frac{1}{4}$ mills are devoted to the public schools, or $\frac{5}{24}$ of the gross income of the state revenue. In addition to this, every male inhabitant of twenty-one years and over is obliged to pay a poll-tax of one dollar for the support of the schools. The revenue in 1899 was $1,126,112. There are about thirty high schools; an industrial college at Ruston, and one at Lafayette; a state normal school at Natchitoches; the Southern University for negroes at New Orleans; the State University and Agricultural and Mechanical College at Baton Rouge; and the Louisiana Chautauqua at Ruston. A textile school will be established in the state, as well as a biological station for fish and fisheries. The Tulane University of Louisiana at New Orleans includes departments of medicine and law, a college of arts and sciences, and one of technology, the Newcomb College for Women, a department for teachers, and a university department for graduate study. There are two colleges of Jesuits, a number of schools and convents of the Catholic denomination; Centenary College, Methodist; Silliman Collegiate Institute, Presbyterian; Keachie College, Baptist; and in New Orleans three sectarian colleges for negroes.

Public Institutions.—There are an insane asylum at Jackson, a lepers' home in Iberville parish, and an institution for the blind and one for the deaf at Baton Rouge. There is a charity hospital at Shreveport, and one at New Orleans. The hospital at New Orleans had, in 1899, 9141 resident patients, and 21,803 patients were treated in the dispensary.

Religion.—The chief denominations are as follows:—Catholics, 355,000; Baptists, 107,200; Southern Methodists, 28,000; Presbyterians, 6590; Episcopalians, 7704; Jews, 11,000. There are also a number of Lutherans and Unitarians. The Protestant denominations count as members of the church only those who have made profession of faith.

Agriculture.—About 4,000,000 acres of land are cultivated. There are 3,000,000 acres of state public lands and large areas of United States public lands subject to homestead entry. The crops produced yearly are valued at $75,000,000. In 1890 the product of Indian corn was 13,081,954 bushels; of oats, 297,271 bushels; of tobacco, 46,845 ℔; of rice, 75,645,433 ℔ (clean rice); of Irish potatoes 375,842 bushels; of sweet potatoes, 1,912,080 bushels; of cow-pease, 78,682 bushels; and of broom corn, 11,420 ℔. In 1900 the product of rice was 902,857 bushels, rough; of corn, 12,759,277 bushels; of oats, 408,170 bushels; of hay, 328,817 bales; of potatoes, 1,275,989 bushels; of sorghum, 13,132 bushels; the number of horses and mules was 275,802; of cattle, 338,369; of sheep, 133,944; of hogs, 198,490. Oranges, lemons, figs, olives, and grapes are also produced, and the fish and oysters are famous.

Sugar.—Of sugar there were produced in 1880, 121,886 tons of 2240 ℔; in 1890, 215,843 tons; in 1898, 245,511 tons. Of molasses there were produced in 1898, 24,952,188 gallons.

Cotton.—Louisiana ranks seventh as a cotton-producing state. In 1890 the cotton acreage was 1,270,154, and the number of bales produced 659,180. In 1897–98 there were 1,245,000 acres producing 740,000 bales, or an average of $\frac{59}{100}$ bales per acre; in 1898–99 there were 1,292,000 acres producing 590,000 bales, or an average of $\frac{45}{100}$ bales per acre. The falling-off in the average yield per acre was due to unfavourable weather. In 1898–99 there were 1595 looms and 65,352 spindles. In 1899–1900 there were 1673 looms and 67,878 spindles. The number of bales of cotton consumed was 16,420.

Lumber.—The timber indigenous to the state consists of yellow pine, cypress, and native southern hardwoods. The eastern pine belt is composed of the longleaf pine, interspersed with some loblolly. It covers an area of about 3900 square miles. The south-western pine belt contains the heaviest growth of longleaf pine timber in the world, covering an area of about 4200 square miles. It merges into the shortleaf forest, which occupies an area of about 7000 square miles, and is in places intermixed with loblolly pine and deciduous hardwoods. The cypress forests of the alluvial and overflowed lands in the southern portions of the state are among the largest and the most heavily timbered in the world. They produce annually about 300,000,000 board feet of lumber. The hardwoods are found in the river bottoms throughout the state. The manufacture of lumber aggregates 600,000 board feet each year, valued at about $6,000,000.

Minerals.—There is a sulphur bed in Calcasieu parish of an average thickness of 100 feet. At a depth of about 425 feet the production in 1896 was 4200 tons, and in 1897 a little over 1000 tons; in 1900 it was closed. A salt mine at Petite Anse produced, in 1890, 39,978 short tons of salt of remarkable purity; and in 1896, 24,236 tons.

Manufactures.—The condition of manufactures in 1890 and 1900 is shown by the following table:—

	1890.	1900.	Per cent. of increase.
Number of establishments	2,613	4,350	66·5
Capital	$34,754,121	$113,084,294	225·4
Salaried officials, clerks, &c.	3,524[1]	3,944	11·9
Salaries	$3,036,995[1]	$3,090,185	1·8
Wage-earners	28,377	42,210	48·7
Total wages	$10,122,569	$15,385,715	52·0
Miscellaneous expenses	$3,760,753	$7,999,870	112·7
Cost of materials used	$33,282,724	$82,299,893	147·3
Value of products	$57,806,713	$121,181,683	109·6

The manufacturing industries are for the most part closely related to the products of the soil, as is shown by the following statistics:—

Industry.	Capital.	Wage-earners.	Products.
Sugar and molasses refining	$52,799,105	6,504	$47,891,691
Lumber and timber products	20,093,044	10,171	17,408,513
Cotton-seed oil and cake	4,622,569	1,317	7,026,452
Rice, cleaning and polishing	1,818,144	412	5,736,451

New Orleans is the principal centre of manufacturing, the number of establishments, number of wage-earners and value of products for this city constituting 35·1, 46·2, and 52·5 per cent. respectively of the totals for the entire state.

Debt and Assessed Valuation.—The total bonded debt of Louisiana, bearing interest in 1899, was $10,877,800; the floating debt was $914,397. The total valuation of real and personal property in 1890 was $495,301,597. The assessed valuation in 1890 was $234,350,791; and, in 1899, $267,723,052. The rate of taxation is six mills on the dollar of the assessed valuation, which should have yielded in 1899 a revenue of some $1,606,338, less $8\frac{1}{2}$ per cent. to cover cost of collection and also non-collections.

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[1] Includes proprietors and firm members, with their salaries.

Banks.—The state bank examiner gives the following figures for state banks in Louisiana in October 1900:—

Capital stock	$7,015,210
Deposits	36,378,809
Real estate	1,803,071
Specie	2,258,334
Currency	2,302,716

Railways.—The total length of railways in 1880 was 652 miles; in 1890, 1740 miles; in 1899, 2410 miles. The chief lines are the Southern Pacific, with a total mileage operated of 437; the Texas and Pacific, with 358; the Kansas City Southern railway, with 222; the Vicksburg, Shreveport, and Pacific, with 170; the Yazoo and Mississippi Valley, with 170; the St Louis, Iron Mountain and Southern railway, with 144.

Newspapers.—In 1900 there were 218 newspapers, including daily, 22; tri-weekly, 1; semi-weekly, 3; weekly, 178; semi-monthly, 4; monthly, 10.

Commerce.—Exports from New Orleans, for year ended 30th June 1900, $114,702,493; imports, $17,498,434. Vessels entered and cleared at port of New Orleans, 3097; tonnage, 4,643,064.

Levees.—The revenue by which the levee system is maintained comes from the United States Government, from a state tax of one mill for a general engineer fund, and from revenues from the thirteen levee districts. From 1898 to 1900 the cubic yardage of work done was 18,792,526, the cost of which was $2,994,957. More than half of the work was done by the United States.

History and Administration.—In 1877 the period of reconstruction ended, owing to the efforts of the White League, and from that time the state has enjoyed a free government and has greatly prospered. In 1890 an attempt was made to renew the charter of the Louisiana State Lottery Company, which offered a large sum annually for the privilege. Governor Nicholls and the Anti-Lottery party resisted the renewal strenuously, but the Bill was passed by the legislature. The United States Government, however, forbade the Lottery Company the use of the mails, and the company withdrew its offer. In 1898 a new constitution was adopted, which superseded that of 1879. Under it the number of representatives in the House may not be more than 116 nor less than 98; and the number of senators not more than 41 nor less than 36. The General Assembly meets every two years on the second Monday of May, and the sessions are limited to sixty days. The governor is elected for four years, and is not again eligible before the expiration of one or more terms. The treasurer is not eligible as his own immediate successor. The judiciary consists of a supreme court of five members appointed for twelve years; of courts of appeal, district courts, and justices of the peace. In New Orleans, besides the courts of appeal and the district courts (civil and criminal), there are city courts and recorder's courts. Lotteries and sales of lottery tickets are prohibited. The leasing or hiring of convicts was prohibited after 1st March 1901. A railway commission of three members is established. The establishment of district schools and district school districts is authorized. No person less than sixty shall vote at any election who shall not have paid a poll-tax for the two preceding years. A code of criminal law ordered by the Constitution has been prepared. A State Board of Charities and Correction has been established to visit institutions and make such suggestions to the governor and legislature as may be necessary. Upon questions submitted to taxpayers women taxpayers have the right to vote, without registration, in person or by their agent. Factories and mines are encouraged by exemption from taxation for ten years from 1st January 1900. As a qualification for voting every citizen must be able to read and write, or must be *bonâ fide* owner of property assessed in the state for not less than $300. This practically disfranchises the negro, and relieves the state from the unfortunate results of the fifteenth amendment to the National Constitution. An exception is made with regard to the educational or property qualifications in favour of persons who were voters in any state on 1st January 1867, in favour of their sons and grandsons, and of persons who were naturalized prior to 1st January 1898; provided they shall have been residents of the state for five years preceding the date of registration, and shall have registered prior to 1st September 1898. The Australian ballot system is in operation. In 1900 the election for state officers resulted in an overwhelming majority for the Democratic party. An important white Republican party was subsequently formed.

(A. Fo.)

Louisiana, a city of Pike county, Missouri, U.S.A., on the west bank of the Mississippi river, below the mouth of the Salt river, in the eastern part of the state, at an altitude of 458 feet. Its site is on the river banks, and it has a fairly regular plan. It is entered by the Chicago, Burlington and Quincy, and the Chicago and Alton railways. Population (1880), 4325; (1890), 5090; (1900), 5131.

Louisville, the largest and most important city of Kentucky, U.S.A., capital of Jefferson county, in the northern part of the state, on the south bank of the Ohio river at the Falls. The city is regularly laid out, with broad streets, most of which are paved with granite blocks, bricks, cobble-stones, or macadam. It is openly built, with numerous parks, and has a good water supply and sewer system. Three bridges connect it with Jeffersonville and New Albany, on the north bank of the Ohio. The railway development has been remarkable. It is entered by ten railways—the Baltimore and Ohio South-Western; the Chesapeake and Ohio; the Chicago, Indianapolis and Louisville; the Cleveland, Cincinnati, Chicago and St Louis; the Illinois Central; the Louisville and Nashville; the Louisville, Evansville and St Louis Consolidated; the Louisville, Henderson and St Louis; the Pittsburg, Cincinnati, Chicago and St Louis; and the Southern. These, with boats on the Ohio, afford excellent facilities for internal commerce, and give the city a large trade. The manufactures, aided by the enormous water-power supplied by the falls in the Ohio, are of great importance. In 1900 the number of establishments was 2307, with a capital of $49,344,701, and an average number of 29,926 hands, whose annual wages amounted to $10,945,720. The cost of materials used was $41,016,391, and the value of products was $79,286,390. The products were in great variety, the following being the principal:—men's clothing (factory product and custom work), $4,710,447; foundry and machine-shop products, $3,233,222; leather, $3,114,731; liquors, $4,691,167; cotton-seed oil and cake, $4,683,343; slaughtering (wholesale), $4,771,608; tobacco, cigars, and snuff, $15,790,366. The total assessed valuation of real and personal property in 1900, on a basis of about 60 per cent. of the full value, was $121,000,000, the net debt was $7,755,071, and the rate of taxation $22·65 per $1000. The total municipal receipts were $4,785,744, and the expenditure $4,459,970. In March 1890 the city was visited by a tornado, which swept across it, killing 76 persons and destroying $3,000,000 worth of property. Population (1890), 161,129; (1900), 204,731, of whom 21,437 were foreign-born and 39,139 were negroes.

Loulé, a town of Portugal, in the district of Faro, 10 miles north-north-west of Faro. It has a trade in palms, agaves, and esparto grass, and manufactures porcelain and leather. Population (1900), 22,511.

Lourdes, a town, arrondissement of Argèles, department of Hautes-Pyrénées, France, 11 miles, in direct line, west-south-west of Tarbes, on the railway from Toulouse to Bayonne. It is a fortified place of the second class, commanding the defile Gave de Pau. A new quarter of the town has grown up near the famous grotto. It stretches for some distance, and comprises the Church of the Rosary, built in 1885–89, a hospital, convents, hotels, and houses for the accommodation of the numerous visitors resorting to the shrine, said to exceed in number 500,000 a year. Population (1881), 4970; (1901), 8708.

Louth, a municipal borough and market-town in the Louth parliamentary division of Lincolnshire, England, on the Lud, 26 miles east-north-east of Lincoln by rail. A hospital has been erected, also a number of almshouses. The Roman Catholic church has been restored. Area of municipal borough, 2749 acres. Population (1881), 10,691; (1891), 10,040; (1901), 9518.

Louth, a maritime county of Ireland, province of Leinster.

Population.—The area of the administrative county in 1900 was 202,174 acres, of which 82,394 were tillage, 89,398 pasture, 190 fallow, 4524 plantation, 1138 turf bog, 1219 marsh, 12,924 barren mountain, and 10,387 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, includes the former county of the town of Drogheda. The population in 1881 was 77,684; in 1891, 71,038; and in 1901, 65,741, of whom 32,623 were males and 33,118 females, divided as follows among the different religions:—Roman Catholics, 60,133; Protestant Episcopalians, 4188; Presbyterians, 987; Methodists, 275; and other denominations, 158. The decrease of population between 1881 and 1891 was 8·56 per cent., and between 1891 and 1901, 8·6 per cent. The average number of persons to an acre in 1891 was ·35, and of the total population, 44,649 inhabited the rural districts, being an average of 168 persons to each square mile under crops and pasture.

The following table gives the degree of education in 1891, excluding the town of Drogheda, which was then a separate county:—

	Males.	Females.	Total.	Percentage.			
				R. C.	Pr.Ep.	Presb.	Meth.
Read and write	18,106	17,210	35,316	63·6	91·7	92·5	94·7
Read only .	3,098	3,567	6,665	13·3	4·5	3·0	2·0
Illiterate .	5,548	5,915	11,463	23·1	3·8	4·5	3·3

The percentage of illiterates among Roman Catholics in 1881 was 32·3. In 1891 (including Drogheda) there were 11 superior schools with 622 pupils (Roman Catholics, 426, and Protestants, 196), and 128 primary schools with 11,073 pupils (Roman Catholics, 10,151, and Protestants, 922). The number of pupils on the rolls of the National schools on 30th December 1900 was 9301, of whom 8642 were Roman Catholics and 659 Protestants.

The following table gives the number of births, deaths, and marriages in the years specified:—

Year.	Births.	Deaths.	Marriages.
1881	2252	1715	392
1891	1526	1291	268
1900	1324	1250	269

In 1900 the birth-rate per thousand was 20·1, and the death-rate 19·0; the rate of illegitimacy was 2·6 per cent. of the total births. The total number of emigrants who left the county between 1st May 1857 and 31st December 1900 was 42,682, of whom 20,812 were males and 21,870 females. The chief towns in the county are Dundalk (13,067 in 1901), Drogheda (12,765 in 1901), Ardee (1882 in 1901).

Administration.—The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1901 being respectively 6011 and 5158. The rateable value in 1900 was £244,327. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises two urban and three rural sanitary districts.

Agriculture.—The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county.

Year.	Wheat.	Oats.	Barley, Flax, Beans, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	3382	26,544	21,923	11,356	9906	1696	22,582	97,889
1891	1048	24,086	14,344	10,824	8391	1874	23,493	83,560
1895	377	24,864	15,293	10,471	9896	1418	26,170	88,489
1900	655	20,789	15,205	9,881	9332	1633	24,889	82,394

For 1900 the total value of the cereal and other crops was estimated at £508,421. The number of acres under pasture in 1881 was 73,185; in 1891, 89,099; in 1900, 89,398.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	11,044	1549	34,739	33,367	10,471	4841	241,466
1891	10,301	1570	41,520	55,388	19,644	5744	240,779
1895	12,034	1664	46,247	41,085	18,492	5022	259,381
1900	10,688	1682	47,285	50,099	15,967	4787	294,609

The number of milch cows in 1891 was 9507, and in 1900, 10,212. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £734,047, the smallest amount in any Irish county. In 1900 the number of holdings not exceeding 1 acre was 1990; between 1 and 5, 1284; between 5 and 15, 2423; between 15 and 30, 1400; between 30 and 50, 604; between 50 and 100, 481; between 100 and 200, 231; between 200 and 500, 114; and above 500, 12—total, 8539. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901, was 276, amounting to £105,272. The number of loans sanctioned for agricultural improvements under sec. 31 of the Land Act, 1881, between 1882 and 1901 was 80, and the amount issued was £8895. The total amount issued on loan for all classes of works under the Land Improvement Acts from the commencement of operations in 1847 to 31st March 1901 was £48,294.

Fisheries.—The number of vessels registered in the deep-sea and coast fishery district of Dundalk in 1900 was 206, employing 743 hands. The number of persons employed in the salmon fishery districts of Drogheda and Dundalk in the same year was 932. (W. H. Po.)

Louvain, one of the largest towns of Belgium, in the province of Brabant, 27 miles east of Brussels. It is connected by rail with Brussels, Malines, Liège, and other important centres, and is chiefly noted for its university and its beer. It has considerable breweries, and factories for boots and shoes and clocks. Population (1880), 35,893; (1900), 42,070.

Löwe, Johann Karl Gottfried (1796–1869), German composer, was born at Löbejün, near Halle, 30th November 1796, and was a choir-boy at Köthen from 1807 to 1809, when he went to the Franke Institute at Halle, studying music with Türk. The beauty of Löwe's voice brought him under the notice of Madame de Staël, who procured him a pension from Jérôme Bonaparte, then king of Westphalia; this stopped in 1813, on the flight of the king. He entered the University of Halle as a theological student, but was appointed cantor at Stettin in 1820, and director of the town music in 1821, in which year he married Julie von Jacob, who died in 1823. His second wife, Auguste Lange, was like himself an accomplished singer, and they appeared together in his oratorio performances with great success. He retained his office at Stettin for 46 years, when, after a stroke of paralysis, he was somewhat summarily dismissed. He retired to Kiel, and died 20th April 1869. He undertook many concert tours during his tenure of the post at Stettin, visiting Vienna, London, Sweden, Norway, and Paris. His high soprano voice (he could sing the music of the "Queen of Night" in *Die Zauberflöte* as a boy) had been replaced by a fine tenor. Löwe was a voluminous composer, and wrote five operas, of which only one, *Die drei Wünsche*, was performed at Berlin, in 1834, without much success; seventeen oratorios, many of them for male voices unaccompanied, or with short instrumental interludes only; choral ballads, cantatas, three string quartets, a pianoforte trio; a work for clarinet and piano, published posthumously; and some piano solos. But the branch of his art by which he is now remembered, and in which he must be admitted to have attained perfection, is the solo ballad with pianoforte accompaniment. His treatment of long narrative poems, in a clever mixture of the dramatic and lyrical styles, was undoubtedly modelled on the ballads of Zumsteeg, and has been copied by many composers since his day. They require a cultivated singer to do them justice, but such things as his setting of the "Erlkönig," a very early example; "Archibald Douglas," "Heinrich der Vogler," "Edward," and "Die Verfallene Mühle," belong to the music that must impress every intelligent hearer. The best of these have been sung in England with great success by Henschel, Gura, Bispham, and almost every distinguished concert-singer. (J. A. F. M.)

Lowell, a city of Massachusetts, U.S.A., capital of Middlesex county, at the junction of the Merrimac and Concord rivers, in the north-eastern part of the state. The city is irregularly laid out, and its business streets are paved with granite blocks, while the others are macadamized or gravelled. Its water supply is pumped from the Merrimac. It is divided into nine wards, and it has railway facilities by branches of the Boston and Maine, and of the New York, New Haven, and Hartford railways. It is one of the chief cities of the country for textile, mainly cotton, manufactures. For this the water power of the Pawtucket Falls in the Merrimac has been utilized, supplemented by steam power. In 1900 the city contained, in all branches of manufacture, 981 establishments, with a total capital of $46,578,193. These employed an average number of 31,377 hands, and the total product was valued at $44,774,525. Of these establishments, eight were cotton mills, with a capital of $21,354,927. In them were employed 13,730 hands, and the product was valued at $17,038,576, or about 38 per cent. of all manufactured products. The product of woollen and worsted goods was valued at $4,689,265; of foundry and machine shop products, $4,258,047; of hosiery and knitted goods, $3,148,110; and of patent medicines and compounds, $1,784,338. The assessed valuation of real and personal property in 1900 was $71,529,515, the net debt was $3,217,731, and the rate of taxation was $18·80 per $1000. Population (1890), 77,696; (1900), 94,969, of whom 40,974 were foreign-born. The death-rate in 1900 was 19·8; in 1890 it was 25·9.

Lowell, James Russell (1819–1891), American author and diplomatist, was born at Elmwood, in Cambridge, Massachusetts, on 22nd February 1819.[1] He was brought up in a neighbourhood bordering on the open country, and from his earliest years he found a companion in nature; he was also early initiated into the reading of poetry and romance, hearing Spenser and Scott in childhood, and introduced to old ballads by his mother. He had for schoolmaster an Englishman who held by the traditions of English schools, so that before he entered Harvard College he had a more familiar acquaintance with Latin verse than fell to the lot of most of his fellows—a familiarity which showed itself later in his mock-pedantic accompaniment to *The Biglow Papers* and his macaronic poetry. He was a wide reader of literature, but a somewhat indifferent student in college, graduating at Harvard without special honours in 1838. During his college course he wrote a number of trivial pieces for a college magazine, and shortly after graduating printed for private circulation the poem which his class asked him to write for their graduation festivities. He was uncertain at first what vocation to choose, and vacillated between business, the ministry, medicine, and law. He decided at last to practise law, and after a course at the Harvard law school, was admitted to the bar. While studying for his profession, however, he continued the pursuit of literature in a random fashion, contributing poems and prose articles to various magazines. At this period he was in a somewhat wayward mood, conscious of a latent power, deeply enamoured of letters, a student of the art of literature, but uncertain just how to direct his impulses. He cared little for the profession of law, regarding it simply as a distasteful means of livelihood, yet his experiments in writing could not greatly encourage him to trust to this for support. An unhappy adventure in love deepened his sense of failure, but a new and profound experience suddenly steadied his purpose, and helped besides to fashion and guide certain vague tendencies which he felt towards the reform movements then stirring in the society about him. He became betrothed to Maria White in the autumn of 1840, and the next twelve years of his life were deeply affected by her influence. She was herself a poet of delicate power, but she was also possessed of a lofty enthusiasm, a high conception of purity and justice, and of a practical temper which led her to concern herself actively in the movements directed against the evils of intemperance and slavery. Lowell was already looked upon by his companions as a man marked by wit and poetic sentiment; Miss White was admired for her beauty, her character, and her intellectual gifts, and the two became thus the hero and heroine among a group of ardent young men and women, who set them upon a daïs, as it were, and bestowed their homage. The first-fruits of this passion was a volume of poems, published in 1841, entitled *A Year's Life*, which was inscribed by Lowell in a veiled dedication to his future wife, and was a record of his emotions under this new experience, with a backward glance at the preceding period of depression and irresolution. The betrothal, moreover, stimulated Lowell to new efforts towards self-support, and though nominally maintaining his law office, he threw his energy into the establishment, in company with a friend, Robert Carter, of a literary journal, to which the young men gave the name of *The Pioneer*. It was to open the way to new ideals in literature and art, and the writers to whom Lowell turned for assistance—Hawthorne, Emerson, Whittier, Poe, Story, and Parsons, none of them yet possessed of a wide reputation—indicate the acumen of the editor. Lowell himself had already turned his studies in dramatic and early poetic literature to account in another magazine, and continued the series in *The Pioneer*, besides contributing poems; but after the issue of three monthly numbers, beginning in January 1843, the magazine came to an end, partly because of a sudden disaster which befell Lowell's eyes, partly through the inexperience of the conductors and unfortunate business connexions.

The venture confirmed Lowell in his bent towards literature. At the close of 1843 he published a collection of his poems, and a year later he gathered up certain material which he had printed, sifted and added to it, and produced *Conversations on some of the Old Poets*. The dialogue form was used merely to secure an undress manner of approach to his subject; there was no attempt at the dramatic. The book reflects curiously Lowell's mind at this time, for the conversations relate only partly to the poets and dramatists of the Elizabethan period; a slight suggestion sends the interlocutors off on the discussion of current reforms in church and state and society. Literature and reform were dividing the author's mind, and continued to do so for the next decade. Just as this book appeared Lowell and Miss White were married, and spent the winter and early spring of 1845 in Philadelphia. Here, besides continuing his literary contributions to magazines, Lowell had a regular engagement as an editorial writer on *The Pennsylvania Freeman*, a fortnightly journal devoted to the Anti-Slavery cause. In the spring of 1845 the Lowells returned to Cambridge and made their home at Elmwood. On the last day of the year their first child, Blanche, was born, but she lived only fifteen months. A second daughter, Mabel, was born six months after Blanche's death, and lived to survive her father; a third, Rose, died an infant. Lowell's mother meanwhile was living, sometimes at home, sometimes at a neighbouring hospital, with clouded mind, and his wife was in frail health. These family troubles and the tie of a narrow income conspired to make Lowell almost a recluse in these days, but from the retirement of Elmwood he sent forth writings which show how large an interest he took in affairs. He contributed poems to the daily press, called out by the Slavery question; he was, early in 1846, a correspondent of the London *Daily News*, and in the spring of 1848 he formed a connexion with the *National Anti-Slavery Standard* of New York, by which he agreed to furnish weekly either a poem or a prose article. The poems were most frequently works of art, occasionally they were tracts; but the prose was almost exclusively concerned with the public men and questions of the day, and forms a series of incisive, witty, and sometimes prophetic diatribes. It was a period with him of great mental activity, and is represented by four of his books which stand as admirable witnesses to the Lowell of 1848, namely, the second series of *Poems*, containing among others "Columbus," "An Indian Summer Reverie," "To the Dandelion," "The Changeling"; *A Fable for Critics*, in which, after the manner of Leigh Hunt's *The Feast of the Poets*, he characterizes in witty verse and with good-natured satire American contemporary writers, and in which, the publication being anonymous, he included himself; *The Vision of Sir Launfal*, a romantic story suggested by the Arthurian legends—one of his most popular poems; and finally *The Biglow Papers*.

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[1] The ancestry of James Russell Lowell was of mingled English and Scottish strain. On his father's side he was descended from Percival Lowell or Lowle, who emigrated from Somersetshire, England, in 1639, to Massachusetts Bay. The descendants of Percival remained in Boston and its vicinity down to James Russell, and contained among them more than one man of note. John Lowell, the grandfather of James Russell, was a judge of the federal court appointed by Washington, and took a conspicuous part in the framing of the Massachusetts constitution; and Charles Lowell, the father, was long honoured as a minister in Boston; Francis Cabot Lowell, an uncle of James Russell, was the organizer of the industries on the banks of the Merrimac which resulted in the building of the city of Lowell, and a son of Francis Cabot was the founder of the Lowell Institute, a centre of diffusing light in Boston. On his mother's side Lowell was descended from the Spences and Traills, who made their home in the Orkney Isles, his great-grandfather, Robert Traill, returning to England upon the breaking out of hostilities in 1775.

James Russell Lowell.
(*From a photograph by Elliott and Fry, London.*)

Lowell had acquired a reputation among men of letters and a cultivated class of readers, but this satire at once brought him a wider fame. The book was not premeditated; a single poem, called out by the recruiting for the abhorred Mexican war, couched in rustic phrase, and sent to the *Boston Courier*, had the inspiriting dash and electrifying rat-tat-tat of this new recruiting-sergeant in the little army of Anti-Slavery reformers. Lowell himself discovered what he had done at the same time that the public did, and he followed the poem with eight others either in the *Courier* or the *Anti-Slavery Standard*. He developed four well-defined characters in the process—a country farmer, Ezekiel Biglow, and his son Hosea; the Rev. Homer Wilbur, a shrewd old-fashioned country minister; and Birdofredum Sawin, a Northern renegade who enters the army, together with one or two subordinate characters; and his stinging satire and sly humour are so set forth in the vernacular of New England, as to give at once a historic dignity to this form of speech. (Later he wrote an elaborate paper to show the survival in New England of the English of the early 17th century.) He embroidered his verse with an entertaining apparatus of notes and mock criticism. Even his index was spiced with wit. The book, a caustic arraignment of the course taken in connexion with the annexation of Texas and the war with Mexico, made a strong impression, and the political philosophy secreted in its lines became a part of household literature. It is curious to observe how repeatedly this arsenal was drawn upon in the discussions in America about the "Imperialistic" developments of 1900. The death of Lowell's mother, and the fragility of his wife's health, led Lowell, with his wife, their daughter Mabel, and their infant son Walter, to go to Europe in 1851, and they went direct to Italy. The early months of their stay were saddened by the death of Walter in Rome, and by the news of the illness of Lowell's father, who had a slight shock of paralysis. They returned in November 1852, and Lowell published some recollections of his journey in the magazines, collecting the sketches later in a prose volume, *Fireside Travels*. He took some part also in the editing of an American edition of the *British Poets*, but the low state of his wife's health kept him in an uneasy condition, and when her death (27th October 1853) released him from the strain of anxiety, there came with the grief a readjustment of his nature and a new intellectual activity. At the invitation of his cousin, he delivered a course of lectures on English poets before the Lowell Institute in Boston in the winter of 1855. This first formal appearance as a critic and historian of literature at once gave him a new standing in the community, and was the occasion of his election to the Smith Professorship of Modern Language in Harvard College, then vacant by the retirement of Longfellow. Lowell accepted the appointment, with the proviso that he should have a year of study abroad. He spent his time mainly in Germany, visiting Italy, and increasing his acquaintance with the French, German, Italian, and Spanish tongues. He returned to America in the summer of 1856, and entered upon his college duties, retaining his position for twenty years. As a teacher he proved himself a quickener of thought amongst students, rather than a close and special instructor. His power lay in the interpretation of literature rather than in linguistic study, and his influence over his pupils was exercised by his own fireside as well as in the relation, always friendly and familiar, which he held to them in the classroom. In 1856 he married Miss Frances Dunlap, a lady who had since his wife's death had charge of his daughter Mabel.

In the autumn of 1857 *The Atlantic Monthly* was established, and Lowell was its first editor. He at once gave the magazine the stamp of high literature and of bold speech on public affairs. He held this position only till the spring of 1861, but he continued to make the magazine the vehicle of his poetry and of some prose for the rest of his life; his prose, however, was more abundantly presented in the pages of *The North American Review* during the years 1862–72, when he was associated with Mr Charles Eliot Norton in its conduct. This magazine especially gave him the opportunity of expression of political views during the eventful years of the War of the Union. It was in *The Atlantic* during the same period that he published a second series of *The Biglow Papers*. Both his collegiate and editorial duties stimulated his critical powers, and the publication in the two magazines, followed by republication in book form, of a series of studies of great authors, gave him an important place as a critic. Shakespeare, Dryden, Lessing, Rousseau, Dante, Spenser, Wordsworth, Milton, Keats, Carlyle, Thoreau, Swinburne, Chaucer, Emerson, Pope, Gray—these are the principal subjects of his prose, and the range of topics indicates the catholicity of his taste. He wrote also a number of essays, such as "My Garden Acquaintance," "A Good Word for Winter," "On a Certain Condescension in Foreigners," which were incursions into the field of nature and society. Although the great bulk of his writing was now in prose, he made after this date some of his most notable ventures in poetry. In 1868 he issued the next collection in *Under the Willows and other Poems*, but in 1865 he had delivered his "Ode recited at the Harvard Commemoration," and the successive Centennial historical anniversaries drew from him a series of stately odes.

In 1877 Lowell, who had mingled so little in party politics that the sole public office he had held was the nominal one of elector in the Presidential election of 1876, was appointed by President Hayes minister resident at the court of Spain. He had a good knowledge of Spanish language and literature, and his long-continued studies in history and his quick judgment enabled him speedily to adjust himself to these new relations. Some of his despatches to the home government were published in a posthumous volume—*Impressions of Spain*. In 1880 he was transferred to London as American minister, and remained there till the close of President Arthur's administration in the spring of 1885. As a man of letters he was already well known in England, and he was in much demand as an orator on public occasions, especially of a literary nature; but he also proved himself a sagacious publicist, and made himself a wise interpreter of each country to the other. Shortly after his retirement from public life he published *Democracy and other Addresses*, all of which had been delivered in England. The title address was an epigrammatic confession of political faith as hopeful as it was wise and keen. The close of his stay in England was saddened by the death of his second wife in 1885. After his return to America he made several visits to England. His public life had made him more of a figure in the world; he was decorated with the highest honours Harvard could pay officially, and with degrees of Oxford, Cambridge, St Andrews, Edinburgh, and Bologna. He issued another collection of his poems, *Heartsease and Rue*, in 1888, and occupied himself with revising and rearranging his works, which were published in ten volumes in 1890. The last months of his life were attended by illness, and he died at Elmwood on 12th August 1891. After his death his literary executor, Charles Eliot Norton, published a brief collection of his poems, and two volumes of added prose, besides editing his letters.

The spontaneity of Lowell's nature is delightfully disclosed in his personal letters. They are often brilliant, and sometimes very penetrating in their judgment of men and books; but the most constant element is a pervasive humour, and this humour, by turns playful and sentimental, is largely characteristic of his poetry, which sprang from a genial temper, quick in its sympathy with nature and humanity. The literary refinement which marks his essays in prose is not conspicuous in his verse, which is of a more simple character. There was an apparent conflict in him of the critic and the creator, but the conflict was superficial. The man behind both critical and creative work was so genuine, that through his writings, and speech, and action he impressed himself deeply upon his generation in America, especially upon the thoughtful and scholarly class who looked upon him as especially their representative. This is not to say that he was a man of narrow sympathies. On the contrary, he was democratic in his thought, and outspoken in his rebuke of whatever seemed to him antagonistic to the highest freedom. Thus, without taking a very active part in political life, he was recognized as one of the leaders of independent political thought. He found expression in so many ways, and was apparently so inexhaustible in his resources, that his very versatility and the ease with which he gave expression to his thought sometimes stood in the way of a recognition of his large, simple political ideality and the singleness of his moral sight.

WRITINGS.—The *Works of James Russell Lowell*, in ten volumes (Boston and New York, Houghton, Mifflin, and Co.), 1890; latest Literary Essays and Addresses, 1891; *The Old English Dramatists*, 1892; *Conversations on some of the Old Poets* (Philadelphia, David M'Kay) (reprint of the volume published in 1843, and subsequently abandoned by its author), 1893; *The Power of Sound: a Rhymed Lecture* (New York, privately printed), 1896; *Lectures on English Poets* (Cleveland, The Rowfant Club), 1899.

MEMOIRS.—*Letters of James Russell Lowell*, edited by CHARLES ELIOT NORTON, in two volumes (New York, Harper and Brothers), 1899.—*Life of James Russell Lowell*, by HORACE E. SCUDDER (Houghton, Mifflin, and Co.), 1901. (H. E. S*.)

Löwenberg, a town of the province of Silesia, Prussia, 39 miles east of Görlitz by rail. It is one of the oldest towns in Silesia, its town hall dating from the 16th century, and a Roman Catholic church from the 13th century (restored in 1862). In the town park there is a marble bust of Blücher (1841) by Rauch, and a monument of the war of 1813 has been erected near by. There are sandstone and gypsum quarries, linen, cotton, and woollen mills, and cultivation of fruit and vegetables. Population (1901), 5293.

Lówestoft, a watering-place, seaport, and municipal borough in the Lowestoft parliamentary division of Suffolk, England, 23 miles south-west of Norwich by rail. In 1885 the town was incorporated, and it is now governed by a mayor, 8 aldermen, and 24 councillors. Technical schools have been built, the town is provided with electric light, and it is proposed to lay down municipal electric tramways. The new town, or South Lowestoft, has an esplanade which, joining the south pier of the harbour, forms a long promenade. The trawl basin was extended in 1892, nearly doubling its size. About 600 smacks and fishing boats belong to the port. Altogether the harbour has between 6000 and 7000 feet of wharfage, and an area of about 50 acres, and the depth is 15–16 feet. The total value of the imports of foreign and colonial merchandise in 1900 was £148,883; of exports, £150,569. The port was entered and cleared by an aggregate of 1577 vessels of 226,079 tons in 1900. Population of municipal borough (2306 acres) (1881), 19,702; (1891), 23,347; (1901), 29,842.

Lozère, a department of the south-east of France, traversed by the Cevennes Mountains and watered by the Lot, the Tara, and the Allier.

Area, 1996 square miles. The population, 141,264 in 1886, had decreased to 124,049 in 1901. Births in 1899, 3438, of which 154 were illegitimate; deaths, 2690; marriages, 839. There were in 1896, 848 schools, with 29,000 pupils, the illiterate constituting 3 per cent. of the population. Out of 1,361,600 acres of cultivated land in 1896, 387,960 acres constituted all the plough-land, the rest of the department being almost all occupied by mountain pastures. The wheat crop of 1899 was valued at only £64,000; meslin, £32,000; rye, £172,000; the other cereals at much smaller values. The produce of the natural pastures and grass lands amounted in 1899 to the value of £312,000. The industrial crops (colza, rape, flax, &c.) make no figure in the official returns of 1899. The production of chestnuts, however, was valued at £41,000. Though in the returns of 1899 the production of mulberry leaves is left blank, yet the same year is credited with the production of 1685 cwts. of silk-worm cocoons. The live stock included in 1899, 317,670 sheep, 71,610 cattle, and 30,030 pigs, but domestic animals of other species were poorly represented. Mining in 1898 produced 900 tons of iron and 2600 tons of lead, while the metallurgic production reached a value of £1200. The industries are in a backward state. Mende, the capital, had, in 1901, 7319 inhabitants.

Luang Prabang, capital of the Lao state of that name, situated on the Me Kong river in 19° 54′ N. and 102° 9′ E. It nestles round the pagoda hill which rises about 200 feet above the plain on the promontory of land round which the Nam Kan winds to the main river. It has a population of about 9000 people. In 1887 it was taken and sacked by the Haw or Black Flags. In 1893 Siam was compelled to renounce her claims to the whole left bank of the Me Kong, including Luang Prabang and the magnificent highlands of Chieng Kwang, which thus now form part of the French Indo-Chinese possessions. That portion of the state which was on the right bank of the Me Kong was not affected by the treaty, except in so far as a portion of it fell within the sixteen miles' zone within which Siam agreed not to keep troops. What trade there is, is in the hands of a few Chinese or Sham traders; hill rice and other jungle products are imported from the surrounding districts by the Ka or hill people. The exports, which include gum benjamin, silk, wax, sticklac, cutch, cardamom, a little ebony, cinnamon, indigo, rhinoceros and deer horns, ivory, and fish roe, formerly all passed by way of Paklai to the Me Nam, and so to Bangkok, but have now almost entirely ceased to follow that route, the object of the French Government being to deflect the trade through French territory. The whole annual trade of the district does not probably exceed £80,000 in value. (See Laos.)

Lubao, a town in the south-western portion of the province of Pampanga, Luzon, Philippine Islands. It lies in a low, fertile, and extensive plain, which is especially suited to the growing of sugar. Many of its inhabitants occupy themselves in the neighbouring nipa swamps, either preparing the nipa leaves for use in house construction, or distilling alcohol from the juice secured by tapping the blossom stalks. Lubao has good water communication with Manila by means of tidal streams and Manila Bay, so that its products are readily marketed. The language is Pampangan. Population, 21,000.

Lübben, a town of Prussia, province of Brandenburg, on the Spree, 47 miles by rail south-south-east of Berlin. It is the chief town of the Spreewald, and has saw-mills, shoe factories, &c., and is famous for its *gurken*, or small pickling cucumbers. Population (1900), 6818.

Lübeck, a state and city of the German empire, situated on an arm of the Baltic Sea, between Mecklenburg and Holstein. (1) The city stands on the river Trave, 10 miles above its entrance into the Bay of Lübeck. In spite of the tendency to modernize its streets and private houses, Lübeck, owing to its churches, town hall (restored), and one or two other public buildings, still preserves something of the character of a mediæval town. The entrance hall of the Hospital of the Holy Ghost is a 13th-century chapel, restored in 1866, and painted by Olbers in 1898. Of modern buildings and institutions the most noteworthy are the law courts (1895), the Roman Catholic church (1889–91), the (Gothic) museum (1892), the synagogue (1880), the imperial post office (1885), the gymnasium (1891), the commercial institute, technical school, school of navigation, teachers' seminary, deaf and dumb asylum, lunatic asylum, zoological gardens, a statue of the poet Geibel (1889), and a fountain (1875) commemorative of the war of 1870–71. Geibel (1815–1884), like the painter Overbeck (1789–1869), was a native of Lübeck. This city is famous for the number as well as wealth of its charitable institutions. Its prosperity depends, and has always depended, principally upon its commerce. But its position as the first German emporium of the west end of the Baltic is being to some extent impaired by Hamburg and Bremen since the construction of the North Sea and Baltic Canal, and by the rapid growth and enterprise of Stettin. In order to counterbalance their rivalry, at all events to some extent, the quays have been extended, a canal (opened in 1900) has been constructed to connect the Trave with the Elbe, the river up to the wharves has been deepened to 25 feet or more (begun in 1900), and the harbour generally has been improved and enlarged. The river is kept open in winter by powerful ice-breakers. A new harbour was made in 1899–1900 on the Wakenitz Canal for boats engaged in inland traffic, more especially on the Elbe and Elbe–Trave Canal. Also, a new railway station is under construction on the right bank of the Trave, near the entrance to the port. Lübeck trades principally with Denmark, Sweden, Finland, Russia, the eastern provinces of Prussia, Great Britain, and the United States. The imports have increased in annual value from £9,721,700 in 1875 to £12,917,500 in 1895 and to £16,327,000 in 1899. The exports have likewise increased, namely, from £8,015,700 in 1875 to £10,553,000 in 1895 and to £12,975,000 in 1899. The number of vessels which entered the port increased from 2301 of 311,457 tons in 1880, to 2316 of 486,820 tons in 1895 and to 2820 of 556,550 tons in 1900. In this last year the merchant fleet numbered 25 vessels of 8830 tons. The industries are steadily growing in importance, the chief being breweries and distilleries, saw-mills and planing-mills, shipbuilding, fish-curing, the manufacture of machinery, engines, bricks, resin, preserves, enamelled and tin goods, cigars, furniture, soap, and leather. Population (1885), 55,399; (1895), 69,874; (1900), 82,098.

(2) The Free State (area, 115 square miles) embraces the city of Lübeck, the town of Travemünde (population, 1800), and various villages, situated partly around and between these two, and partly as exclaves in Lauenburg and Holstein, the total population being 83,324 in 1895 and 96,775 in 1900, of whom 47,784 were males and 48,991 females. The people are nearly all (97·5 per cent.) of the Lutheran faith. The state income was £296,500 in 1900–1, and the expenditure £311,000. About one-half of the income is derived from direct and indirect taxes, and the other half from domain lands, from interests and dividends, and from contributions from Imperial taxes and customs (Lübeck joined the Zollverein in 1868). The state debt amounted in 1900 to £1,617,300. In 1900 the state's contribution to the empire amounted to £41,965. Lübeck has one vote in the Federal Council of the empire, and sends one representative to the Imperial Diet. In 1900 the state possessed 4003 horses, 8542 cattle, 10,485 pigs, and 3175 sheep. Hay, potatoes, oats, rye, and wheat are the principal crops cultivated. The breweries in 1899 produced 2,706,000 gallons of beer.

(J. T. Be.)

Lublin, a province of Russian Poland, bounded on the north by Siedlce, on the east by Volhynia, on the south by Galicia, and on the west by Radom. Area, 6499 square miles. The surface is an undulating plain, built up of Cretaceous deposits, 800 to 900 feet in altitude, and reaching in one place 1050 feet; it is covered with thick forests of oak, beech, and lime, is intersected by countless ravines, and is thinly inhabited. A wide marshy lowland spreads between the Vistula and the Wieprz. It is drained by the Vistula in the west and by the Bug along its eastern frontier, as well as by their tributaries—Wieprz, San, Tanew, and Kushva. Parts of the province, being covered with black earth, are very fertile, but other parts are sandy. Owing to this fertility and the vicinity of good markets, agriculture is in a good condition and improving. Many Germans settled in the province before immigration was stopped by the law of 1887.

Nearly one-third of the total area is under forests; meadows and pastures cover nearly 320,000 acres, and the remainder is under the plough. Rye, oats, wheat, and potatoes are the chief crops, rye and wheat being considerable items of export. Flax, hemp, and beetroot are also cultivated. There were in 1894, 194,191 horses, 377,465 horned cattle, and 368,827 sheep, of which a great number were of finer breeds. In 1897 the population was 1,201,549, of whom 604,886 were women. The Greek Orthodox (chiefly Little Russians in the south-east) numbered 241,523, Roman Catholics (*i.e.*, Poles), 754,693; Jews, 170,541; Protestants, 33,669; and Baptists, 1086. The urban population was 148,196 in 1897. There were 34,107 military. The factories and other industrial establishments, 1538 in number, employ about 7000 workers, and consist chiefly of distilleries, sugar-works, steam flour-mills, tanneries, saw-mills, and factories of bent-wood furniture. Domestic industries are widely developed in the villages. The navigation of the rivers occupies a considerable portion of the population. There were in 1895, 610 schools, in which 30,183 children (7879 girls) received education, there being one school for every 1954, and one pupil for every 40 inhabitants. There was an agricultural institute at Nowa-Alexandrya, 1 seminary for teachers, 1 theological seminary, 6 gymnasia, 482 primary schools, and 105 Jewish *heders*. The government is divided into nine districts, the chief towns of which are Lublin, capital of the province (50,152 inhabitants in 1897); Bilgoray (6286); Chełm (19,236, with archæological museum); Hrubieszow (10,699); Janów (7927); Krasnystaw (8879); Lubartow (5249); Nowa-Alexandrya or Puławy (3892); and Tomaszów (21,041). (P. A. K.)

Lubny, a district town of Russia, government of Poltava, 14 miles from the Romodan station of the Kharkov–Nikolaev railway. It is a very old town, being mentioned in 1107. Almost from its foundation gardening has been a favourite occupation of the inhabitants, and Peter I. founded here a botanic garden for the cultivation of medical plants. Gardening and the preparation of jam, dried and pickled vegetables, &c., are carried on as a trade. The town has a meteorological observatory, two gymnasia, a lower agricultural school, &c., and has lately been growing. Population (1897), 10,108, or 12,445 with the suburbs.

Lubrication.—Our knowledge of the action of oils and other viscous fluids in diminishing friction and wear between solid surfaces has within recent years undergone a complete revolution, and from being purely empirical has become a connected theory, based on the known properties of matter, subjected to the definition of mathematical analysis and verified by experiment. The theory was published in 1886 (*Phil. Trans. Roy. Soc.*, 1886, pt. i. pp. 157–234); but it is the purpose of this article not so much to explain its application, as to give a brief account of the introduction of the misconceptions that so long prevailed, and of the manner in which their removal led to its general acceptance.

A revolution of ideas in physical science can result only from some discrepancy between the actual results observed, in certain circumstances, and the conclusions arrived at for the same circumstances by means of geometrical and physical analyses. Such discrepancies are evidence that some circumstance has been left out of account in the previous analyses, and indicate the need for an extension of the theory, though they do not, of necessity, furnish any clue to the particular circumstance omitted or indicate the character of the extension required. The circumstance, in respect of friction and lubrication, of which account was only taken after the year 1883, is altogether singular in the history of physics, since up to that year no one had any idea that our knowledge was other than purely empirical, involving no theoretical analysis, and hence subject to no discrepancy. Friction, or resistance to tangential shifting of matter over matter, whatever the mode and arrangement, differs greatly according to the materials, but, like all material resistance, is essentially limited. The range of the limits in available materials has a primary place in determining mechanical possibilities, and from the earliest times they have demanded the closest attention on the part of all who have to do with structures or with machines, the former being concerned to find those materials and their arrangements which possess the highest limits, and the latter the materials in which the limits are least. Long before the reformation of science in the 15th and 16th centuries both these limits had formed the subject of such empirical research as disclosed numerous definite although disconnected circumstances under which they could be secured; and these, however far from the highest and lowest, satisfied the exigencies of practical mechanics at the time, thus initiating the method of extending knowledge which was to be subsequently recognized as the only basis of physical philosophy. In this purely empirical research the conclusion arrived at represented the results for the actual circumstance from which they were drawn, and thus afforded no place for theoretical discrepancies. However, in the attempts at generalization which followed the reformation of science, opportunity was afforded for such discrepancies in the mere enunciation of the circumstances in which the so-called laws of friction of motion are supposed to apply. The circumstances in which the great amount of empirical research was conducted as to the resistance between the clean, plane, smooth surfaces of rigid bodies moving over each other under pressure, invariably include the presence of air at atmospheric pressure around, and to some extent between, the surfaces; but this fact had received no notice in the enunciation of these laws, and this constitutes a theoretical departure from the conditions under which the experience had been obtained. Also, the theoretical division of the law of frictional resistance into two laws—one dealing with the limit of rest, and the other asserting that the friction of motion, which is invariably less in similar circumstances than that of rest, is independent of the velocity of sliding—involves the theoretical assumption that there is no asymptotic law of diminution of the resistance, since, starting from rest, the rate of sliding increases. The theoretical substitution of ideal rigid bodies with geometrically regular surfaces, sliding in contact under pressure at the common regular surface, for the aërated surfaces in the actual circumstances, and the theoretical substitution of the absolute independence of the resistance of the rate of sliding for the limited independence in the actual circumstances, prove the general acceptance of the conceptions—(1) That matter can slide over matter under pressure at a geometrically regular surface; (2) That, however much the resistance to sliding under any particular pressure (the coefficient of friction) may depend on the physical properties of the materials, the sliding under pressure takes place at the geometrically regular surface of contact of the rigid bodies; and (3) as the consequence of (1) and (2), That whatever the effect of a lubricant, such as oil, might have, it could be a physical surface effect. Thus not only have these general theoretical conceptions, resulting from the theoretical laws of friction, failed to afford any indication that the lubricant may diminish the resistance by the mere mechanical separation of the surfaces, but they have absolutely precluded the idea that such might be the case. The result was that, notwithstanding the soundness of the method employed in the early start, and the continued efforts demanded by practical mechanics, all subsequent attempts to reduce the empirical facts, where a lubricant was used, to such general laws as might reveal the separate functions of the somewhat complex circumstances on which lubrication depends, and so afford guidance for further extension, completely failed. Thus in the early part of the year 1883 the science of lubrication had not advanced beyond the empirical stage.

This period of stagnation was terminated by an accidental phenomenon observed by Mr Beauchamp Tower, while engaged on his memorable research on the friction of the "journals" of railway carriages. His observation led him to a line of experiments which afforded conclusive evidence that in these experiments the general function of the lubricant was the mechanical separation of the metal surfaces by a layer of fluid of finite thickness, thus upsetting once for all the preconceived ideas as expressed in the laws of the friction of motion. On the publication of Mr Tower's reports (*Proc. Inst. M. E.*, November 1883), it was at once recognized by several physicists (*B. A. Report*, 1884, pp. 14, 625) that the evidence they contained afforded a rational basis for further study of the actions involved, indicating, as it does in no uncertain manner, the circumstances—namely, the properties of viscosity and cohesion possessed by fluids—account of which had not been taken in the previous theoretical conclusions. When this was recognized it also became apparent that continuous or steady lubrication, such as that of Mr Tower's experiments, is only secured when the solid surfaces separated by the lubricant are so shaped that the thickness at the ingoing side is greater than that at the outgoing side. With respect to what has already been said of the singular obscurity of the circumstances which were overlooked in the laws of friction, it is important to notice that the accidental circumstances which produced the phenomenon observed by Mr Tower are such as in all probability had never occurred before, so that their subsequent recurrence was equally improbable. Moreover, up to the present time these circumstances are unique in respect of the evidence they afford as to the mechanical action of the lubricant, the thickness of the film of which, although finite, is much too small to admit of direct measurement.

Thus it was the discovery by Mr Tower that the lubricant separated the solid surfaces, which put an end to the period of stagnation; while the appreciation of the significance of this discovery, which immediately followed, was the result of the preparation of the ground by the study of the properties of resistance possessed by all fluids to rates of distortional motion. The analyses of the viscous properties of fluids, and of the motions of fluids, when these viscous resistances are taken into account, have exercised the highest powers of mathematicians, even when no boundaries had to be considered. When the general equations of viscous fluids had, as the result of the labours of Navier (1822),[1] Cauchy,[2] Poisson,[3] St Venant,[4] and in 1845 of Sir G. Gabriel Stokes,[5] been shown to involve no other assumption than that the stresses, other than the pressure equal in all directions, are linear functions of the distortional rates of strain multiplied by a constant coefficient, it was found that the only solutions of which the equations admitted, when applied to fluids flowing between fixed boundaries, as water in a pipe, were singular solutions for steady or steady periodic motion, and that the conclusions they entailed, that the resistance would be proportional to the velocity, were for the most part directly at variance with the common experience that the resistances varied with the square of the velocity. This discrepancy was sometimes supposed to be the result of eddies in the fluid, but it was not till the year 1883 that it was discovered by experiments with colour bands that, in the case of geometrically similar boundaries the existence or non-existence of such eddies depended upon a definite relation between the mean velocity (U) of the fluid, the distance between the boundaries, and the ratio of the coefficient of viscosity to the density (μ/ρ), expressed by $UD\rho/\mu = K$, where K is a physical constant independent of units, which has a value between 1900 and 2000, and for parallel boundaries D is four times the area of the channel divided by the perimeter of the section (*Phil. Trans. R. S.* part iii., 1883, pp. 935–982). K is thus a criterion at which the law of resistance to the mean flow changes suddenly (as U increases), from being proportional to the flow, to a law involving higher powers of the velocity at first, but as the rates increase approaching an asymptote in which the power is a little less than the square.

This sudden change in the law of resistance to the flow of fluid between solid boundaries, depending as it does on a complete change in the manner of the flow—from direct parallel flow to sinuous eddying motion—serves to determine analytically the circumstances as to the velocity and the thickness of the film under which any fluid having a particular coefficient of viscosity can act the part of a lubricant. For as long as the circumstances are such that $UD\rho/\mu$ is less than K, the parallel flow is held stable by the viscosity, so that only one solution is possible—that in which the resistance is the product of μ multiplied by the rate of distortion, as $\mu\frac{du}{dy}$; in this case the fluid has lubricating properties. But when the circumstances are such that $UD\rho/\mu$ is greater than K, other solutions become possible, and the parallel flow becomes unstable, breaks down into eddying motion, and the resistance varies as ρu^n, which approximates to $\rho u^{1.78}$ as the velocity increases; in this state the fluid has no lubricating properties. Thus, within the limits of the criterion, the rate of displacement of the momentum of the fluid is insignificant as compared with the viscous resistance, and may be neglected; while outside this limit the direct effects of the eddying motion completely dominate the viscous resistance, which in its turn may be neglected. Thus K is a criterion which separates the flow of fluid between solid surfaces as definitely as the flow of fluid is separated from the relative motions in elastic solids, and it is by the knowledge of the limit on which this distinction depends that the theory of viscous flow can with assurance be applied to the circumstance of lubrication.

Until the existence of this physical constant was discovered, any theoretical conclusions as to whether in any particular circumstances the resistance of the lubricant would follow the law of viscous flow or that of eddying motion was impossible. Thus Mr Tower, being unaware of the discovery of the criterion, which was published in the same year as his reports, was completely thrown off the scent in his endeavour to verify the evidence he had obtained as to the finite thickness of the film by varying the velocity. He remarks in his first report that, "according to the theory of fluid motion, the resistance would be as the square of the velocity, whereas in his results it did not increase according to this law." That such a discrepancy, had it not been immediately removed by the recognition of the existence of the criterion, must still have obscured the subject, affords a proof that Mr Tower's discovery occurred at the earliest time that physical science was ready for its full appreciation. The rational theory of lubrication does not, however, depend solely on the viscosity within the interior of fluids, but also depends on the surface action between the fluid and the solid. In many respects the surface actions, as indicated by surface tension, are still obscure, and there has been a very general tendency to assume that there may be discontinuity in the velocity at the common surface. But whatever these actions may be in other respects, there is abundant evidence that there is no appreciable discontinuity in the velocity at the surfaces as long as the fluid has finite thickness. Hence in the case of lubrication the velocities of the fluid at the surfaces of the solids are those of the solid. In as far as the presence of the lubricant is necessary, such properties as cause oil in spite of its surface tension to spread even against gravity over a bright metal surface, while mercury will concentrate into globules on the bright surface of iron, have certainly an important place in securing lubrication where the action is intermittent, as in the escapement of a clock. If there is oil on the pallet, although the pressure of the tooth causes this to flow out laterally from between the surfaces, it goes back again by surface tension during the intervals; hence the importance of using fluids with low surface tension like oil, or special oils, when there is no other means of securing the presence of the lubricant.

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[1] *Mém. de l'Acad.*, vol. vi. p. 389.

[2] *Mém. des Sav. Étrang.*, vol. i. p. 40.

[3] *Mém. de l'Acad.*, vol. x. p. 345.

[4] *B. A. Report*, 1846.

[5] *Cambridge Phil. Trans.*, 1845 and 1857.

The differential equations for the equilibrium of the lubricant are what the differential equations of viscous fluid in steady motion become when subject to the conditions necessary for lubrication as already defined—(1) The velocity is below the critical value; (2) At the surfaces the velocity of the fluid is that of the solid; (3) The thickness of the film is small compared with the lateral dimensions of the surfaces and the radii of curvature of the surfaces. By the first of these conditions all the terms having ρ as a factor may be neglected, and the equations thus become the equations of equilibrium of the fluid; as such, they are applicable to fluid whether incompressible or elastic, and however the pressure may affect the viscosity. But the analysis is greatly simplified by omitting all terms depending on compressibility, and by taking μ constant; this may be done without loss of generality in a qualitative sense. With these limitations we have for the differential equation of the equilibrium of the lubricant:—

$$\left.\begin{array}{l} 0=\dfrac{dp}{dx}-\mu\nabla^2 u,\ \text{\&c., \&c.,}\ 0=\dfrac{du}{dx}+\dfrac{dv}{dy}+\dfrac{dw}{dz} \\ 0=p_{yx}-\mu\left(\dfrac{du}{dy}+\dfrac{dv}{dx}\right),\ \text{\&c., \&c.} \end{array}\right\} \quad . \quad (1)$$

These are subject to the boundary conditions (2) and (3). Taking x as measured parallel to one of the surfaces in the direction of relative motion, y normal to the surface, and z normal to the plane of xy by condition (3), we may without error disregard the effect of any curvature in the surfaces. Also v is small compared with u and w, and the variations of u and w in the directions x and z are small compared with their variation in the direction y. The equations (1) reduce to

$$\left.\begin{array}{l} 0=\dfrac{dp}{dx}-\mu\dfrac{d^2u}{dy^2},\quad 0=\dfrac{dp}{dy},\quad 0=\dfrac{dp}{dz}-\mu\dfrac{d^2w}{dy^2},\quad 0=\dfrac{du}{dx}+\dfrac{dv}{dy}+\dfrac{dw}{dz} \\ 0=p_{yx}-\mu\dfrac{du}{dy},\quad 0=p_{yz}-\mu\dfrac{dw}{dy},\quad p_{xz}=0. \end{array}\right\} \quad (2)$$

For the boundary conditions, putting $f(x, z)$ as limiting the lateral area of the lubricant, the conditions at the surfaces may be expressed thus:—

$$\left.\begin{array}{c} \text{when } y=0,\quad u=\mathrm{U}_0,\quad w=0,\quad v=0 \\ \text{when } y=h,\quad u=\mathrm{U}_1,\quad w=0,\quad v_1=\mathrm{U}_1\dfrac{dh}{dx}+\mathrm{V}_1 \\ \text{when } f(x, z)=0,\quad p=p_0 \end{array}\right\} \quad . \quad . \quad (3)$$

Then, integrating the equations (2) over y, and determining the constants by equations (3), we have, since by the second of equations (2) p is independent of y,

$$\left.\begin{array}{l} u=\dfrac{1}{2\mu}\dfrac{dp}{dx}(y-h)y+\mathrm{U}_0\dfrac{h-y}{h}+\mathrm{U}_1\dfrac{y}{h} \\ w=\dfrac{1}{2\mu}\dfrac{dp}{dz}(y-h)y \end{array}\right\} \quad . \quad . \quad (4)$$

Then, differentiating equations (4) with respect to x and z respectively, and substituting in the 4th of equations (2), and integrating from $y=0$ to $y=h$, so that only the values of v at the surfaces may be required, we have for the differential equation of normal pressure at any point x, z, between the boundaries:—

$$\frac{d}{dx}\left(h^3\frac{dp}{dz}\right)+\frac{d}{dz}\left(h^3\frac{dp}{dz}\right)=6\mu\left\{(\mathrm{U}_0+\mathrm{U}_1)\frac{dh}{dx}+2\mathrm{V}_1\right\} \quad . \quad (5)$$

Again differentiating equations (4), with respect to x and z respectively, and substituting in the 5th and 6th of equations (2), and putting f_x and f_z for the intensities of the tangential stresses at the lower and upper surfaces:—

$$\left.\begin{array}{l} f_x=\mu(\mathrm{U}_1-\mathrm{U}_0)\dfrac{1}{h}\mp\dfrac{h}{2}\dfrac{dp}{dx} \\ f_z=\mp\dfrac{h}{2}\dfrac{dp}{dx} \end{array}\right\} \quad . \quad . \quad . \quad (6)$$

Equations (5) and (6) are the general equations for the stresses at the boundaries at x, z, when h is a continuous function of x and z, μ and ρ being constant.

For the integration of equations (6) to get the resultant stresses and moments on the solid boundaries, so as to obtain the conditions of their equilibrium, it is necessary to know how x and z at any point on the boundary enter into h, as well as the equation $f(x, z)=0$, which determines the limits of the lubricating film. If y, the normal to one of the surfaces, has not the same direction for all points of this surface, in other words, if the surface is not plane, x and z become curvilinear co-ordinates, at all points perpendicular to y. Since, for lubrication, one of the surfaces must be plane, cylindrical, or a surface of revolution, we may put $x=\mathrm{R}\theta$, $y=r-\mathrm{R}$, and z perpendicular to the plane of motion. Then, if the data are sufficient, the resultant stresses and moments between the surfaces are obtained by integrating the intensity of the stress and moments of intensity of stress over the surface.

This, however, is not the usual problem that arises. What is generally wanted is to find the thickness of the film where least (h_0), and its angular position with respect to direction of load, to resist a definite load with a particular surface velocity. If the surfaces are plane, the general solution involves only one arbitrary constant, the least thickness (h_0); since in any particular case the variation of h with x is necessarily fixed, as in this case lubrication affords no automatic adjustment of this slope. When both surfaces are curved in the plane of motion there are at least two arbitrary constants, h_0, and ϕ the angular position of h_0 with respect to direction of load; while if the surfaces are both curved in a plane perpendicular to the direction of motion as well as in the plane of motion, there are three arbitrary constants, h_0, ϕ_0, z_0. The only constraint necessary is to prevent rotation in the plane of motion of one of the surfaces, leaving this surface free to move in any direction and to adjust its position so as to be in equilibrium under the load.

The integrations necessary for the solutions of these problems are practicable—complete or approximate—and have been effected for circumstances which include the chief cases of practical lubrication, the results having been verified by reference to Mr Tower's experiments. In this way the verified theory is available for guidance outside the limits of experience as well as for determining the limiting conditions. But it is necessary to take into account certain subsidiary theories. These limits depend on the coefficient of viscosity, which diminishes as the temperature increases. The total work in overcoming the resistance is spent in generating heat in the lubricant, the volume of which is very small. Were it not for the escape of heat by conduction through the lubricant and the metal, lubrication would be impossible. Hence a knowledge of the empirical law of the variation of the viscosity of the lubricant with temperature, the coefficients of conduction of heat in the lubricant and in the metal, and the application of the theory of the flow of heat in the particular circumstances, are necessary adjuncts to the theory of lubrication for determining the limits of lubrication. Nor is this all, for the shapes of the solid surfaces vary with the pressure, and more particularly with the temperature.

The theory of lubrication has been applied to the explanation of the slipperiness of ice. See *Manchester Memoirs*, 7th February 1899. (O. R.)

Lucca, a town, archiepiscopal see, and capital of the province of Lucca, Tuscany, Italy, 13 miles by rail north-east of Pisa. In the city, which is still encircled by its mediæval walls, there is a marble monument to Duchess Maria Louisa, who in 1820 built the aqueduct of 459 arches which brings water from the Pisan hills. The cathedral treasures embrace sculptures and other artistic objects, and a collection of 4000 MSS. In San Francesco, one of the seventy churches, are the tomb of Castruccio Castracane and the mausoleum of the Guidiccioni; while the figure of the archangel which crowns San Michele is the most conspicuous object within the city walls. There are also a technical school and an institute of music. The river Serchio affords water-power for numerous factories. The most important branches of industry are the manufacture of jute goods, tobacco, silks, and cottons. Lucca was the birthplace of the sculptor Civitale (1436–1501), whose masterpieces adorn the cathedral and the church of the Santa Trinita. Population (1881), 68,063; (1901), 74,718.

Lucca, Baths of.—The sketch in Heine's *Reisebilder: II. Italien*, should be mentioned. Population (1881), 8241; (1898), 9000.

Lucena, a town of Spain, in the province of Cordoba. The population in 1897 was 21,087. The local trade in agricultural products is still important, but the industries have greatly declined, except the manufactures of brandy, matches, and earthenware, especially the large jars used to contain oil or wine, some of which hold over 300 gallons.

Lucerne, one of the cantons of Switzerland, ranking next to Zürich and Bern. Its total area is 579 square miles; woods occupying 119 square miles; vineyards, ·1; and arable or pasture land, 408½ square miles. The loftiest point in the canton is Pilatus (6995 feet), to near the summit of which a cog-wheel railway runs from Alpnach-Stad, while on the other side of the lake is the equally accessible and famous ridge of the Rigi (5906 feet). The population of the canton in 1880 was 134,708, and in 1900, 146,912. In 1900 there were 253 inhabitants to the square mile. The Protestants had risen from 3823 in 1870 to 12,406 in 1900; in 1888 there were 201 Jews, and in 1900, 336; the rest of the population was Romanist. Practically the whole population is German-speaking; there were 2302 Italians and 781 French-speaking persons in 1900. The cantonal constitution of 1875 has only been slightly modified. There is a legislature, elected in the fifty-five electoral circles by a popular vote, and holding office for four years, as does the executive of seven members, elected by the legislature. Five thousand citizens can demand a "facultative referendum" as to all legislative projects, or the revision of the cantonal constitution, and can also end the mandate of the cantonal legislature before its term of office has expired. In 1893 a cantonal vote refused to sanction the introduction of proportional representation as to the election of members of the cantonal legislature. The state revenue of Lucerne in 1897 was 2,115,860 francs (a rise of 33½ per cent. since 1885); and the state expenditure, 2,116,112 francs (a rise of 32½ per cent. since 1885); but in 1898 there was a deficit of 35,792 francs. In 1897 the public debt of the canton was 6,789,000 francs.

See *Geschichtsfreund* (organ of the Hist. Soc. of the Four Forest Cantons). From 1844.—Von Liebenau. *Das alte Luzern.* Lucerne, 1881.—Pfyffer. *Geschichte d. Stadt u. Kant. Luzern.* New edition, 2 vols. Lucerne, 1861.—Von Segesser. *Rechtsgeschichte d. Staat u. Republik Luzern.* 4 vols. Lucerne, 1850–58; and *45 Jahre (1841–1887) im Luzernischen Staatsdienst.* Bern, 1887.—Sowerby. *The Forest Cantons of Switzerland.* London, 1892. (W. A. B. C.)

Lucerne, the chief town of the Swiss canton of that name. Lucerne is the tourist capital of Switzerland, being on the main route between Basel (59 miles distant by rail) and Italy *viâ* the St Gothard Railway. Its prosperity has always been bound up with the St Gothard Pass, so that the successive improvements effected on that pass (mule path in the 13th century, carriage road in 1820–30, railway in 1882) have always had much influence on its growth. In 1880 the population of the town was 17,758, and in 1900 it was 29,600. The inhabitants are mostly Romanist and German-speaking. In 1888 there were 2757 Protestants (as against 1912 in 1880) and 182 Jews, while 293 persons were French-speaking and 285 Italian-speaking.

The prehistoric antiquities, trophies from Sempach, &c., are all in the Rathhaus, not in the Cantonal Museum. It is the town (not the cantonal) library that is so rich in works relating to Swiss history; it is now the official centre wherein are gathered all such works or MSS. dating from before the Reformation. Next to the Lion Monument is the "Glacier Garden," a series of potholes worn in the rock bed of an ancient glacier by the action of water which whirls round stones; some of the actual stones still exist *in situ*.

The Lake of Lucerne (*Vierwaldstättersee*) is often called the "Lake of the Four Forest Cantons" (*i.e.*, Uri, Schwyz, Unterwalden, and Lucerne), but this is a mistranslation, for "wald" does not here mean "forest," but is a historical corruption of "vallis," so that the name simply means the four Alpine valleys that lie round the lake. The area of the lake is 44½ square miles; of this 15½ square miles belong to the canton of Lucerne, 13 square miles to Nidwalden, 1 square mile to Obwalden, 7½ square miles to Uri, and 7½ square miles to Schwyz. Its height above the sea-level is 1434 feet, while its maximum depth is 702 feet. The Bürgenstein is properly the Bürgenstock, and thither a funicular railway leads up from Kehrsiten, while from Alpnach-Stad a line runs up to Pilatus, and from Vitznau another to the Rigi. Flüelen is the port of Altdorf, and Brunnen of Schwyz—in each case both places are on the St Gothard Railway. It is possible (though authentic history is silent on the point) that meetings on the Grütli (properly Rütli, *i.e.*, the little "clearing" in the forest) may have taken place before the first league of 1291, or the second (after Morgarten) in 1315. But the date of 1307 was invented by Tschudi, and is historically quite impossible. (W. A. B. C.)

Luchu Archipelago, The (called also Riukiu, Loo-choo, and Liukiu), a long chain of islands stretching from a point 80 miles south of Kiushiu to a point 73 miles distant from the north-eastern coast of Formosa, and lying between 24° and 30° N. and 123° and 130° E. The almost equal proximity of the islands to Japan on the north and to the formerly Chinese island of Formosa on the south accounts for the dual allegiance their inhabitants paid for many years to the two neighbouring empires, and also for the mixture of Japanese and Chinese elements in their civilization. The islanders themselves carry their history far back into the ages, but we do not find ourselves upon unquestionably solid ground until the beginning of the 17th century, when the feudal chief of Satsuma, resenting an attempt on the part of the islanders to sever relations with Japan, invaded Luchu and annexed the northern section of the archipelago. China, on the other hand, though receiving periodically from the Luchuans presents which she interpreted as tribute, and though taking a benevolent interest in the welfare of the islanders, never made any display of force or attempted to bring them under her military sway. The practical incongruity of that state of affairs did not force itself upon Japan's attention so long as her own empire was divided into a number of semi-independent principalities. But in 1879 the Japanese Government, treating Luchu as an integral part of the Mikado's dominions, dethroned its prince, pensioned him as the other feudal chiefs had been pensioned, and converted Luchu into a prefecture under the name of Okinawa. This name signifies "extended rope," and alludes to the lengthy attenuated nature of the archipelago. China remonstrating, a conference was held in Peking, when plenipotentiaries of the two empires signed an agreement in the sense that the archipelago should be divided equally between the claimants. The Chinese Government, however, refused to ratify this compromise, and the Japanese, abandoning all hope of an amicable settlement, continued their measures for the effective administration of all the islands. Ultimately (1895) Formosa also came into Japan's possession, and her title to the whole chain of islands is no longer disputed.

Japanese cartographers reckon the Luchu islands as 55, having a total coast-line of 768 miles, an area of 935 square miles, and a population of 453,550 (1898). They divide them into three main groups, of which the northern is called Oshima-shotô; the central, Okinawa-guntô; and the southern, Sakishima-rettô. The terms *shotô*, *guntô*, and *rettô* signify "archipelago," "cluster of islands," and "string of islands" respectively. The last-named group is subdivided into Miyako-guntô and Yayeyama-guntô. The principal islands of these various groups are:—

Oshima-shotô—				
Anami-Oshima . .	34	miles long and	17	broad
Tokuno-shima . .	16	,, ,,	8½	,,
Okinawa-guntô—				
Okinawa-jima . .	63½	miles long and	14½	broad
Kume-jima . .	9¾	,, ,,	7½	,,
Okinoerabu-jima .	9½	,, ,,	5	,,
Ihaya-jima . .	5	,, ,,	2½	,,
Miyako-guntô—				
Miyako-jima . .	12¼	miles long and	12	broad
Erabu-jima . .	4¾	,, ,,	3½	,,
Yayeyama-guntô—				
Ishigaki-jima . .	24½	miles long and	14½	broad
Iriomote-jima . .	14½	,, ,,	14	,,
Yonakuni-jima . .	7⅓	,, ,,	3½	,,

The remaining islands of the archipelago are of very small size. Almost at the extreme north of the chain there are two islands with active volcanoes: Nakano-shima (3485 feet), and Suwanose-jima (2697 feet), but the remaining members of the group give no volcanic indications, and the only other mountain of any size is Yuwan-dake (2299 feet) in Anami-Oshima. The capital town is Shuri in Okinawa, with a population of 24,809. The scenery of Luchu is unlike that of Japan. Though so close to the tropics, the islands cannot be said to present tropical features: the bamboo is rare; there is no high grass or tangled undergrowth; open plains are numerous; the trees are not crowded together; lakes are wanting; the rivers are insignificant; and an unusual aspect is imparted to the scenery by numerous coral crags. The climate is, of course, much warmer than that of Japan, the mean normal temperature in Nafa, the chief town of Okinawa, being 22° 5′ C., whereas that in Tôkyô is only 14° C. The maximum range of the thermometer during summer does not greatly differ in the two places; but while the lowest reading for Tôkyô in winter is − 6° 4′ C., the corresponding figure at Nafa is 8° 3′ C., a difference of over 14° C.

Luchu is noted for the production of particularly durable vermilion-coloured lacquer, which is much esteemed for table utensils in Japan. The islands also manufacture certain fabrics which are considered a speciality. These are *Riukiu-tsumugi*, a kind of fine pongee; the so-called *Satsuma-gasuri*, a cotton fabric greatly used for summer wear; *bashô-fu*, or banana-cloth (called also *aka-bashô*), which is woven from the fibre of a species of banana; and *hoso-jôfu*, a particularly fine hempen stuff, made in Miyako-jima, and demanding such difficult processes that six months are required to weave and dye a piece 9½ yards along.

Population and customs.

It has been generally agreed by competent observers that although the upper classes in Luchu and Japan resemble each other almost to identity, there are palpable differences between the lower classes, the Luchuans being shorter and better proportioned than the Japanese, having higher foreheads, eyes not so deeply set, faces less flattened, arched and thick eyebrows, better noses, less marked cheek-bones, and much greater hairiness. The last characteristic has been attributed to the presence of Ainu blood, and has suggested a theory that when the Japanese race entered south-western Japan from Korea, they drove the Ainu northwards and southwards, one portion of the latter finding their way to Luchu, the other to Yezo. Women of the upper class never appear in public in Luchu, and are not even alluded to in conversation, but women of the lower orders go about freely with uncovered faces, attending market, carrying loads on their heads, and doing their share of agricultural labour. The Luchu costume resembles that of Japan, the only marked difference being that the men use two hairpins, made of gold, silver, pewter, or wood, according to the rank of the wearer. Young men shave their faces until the age of twenty-five, after which moustache and beard are allowed to grow, though the cheeks are kept free from hair. Their burial customs are peculiar. The corpse, immediately after death, is concealed by curtains and guarded by relatives, who also accompany it to the grave. The mourning, however, is done by professionals, who on the way to the tomb groan, stagger, and weep as though they were completely overcome with grief. Sepulchres are generally mitre-shaped, and are scattered all over the country, according to Chinese fashion. In the third year after interment, the nearest of kin wash the bones and deposit them "in earthenware urns of curious make, ornamented with the lotus and other emblems that bear witness to a formerly penetrating Buddhist influence, now almost extinct. The remains of married couples rest together in the same large urn. Bachelors and spinsters—but Luchu harbours few such—have urns half the size. All the urns of a family are ranged round the interior of the vault on shelves, in order of precedence." The marriage customs are still more peculiar. Preliminaries are negotiated by a middleman, as in China and Japan, but the subsequent procedure takes the following form:—"The bride is escorted to the man's house at one or two o'clock in the morning, surrounded by all her relations. . . . She and the bridegroom exchange cups of *sake*"—precisely the Japanese custom—"after which she is at once led home again. This brief ceremony is repeated three nights running, after which she remains three days with her parents, while the bridegroom is carried off by his friends to a brothel, where they hold high revel. The object of this step, so far as the man is concerned, is that he may, on the very threshold of matrimony, prove his independence of wifely leading-strings, while to the woman it gives an opportunity to display freedom from jealousy, which is considered the worst of all feminine vices. After three days spent in this manner, the bridegroom goes home, being joined by the bride, who keeps house with him for another period of three days, at the expiration of which the bride goes to her parents' home, whither the bridegroom follows her. Her relations await his arrival with a pestle, painted and ornamented to represent a horse, on which he rides in, while all the boys of the neighbourhood greet his advent with drums and tomtoms and anything that will make a noise. A grand family feast then takes place, after which the happy couple return home, and the long wedding ceremonies are at last concluded."

The chief staple of the people's diet is sweet potatoes, and pork is the principal luxury, as in China. An ancient law, still in force, requires each family to keep four pigs. In times of scarcity a species of sago (obtained from the *Cycas revoluta*) is eaten. The country is infested with venomous snakes called *habu* (*Trimeresurus*), which attain a length of from 6 to 7 feet and a diameter of from 2½ to 3 inches. Their bite generally causes speedy death, and in the island of Anami-Oshima they claim many victims every year. There is a remarkable absence of religious influence in Luchu. Places of worship are scarcely to be seen, and the only function now discharged by Buddhist priests seems to be to officiate at funerals. On the other hand, the people are distinguished by gentleness, courtesy, and docility, as well as by marked avoidance of crime and practical love of peace. With the exception of petty thefts, their Japanese administrators find nothing to punish, and for nearly three centuries no such thing as a lethal weapon has been known in Luchu. Professor Chamberlain records his opinion that the Luchuan language resembles the Japanese in about the same degree as Italian resembles French, and says that a little investigation proves the two to be sister tongues, many words being identical, others differing only by letter changes which follow certain fixed analogies, and sentences in the one being capable of translation into the other word for word, almost syllable for syllable. (F. BY.)

Luckenwalde, a town of Prussia, on the Nuthe, 30 miles south of Berlin by rail, in the circle of Jüterbog-Luckenwalde, government district of Potsdam, province of Brandenburg. It has three Protestant churches, a Catholic church, a *real*-progymnasium, a higher-grade school, cloth, hat, bronze-ware, paper, and enamel factories, wool-spinning, and machinery works. Population (1890), 18,398; (1900), 20,986.

Lucknow, a city, district, and division of British India, the capital of Oudh, mainly on the right bank of the winding river Gumti, which is crossed by two railway and three road bridges, 364 feet above the sea; 46 miles by rail north-east of Cawnpore, and 610 miles from Calcutta. Area, about 13 square miles. Population (1881), 261,303; (1891), 273,028; (1901), 263,951, being the fifth largest city in India. The municipality of Lucknow, with a population of 267,910, is governed by a board of 32 members, of whom 24 are elected, with the district magistrate as *ex officio* chairman. The municipal income in 1897–98 was Rs.3,96,439, of which Rs.2,70,961 was derived from octroi; incidence of taxation, R.1:2:2 per head. The water-works supply annually about 350,000,000 gallons of filtered water, at a total cost of about 6 annas per thousand gallons. During 1897–98, Rs.56,788 was expended on water-supply, Rs.6856 on drainage, and Rs.29,666 on other public works. The death-rate in 1897 was 55·03 per thousand, compared with an average of 42·47 for the previous five years. The chief educational institution is the aided Canning College, with an Oriental department; the number of students in 1896–97 was 258. There are also two unaided colleges, the Christian and the Women's, with a total of 34 students; the Colvin School, for sons of Taluqdars, the landlords of Oudh, with 32 pupils, of whom 14 were Mahommedans; the Crosthwaite Girls' School, for the higher education of native ladies, under an English lady superintendent, supported by an endowment of about Rs.2,00,000, with 19 pupils; the Martinière, where about 150 soldiers' children are educated entirely free of expense out of a foundation left by General Claude Martin in 1800; and several high schools. Mention should also be made of the Lady Lyall Hospital, with an endowment of about Rs.1,00,000; and of the Government lunatic asylum, with 247 inmates. There are about 140 printing-presses, issuing 3 English and 30 vernacular newspapers. The largest manufactory is a paper-mill, employing 550 hands, with an out-turn valued at Rs.7,60,000. There are also a flour-mill, and factories for ice and mineral waters. The native manufactures of gold and silver brocade, muslins, embroidery, glasswork, and moulding in clay maintain their reputation. Lucknow is the centre of the Oudh and Rohilkhand railway system, with large workshops. Lines radiate to Cawnpore, Bareilly, Gonda, Faizabad, and Rae Bareli. In 1898 the last line was extended to Benares, 139 miles. Lucknow is the headquarters of the Oudh military division. The cantonments, 3 miles east of the city, usually contain 3 batteries of artillery, and both European and native regiments of cavalry and infantry.

The district of LUCKNOW lies on both sides of the river Gumti. Area, 967 square miles; population (1881), 696,824; (1891), 774,163; and (1901), 793,334, showing an increase of 11 per cent. between 1881 and 1891, and of 2·47 per cent. between 1891 and 1901; average density, 820 persons per square mile; land revenue and rates, Rs.7,65,965, the incidence of assessment being R.1:7:0 per acre; cultivated area, 277,183 acres, of which 108,641 were irrigated from wells, &c.; number of police, 2591; number of vernacular schools (1896–97), 76, with 3244 pupils; death-rate (1897), 43·38 per thousand.

The division of LUCKNOW contains the western half of Oudh. It comprises the six districts of Lucknow, Unao, Sitapur, Rae Bareli, Hardoi, and Kheri. Area, 12,040 square miles; population (1881), 5,325,601; (1891), 5,856,559; and (1891), 5,977,116, showing an increase of 10 per cent. between 1881 and 1891, and of 2·06 per cent. between 1891 and 1901; average density, 496 persons per square mile. (J. S. CO.)

Lucon, a French town in the arrondissement of Fontenay-le-Comte, department of Vendée, 19 miles south-east of La Roche sur Yon, on the railway from Nantes to Bordeaux, and on the canal of Lucon (9 miles long), which affords communication with the sea in the Bay of Aiguillon. Between Lucon and the sea stretch wide marshy plains, the bed of the former gulf, partly drained by numerous canals, and in the reclaimed parts yielding excellent pasturage, while in other parts are productive salt-marshes, and ponds for the rearing of mussels and other shell-fish. Lucon is the seat of a bishopric, established in 1317, and held by Richelieu from 1607 to 1624, but the cathedral church, partly of the 11th century and partly of various later periods, was originally an abbey church. The façade and the clock tower date from about 1700, and the tower is surmounted by a notched spire rising to a height of 275 feet above the ground, attributed to the architect François Leduc of Tuscany. In the choir, which dates from the 14th century, are some remains of mural paintings. The cloisters are of the 15th or 16th century. Adjacent is the bishop's palace, with a theological library of 30,000 volumes, and there is a very fine public garden. The town has some small industries, including the manufacture of liqueurs, mustard, clogs, and boot-heels, and iron and copper founding. Population (1881), 5835; (1901), 6757.

Lüdenscheid, a town of Prussia, province of Westphalia, 19 miles by rail south-south-east of Hagen. It is the seat of various hardware manufactures (metal-plated and tin-plated goods, buckles, fancy nails, &c.), iron-foundries, and machine shops, and has a couple of churches, and monuments to the Emperor William I. and the war of 1870–71. Population (1885), 15,067; (1900), 25,520.

Ludhiana, a town and district of British India, in the Jullundur division of the Punjab. The town is 8 miles from the present left bank of the Sutlej, 228 miles by rail north-west of Delhi. Population (1881), 44,163; (1891), 46,134; municipal income (1897–98), Rs.84,381; death-rate (1897), 46 per thousand. It is an important centre of trade in grain, and has manufactures of shawls, &c., by Kashmiri weavers, and of scarves, turbans, furniture, and carriages. The municipality has raised a loan of Rs.38,000 for sewerage works. There is an American Presbyterian mission, besides a medical school for Christian women, founded in 1894, with a staff of four lady doctors and 24 students in 1896–97; three high schools, including a Christian boys' boarding-school; 2 middle schools; a Sanskrit school; and an industrial school, opened in 1896, with 77 pupils. There are ten printing-presses, issuing five newspapers and periodicals, and four religious and educational associations.

The district of LUDHIANA lies south of the river Sutlej, and north of the native states of Patiala, Jhind, Nabha, and Maler Kotla. Area, 1453 square miles; population (1881), 618,835; (1891), 648,722; (1901), 673,502, showing an increase of 5 per cent. between 1881 and 1891, and of 3·82 per cent. between 1891 and 1901; average density, 463 persons per square mile. The land revenue and rates in 1897–98 were Rs.11,16,131, the incidence of assessment being R.1:4:2 per acre; cultivated area, 669,236 acres, of which 275,292 were irrigated from wells, &c., including 91,383 from Government canals; number of police, 507; number of schools (1896–97), 275, attended by 9489 boys, being 16 per cent. of the boys of school-going age; death-rate (1897), 34·7 per thousand. The principal crops are wheat, millet, pulse, maize, and sugar-cane. The district is crossed by the main line of the North-Western railway from Delhi to Lahore, 35 miles. Part of it is watered by the Sirhind canal.

Ludington, a city of Michigan, U.S.A., capital of Mason county, on the western shore of the Lower Peninsula of Michigan, on the Pere Marquette railroad, at an altitude of 587 feet. It has an excellent harbour and much lake commerce. It contains several saw-mills and other wood-working establishments. Population (1880), 4190; (1890), 7517; (1900), 7166.

Ludinovsk, a town of Russia, government of Kaluga, 27 miles by rail from the Zhukovka station of the Orel and Smolensk railway. It belongs to the group of iron and glass works, the so-called "Maltsoff's Works." It was founded in 1755, but attained its present importance after 1875, when iron works and large locomotive and railway-carriage works were opened. Population (1897), 12,000.

Ludwig II., Otto Friedrich Wilhelm, king of Bavaria (1845–1886), was born at Munich on the 25th of August 1845, as eldest son of Prince Maximilian, son and heir to the king, Ludwig I. His mother was Maria, daughter of Prince William of Prussia (brother of King Friedrich William III.), and therefore first cousin to the Emperor William I.; she joined the Roman Catholic Church in 1874, and died in 1889. During the revolution of 1848 Ludwig I., whose passion for Lola Montez had caused a temporary quarrel between him and his subjects, abdicated; he lived in retirement till 1868. Maximilian, who then succeeded, died on the 10th of March 1864; Ludwig therefore came to the throne at the early age of eighteen. From both his father and grandfather he had inherited a keen interest in art, and almost the first use which the young king made of his power was to summon Richard Wagner to Munich. Admiration for his musical genius became the basis for a warm personal friendship, which was looked on with much displeasure by the people of Munich, and especially by the Clerical party, who declared that Wagner was a Prussian agent. The king caused his operas to be performed, and formed great projects of establishing a new school of music under Wagner's direction, as well as of enabling the musician to realize his dream of a magnificent festival-house for opera and concerts, a plan to which he was naturally attracted by his hereditary taste for building. He was, however, compelled to give way before the opposition of his ministers and subjects, and had eventually to request Wagner to leave Munich. The friendship thus begun continued till Wagner's death; on more than one occasion the king visited him privately in Switzerland, and he gave valuable support and assistance to the erection of the opera-house at Bayreuth. From the first Ludwig's interest in political affairs was spasmodic and uncertain; he showed at times much intelligence and insight, but after the first year of his reign he avoided appearing in public, and caused much inconvenience to his ministers by prolonged absence. His strongest feeling was dislike to the Ultramontanes, and in this he continued the policy of his house, but it was increased by their opposition to Wagner. He took no part and apparently little interest in the crisis of 1866, though the very existence of Bavaria was in danger, but after the war was over he gave his warm support to the Liberal ministry of Hohenlohe, and characteristically, as a symbol of the new alliance with Prussia, offered the Prussian king the joint ownership of the castle of Nuremberg, the ancient home of the Hohenzollerns. When Hohenlohe was defeated in the election of 1869 the king refused to accept his resignation, and would not receive a deputation from Parliament which called to present an address praying him to dismiss his ministers: he reprimanded those members of the royal family, including his uncle Prince Luitpold, who had voted against his ministers. He was obliged eventually to accept Hohenlohe's resignation, but his dislike of the Ultramontanes was of much value to Germany, when in 1870 he came for a short term into a position of great political importance. A considerable party in Bavaria would gladly have refused the assistance which by treaty they were bound to give to Prussia; the king, however, by promptly ordering the mobilization of the army, ensured the fidelity of Bavaria to the German cause. As in 1866, he took no part in the campaign, and he was one of the very few German princes who never appeared at Versailles; Bavaria was represented by Prince Luitpold. As ruler of the chief of the German states, it fell to Ludwig, in the name of the German princes, to invite the king of Prussia to assume the title of emperor. This he did in a letter of 17th November to the king and in a circular despatch to the rulers of the other states. His name thereby was closely associated with the foundation of the empire, and the reputation of a patriotic prince added to the popularity which his artistic interests, his personal appearance, and his romantic habits had already secured him. Both letters, as is now known, were copied from drafts sent to him by Bismarck, for the king was unable to bring himself without assistance to take this step. While he acquiesced in the new position which Bavaria occupied, he did not always succeed in veiling the jealousy with which he regarded the new greatness of the Hohenzollerns. In the following years he continued his support to the Liberals, though he scarcely ever spoke to his ministers, and protected the Old Catholics and Döllinger, who had been his tutor, when they refused to accept the Papal infallibility. As years went on the marks of the mental disease to which he finally fell a victim became more apparent. A visit to Paris in 1874 stirred up afresh the passion for building. He seems to have taken Louis XIV. and Louis XV. as his models. Already he had made great additions to the castle of Hohenschwangau, which had been erected by his father; he built two magnificent palaces at Neu Schwanstein and Lindenhof in the Bavarian highlands; then he began a fourth, which was to be an imitation of Versailles, not only in style but in magnificence, on an island in the Chiemsee. Financial difficulties caused by this profuse expenditure made it necessary to interfere. An inquiry ordered by the ministers disclosed abundant evidence of insanity, of which the most marked symptom was the avoidance of all human intercourse, and on 10th June 1886 a proclamation was published creating Prince Luitpold regent on the ground that the king was incapable of reigning. The procedure was that required by the constitution. After some difficulty Ludwig, who attempted to resist, was placed in confinement in Berg, one of the royal palaces. On 13th June he was allowed to go out walking with a single medical attendant; in the evening both were discovered drowned in the lake adjoining the castle. It is probable that the king had attempted to escape by swimming across the lake, and that the doctor had been drowned in the attempt to prevent this.

Ludwig was unmarried, an engagement to the Duchess Sophie, daughter of Maximilian, duke of Bavaria, having been broken off. He was therefore succeeded by his only brother, Otto (born 1848). As the new king had since 1872 suffered from an incurable mental disease, Prince Luitpold was reappointed regent. He was born on the 12th of March 1821, and was the third son of King Ludwig I., the second being Otto, king of Greece, who had died without issue. Though more favourably inclined to the Clerical party than his nephew had been, he made no sudden change in the Government, but he gradually brought to an end the long struggle over the Old Catholics. While a loyal adherent of the imperial constitution, he showed himself able to maintain the privileges and dignity of Bavaria as an equal ally of Prussia. In case of the death of King Otto the succession rested with him or his sons. He married a daughter of Leopold II., grand duke of Tuscany, and his two eldest sons, Ludwig and Leopold, were also married to Austrian princesses, one to Marie of Modena, the other to Gisela, daughter of the emperor of Austria; both had numerous families, so that the continuance of the succession appears secured.

See L. v. Kobell. *Unter den vier ersten Königen Bayerns* and *König Ludwig II. und Fürst Bismarck im Jahre* 1870.—Carl v. Heigel. *König Ludwig II. v. Bayern.*—C. Beyer. *König Ludwig II. v. Bayern.*—Frances Gerard. *The Romance of Ludwig II. of Bavaria.*

(J. W. He.)

Ludwig, Carl Friedrich Wilhelm (1816–1895), German physiologist, was born at Witzenhausen, near Cassel, on 29th December 1816. After attending the gymnasium at Hanau, he studied medicine at Erlangen and Marburg, taking his doctor's degree at the latter university in 1839. He made Marburg his home for the next ten years, studying and teaching anatomy and physiology, first as prosector to Fick (1841), then as *privat-docent* (1842), and finally as extraordinary professor (1846). In 1849 he was chosen professor of anatomy and physiology at Zürich, and six years afterwards he went to Vienna as professor in the Josephinum (school for military surgeons). In 1865 he assumed the duties of the newly-created chair of physiology at Leipzig, and continued to perform these for thirty years, until his death on 23rd April 1895. Ludwig's name is prominent in the history of physiology, and he had a large share in bringing about the change in the method of that science which took place about the middle of the 19th century. Together with his friends Helmholtz, Brücke, and du Bois-Reymond, whom he met for the first time in Berlin in 1847, he rejected the assumption then generally accepted that the phenomena of living animals depend on special biological laws and vital forces different from those which operate in the domain of inorganic nature; and, insisting that they are to be defined in physical and chemical terms, he sought to explain them by reference to the same laws as are applicable in the case of physical and chemical phenomena. This point of view was expressed in his celebrated *Text-Book of Human Physiology* (1852–56), which was dedicated to the three friends mentioned above, but it is as evident in his earliest paper (1842) on the process of urinary secretion as in all his subsequent work. As an original investigator, Ludwig exercised enormous influence on the progress of physiology, not only by the discoveries he made, but also by the new methods and apparatus he introduced to its service. Thus in regard to secretion, he showed that secretory glands, such as the submaxillary, are something more than mere filters, and that their secretory action is attended by chemical and thermal changes both in themselves and in the blood passing through them. He demonstrated the existence of a new class of secretory nerves that control this action, and by showing that if the nerves are appropriately stimulated the salivary glands continue to secrete, even though the animal be decapitated, he initiated the method of experimenting with excised organs. In studying the movements of the blood and lymph in the body, he devised the kymograph as a means of obtaining a written record of the variations in the pressure of the blood in the blood-vessels; and this apparatus not only conducted him to many important conclusions respecting the mechanics of the circulation, but afforded the first instance of the use of the graphic method in physiological inquiries, to which it has since been widely applied. For the purpose of his researches on the gases in the blood, he designed the mercurial blood-pump which in various modifications has come into extensive use, and by its aid he made many investigations on the gases of the lymph, the gaseous interchanges in living muscle, the significance of oxidized material in the blood, &c. There is indeed scarcely any branch of physiology, except the physiology of the senses, to which he did not make important contributions. He was also a great power as a teacher and the founder of a school. A keen judge of the abilities of his pupils, he had also a remarkable faculty for awakening their enthusiasm and for inciting them to do the best of which they were capable. Under him the Physiological Institute at Leipzig became an organized centre of physiological research, whence issued a steady stream of original work; and though the papers containing the results usually bore the name of his pupils only, every investigation was inspired by him and carried out under his personal direction. Thus his pupils gained a practical acquaintance with his methods and ways of thought, which could scarcely have been acquired by mere attendance at lectures, and, coming as they did from all parts of Europe, they returned as apostles to their own countries to spread and extend his doctrines. It need scarcely be added that Ludwig was no anti-vivisectionist. Possessed himself of extraordinary manipulative skill, he abhorred rough and clumsy work, and he insisted that experiments on animals should be planned and prepared with the utmost care, not only to avoid the infliction of pain (which was also guarded against by the use of an anæsthetic), but to ensure that the deductions drawn from them should have their full scientific value. (H. M. R.)

Ludwigsburg, a town of Germany, in Würtemberg, 9 miles north of Stuttgart by rail. It contains the magnificent palace of the kings of Würtemberg. In 1882 the sculptor Hofer presented to the town a marble statue of Schiller. It has developed considerable industrial activity in organs, chemicals, cloth, linens, cottons, gold and silver wire, and beer. Population (1885), 16,201; (1900), 19,359.

Ludwigshafen, a rapidly-growing industrial town of Bavaria, Germany, on the left bank of the Rhine, immediately opposite to Mannheim, in the Palatinate district. It has a fast-increasing trade in iron, timber, coal, and agricultural products, a trade which is fostered by a free harbour (opened in 1897); and also large factories for aniline dyes and soda, iron-foundries, and production of cellulose, artificial manure, artificial wool, vehicles, flour and malt, saw-mills and breweries. The place, which was first founded in 1843, was only made a town in 1859. Population (1885), 21,042; (1900), 61,905.

Ludwigslust, a town of Germany, grand-duchy of Mecklenburg-Schwerin, 22 miles by rail south by east of Schwerin. The castle, built by Duke Christian Ludwig in 1772–79, was the favourite autumn residence of the grand-duke. There are also a couple of other ducal residences, a fine park, and a monument of the Grand-Duke Frederick Francis I. (1869). The parish church is in the form of a Greek temple. Population (1900), 6634.

Lugano, the most important town in the Swiss canton of Tessin or Ticino, though Bellinzona is the sole political capital. It is 124¼ miles by the St Gothard railway from Lucerne, and 48½ miles from Milan. The ancient church of San Lorenzo has since 1888 been the see of the bishop of Lugano, which is held for the present with that of Basel. There are railways from Lugano (902 feet) up Monte San Salvatore, and up Monte Generoso opposite. Population (1888), 7097; (1900), 9553.

Lugano, Lake of, has an area of 19·4 square miles, of which 7·5 square miles belong to Switzerland and 11·9 square miles to Italy. It is 899 feet above the level of the sea, while its greatest depth is 945 feet. It is traversed between Melide and Bissone by a great stone dam (with openings at each end), over which the high road and the St Gothard railway are carried.

Lugansk (also LUGAÑ and LUGANSKIY ZAROD), a district town of Russia, government and 143 miles north-east of Ekaterinoslav, on the Catherine railway. It has a gymnasium, a technical railway school, and a first-class meteorological observatory, besides cast-iron, steel, and cartridge works belonging to the Crown, distilleries, breweries, tanneries, soap and candle works, and steam flour-mills. Population (1897), 20,419.

Luganskaya, Cossack village of Russia, province of the Don Cossacks, on Lake Stanichnoye, 70 miles east of Bakhmut railway station. It is a wealthy village, with considerable trade in corn and exports of different kinds of raw produce, &c. Population (1897), 20,381.

Lugo, a town of the province of Ravenna, Emilia, Italy, 18 miles west of Ravenna, on a branch line which joins the Bologna–Brindisi railway at Faenza. An important fair is held during September. There are manufactures of ropes, furniture, and ironmongery. Population, 17,500.

Lugo, a maritime province in the north-east of Spain. Its area is 3787 square miles, divided into 11 administrative districts and 64 parishes. The population is increasing, despite the flow of emigrants to Portugal and South America, and numbered 459,119 persons in 1897. The birth-rate is 3·31 per cent. and the death-rate 2·86 per cent.; the proportion of illegitimate births is very high—10·30 per cent. The means of communication are insufficient, though there are 98 miles of first-class roads, and the railway from Valencia to Corunna runs through the province. The only important industries are those connected with leather, preserves, coarse woollen and linen stuffs, timber and osier work. About 250 coasting vessels are registered at the ports, and about as many boats constitute the fishing fleet, which brings in lampreys, soles, tunny, and sardines, the last two being salted and tinned for export. The mountainous parts are still well wooded. Agriculture is in a very backward condition, mainly owing to the extreme division of land that prevails throughout Galicia, and cattle-rearing has declined in consequence of the cessation of the export trade to Great Britain. The live stock numbered in 1898, 11,305 horses, 2213 mules, 1880 asses, 120,793 cattle, 136,512 sheep, 30,885 goats, and 108,263 pigs. There were only six productive mines in 1898, four of coal and two of antimony, while the unproductive mines numbered 132.

Lugo, town in Spain, on the Minho, 51 miles east by north of Santiago, capital of the province of the same name. It has extended much beyond the fine old Roman walls. The chief local industries are tanning and the manufacture of linen and woollen stuff. Nine new suburbs, thickly peopled, have sprung up around the old city. Population (1897), 25,568.

Luitpold, of Bavaria. See Ludwig II.

Luleå, a seaport town of Sweden, capital of the county of Norrbotten, on the peninsula of Sandö, at the mouth of the Luleå (river Lule), near the north-west corner of the Gulf of Bothnia, connected at Boden (22 miles to the north) with the main line of railway from Stockholm to the north of Finland, and the seaward terminus of the Luleå–Ofoten railway. It is the shipping place of the iron ore mined at Gellivare, 127 miles north by west. The quantity of iron exported increased from 21,000 tons in 1880 to 1,054,575 tons in 1900. The only other export of moment is timber, of which 4 to 7 million cubic feet are exported annually (over 7 million cubic feet in 1899). The port was cleared by 191 vessels of 79,300 tons in 1887 and by 446 vessels of 630,503 tons in 1900, of which 126 of 212,668 tons were British. As a rule, the port is closed to navigation by ice from November to the end of May. The southern entrance to the harbour was in 1893 deepened to admit vessels drawing 23 feet, and in 1901 a beginning was made with the widening of it to double its present width, and with the construction of additional quays. The town was almost entirely burnt down in 1887, and its buildings are new—the church (1888–93), the Norrbotten Museum, and a technical school being the most important. Population (1880), 3120; (1890), 4755; (1900), 9484. The district between Luleå and Boden is well cultivated, and had in 1897 a population of about 20,000.

In the years 1884–87 a railway line was laid temporarily from Luleå to Gellivare (127 miles; to the mines, 131 miles) by an English company; but in 1889 the company failed, and in 1891 the line was taken over by the Swedish Government, who paid £362,210 for it, and completed the line in 1892–94 at a further cost of £155,560. In 1898 the Swedish Parliament voted £1,194,350 for the continuation of the line from Gellivare, past the iron-fields of Kirunavaara and Luossavaara (68 miles farther north) to the Norwego-Swedish frontier, a distance of 147 miles from Gellivare. In the same year the Norwegian Parliament voted £472,220, and in 1900 an additional sum of £180,500, for the building of the Norwegian section of the line from Victoria Harbour (or Narvik) on Ofoten Fjord up to the frontier, a distance of 26 miles; Luleå to Victoria Harbour, 300 miles. When the Gellivare-Ofoten portion of the line is finished, it will enable the iron ore to be shipped in winter on the Norwegian side.

Lumbering. See Forests and Forestry.

Lunacy. See Insanity.

Lund, a university town of Sweden, 11 miles north-east from Malmö, on the railway to Stockholm. In 1899 the university was attended by 626 students, there being about 110 professors and lectors. In 1897 the university library numbered about 163,000 volumes and 4900 MSS. Important buildings include the botanical museum, with gardens, an astronomical observatory (55° 41′ 52″ N. and 13° 11′ 15″ E.), built in 1866, though observations had been carried on since 1760; the university hall (1878–82); the academic union of the students (1851), containing an art museum; the museum (1882) of the History of Civilization (*Kulturhistorie*) Society, with valuable ethnographical and industrial art collections, illustrating life in southern Sweden from early times; All Saints' Church (1887–91); a diocesan school (1896), normal school for women, deaf and dumb school, and technical school. The industries are chiefly sugar-refining, iron-works, brick-works, and manufacture of furniture and gloves. Population (1880), 14,304; (1900), 16,621.

Lund, Troels Frederik (1840-——), Danish historian, was born in Copenhagen on the 5th of September 1840. His father's first wife was the sister of the celebrated philosopher, Sören Kierkegaard, who exercised a considerable influence on the early years of the historian. Troels Lund was long in discovering the bent of his own mind. He entered the university as a student in 1858, read Plato, wrote verses, and vaguely determined to become a zoologist. Circumstances enabled him to prolong his youth in dreams and the contemplation of outdoor life. About the age of thirty he took a post under Government, which brought before his notice the treasures of the secret archives of Denmark. Curiosity awakened in him an overpowering interest; he pushed his researches farther and farther until he became a historian. His first work, however, *Historical Sketches from Unpublished Sources*, did not appear until 1876, but after that time his activity was stupendous. In 1879 was published the first volume of his *History of Daily Life in Denmark and Norway at the Close of the 16th Century*, of which the fourteenth volume appeared in 1901. Troels Lund was the pioneer of the remarkable generation of young historians who came forward in the North about 1880, and he remained the most original and most conspicuous of them. His principal peculiarity, in which he is already imitated by a school not only at home, but in Germany, Sweden, and Norway, is his neglect of purely political history. Saying very little about kings, armies, and governments, he concentrates his attention on the life, death, employments, pleasures, and prejudices of the ordinary men and women of the age with which he deals, using to illustrate his theme a vast body of documents hitherto neglected by the official historian. The penultimate volume of his great work—called *The Illumination of Life*—treats a wider theme than any of the preceding, and aims at a rapid study of the advance of moral light after the Renaissance. The other writings of Dr Troels Lund are either polemical, or are chips from his central workshop. He has the charm of a singularly animated and lucid style, which reminds the English reader in some degree of that of Froude. Dr Lund was appointed historiographer-royal to the king of Denmark and comptroller of the Order of the Dannebrog. There was probably no living man to whom the destruction of the archives, when Christiansborg Castle was accidentally burned in 1884, was so acute a matter of distress. But his favourite and peculiar province, the MSS. of the 16th century, was happily not involved in that calamity.

Lundenburg (Czech, *Břeclava*), a town in South Moravia, on the Thaya river, on the border of Lower Austria. In the Middle Ages it was the Moravian capital and ducal residence. A short distance from Lundenburg is an estate of Prince Liechtenstein (Eisgrub), with a park over a hundred square miles in area, containing two small towns and several villages, together with various ornamental buildings, including a château in the style of Windsor Castle. Lundenburg has important markets, a considerable industry (sugar, starch, brewing, and distilling), and trade in timber. Population (1890), 5968; (1900), 6776, chiefly German.

Lüneburg, a town of Prussia, province of Hanover, on the river Ilmenau (a tributary of the Elbe), 30 miles by rail south-east of Hamburg. A museum (1891) with industrial, art, and natural science collections, and the bronze statue of the Emperor William I. (1898) are the principal new features. Besides its salt-works, brine spring, and gypsum quarries, Lüneburg has lime-kilns, cement factories, iron-works, carpet and artificial manure factories. It is also noted for its gardening, and has a trade in wine. Population (1885), 19,336; (1900), 24,693.

Lunel, a town, arrondissement of Montpellier, department of Hérault, France, 15 miles east-north-east of Montpellier, on the railway from that place to Tarascon, and at the head of the Lunel canal, which connects it with the *étang* of Maugio on the Mediterranean, and with the Cette-Rhône canal. The church, partly Romanesque, contains some old paintings, and in the Place de la République is a small copy of Bertholdi's statue, "Liberty enlightening the World." Absinthe is distilled, and trade is still carried on in wine, but the ravages of the phylloxera have greatly reduced the production in the district. The traffic on the Lunel canal in 1900 was represented by 338 boats, carrying over 9000 tons of merchandise, chiefly agricultural products and provisions. Population (1881), 6056; (1901), 7532.

Lunéville, chief town of arrondissement, department of Meurthe-et-Moselle, France, 17 miles east-south-east of Nancy, on the railway from Paris to Strasburg. The War Monument, commemorative of 1870–71, stands opposite the Hôtel de Ville, and there are statues of the Conventional Abbé Grégoire (d. 1831) and of General Lasalle (d. 1809). The gardens around the château now form a public promenade. Manufactures are very important, and include, among other things, cotton and silk hosiery, watch-glasses, porcelain, toys, fruit essences, and automobiles. There are salt-works and glass-works in some of the suburbs. Population (1881), 14,379; (1891), 16,530; (1901), 23,269.

Lungchow, a town in the province of Kwangsi, China, situated in 22° 21′ N. and 106° 45′ E., near the Tongking frontier. It was selected as the seat of frontier trade by the French convention of 1886, and was opened in 1889, but the overland trade so far has been insignificant. In 1898 the total value amounted to only H. taels 134,000 (£20,000), and in 1899 to H. taels 85,000 (£12,700). It is proposed to extend the Tongking system of railways, which is completed as far as Langson, to Lungchow, and thence to the large Chinese town of Nanning on the West river. Lungchow is a Chinese military station of some importance. It has a civilian population of about 22,000.

Lushai Hills, The, a district of British India, in the south of Assam. It consists of two tracts, formerly known as the North and South Lushai Hills, the latter of which was transferred from Bengal to Assam in 1898.

The Lushais or Kukis are a numerous tribe, who differ from their neighbours in recognizing hereditary chiefs. Some of them live in the Chittagong Hill. Tracts, and a few have settled in Assam. But their home is the mountainous region that extends from Tipperah in Bengal to the Chin Hills of Burma. Order is now maintained by a military police force of 1000 men, with its headquarters at Aijal. The area of the North Lushai Hills is estimated at 3500 square miles. The population of the district (North and South Lushai Hills) was 82,344 in 1901. A house-tax is levied at the rate of Rs.2 per house, yielding Rs.15,263 in 1897–98. Each house is also liable to supply one coolie to work for ten days in the year, being paid 8 annas a day. In 1897–98 the quantity of labour thus impressed was equal to 65,393 days. The total expenditure on public works, chiefly roads, was Rs.1,10,303. Two missionaries, who handed over their work in 1898 to the Welsh Calvinistic Mission, have established a school at Aijal, with 68 boys, and have also reduced the Lushai language to writing, a dictionary and handbook having been printed by the Government press at Shillong.

Lussin, a small but important island in the Quarnero, in the Austrian crownland of Istria, lying west and south of Cherso, with which it is connected by a turn-bridge. It is 24 miles in length, and is little more than 300 yards in breadth at its narrowest point. Together with the adjacent islands of Cherso and Veglia it forms the government district of Lussin. Population of the island (1890), 11,838; (1900), 11,615; of the government district (1890), 39,989; (1900), 41,030, of whom about one-fifth were Italian, the remainder Serbo-Croatian. Lussin-Piccolo, the chief town and principal harbour, is the most important trading centre of the Quarnero islands. It is one of the largest and most frequented harbours of the monarchy, a steamship station of the Austrian Lloyd, and a popular winter resort, with a climate resembling that of Nice. Population (1890), 7634; (1900), 7207. Lussin-Grande, on the east side of the island (2349 inhabitants), has an old Venetian palace and a shipbuilding wharf.

Lutherans.—Although since 1871 the German empire has been united for military and foreign purposes, and although since the 1st of January 1900 a certain partial unification of laws has taken place throughout the empire, yet each of the smaller states still retains its own reigning sovereign, its parliament, and its own Evangelical Church. Moreover, even where smaller states have been absorbed into the kingdom of Prussia as provinces, *e.g.*, Nassau or Hanover, their old distinct church establishments continue under the title of provincial churches, and the original church of the kingdom itself is known as that of "Old" Prussia. There is thus no corporate unity yet subsisting between the various state Evangelical bodies, and even the more strictly separated "Old" Lutherans still continue to maintain distinct from the state their "Evangelical Lutheran" congregations. Within each state church the two schools exist side by side, Orthodox and Reformed, or conservative and liberal, as they are called. It depends upon accidental circumstances of appointment or election whether the teaching in any parish is of one kind or the other; sometimes, where there is more than one minister, it may be of both. With the growth of rationalism the liberal theology of the Evangelical churches has become scarcely distinguishable from Unitarianism, so that even within the limits of any "State Evangelical United Church" (*Evangelische Unirte Landeskirche*) the widest differences of doctrine may and do prevail. In the meantime a voluntary biennial conference is held at Eisenach, where matters of general interest may be discussed; but its resolutions have no necessarily unifying influence, and certainly have no binding force. A committee was in 1902 formed at Gotha, at the instance of the German emperor, to inquire into the feasibility of a general union of the (about) thirty Evangelical sects.

Evangelicals may be said to form about 58 per cent. of the population of the German empire, which in 1895 was 52,250,000, as against 39 per cent. of Roman Catholics. These are the two leading religions of Germany, about 3 per cent. only of the population in general being members of other religious bodies. The figures vary very much, as there is a continuous change going on from one to the other, and as there is a large emigration to countries beyond the seas. Since the formation of the empire, inland migration from one state to another has been much greater than before, a thing due to the wide appointment of officials and the dispersion of the army, to the vast increase of opportunities of industrial employment, to the greatly developed facilities of travel between the states, and other causes. This migration has brought about an increasing frequency of intermarriages between Protestants and Catholics, which forms a very important factor in religious change. It would appear that Catholicism increases in Eastern Prussia, Bavaria, Saxony, and Würtemberg, whilst Evangelicalism, at least nominally, is increasing in large cities and in general throughout the rest of Germany. It has been calculated that in Prussia alone Evangelical ministry must be provided for persons speaking twenty different languages.

The Evangelical theory still holds that in each state the sovereign is the religious ruler or *summus episcopus*. He appoints a minister of public worship, and through him nominates the members of a governing body, called in the older states an *Oberkirchenrath* or Supreme Church Council, and in the newer states a *Consistorium*. This governing body deals with property, patronage, and other ruling and legal matters. Each parish, on the other hand, elects its own parish council for parochial affairs, church tax assessments, &c., and this council possesses legal rights. Delegates from these parish councils form the *Landessynode* or National Synod, which is a kind of church parliament. In cases that call for it, committees of the consistory and synod confer. Those who are entitled to vote for parochial councils do not, however, take very great part in the elections, except in Alsace-Lorraine, where nearly half the voters go to the poll.

The income of the Evangelical churches is derived from four sources. The state makes an annual provision for clergy stipends, officers' salaries, church maintenance, &c., and sometimes makes special grants for improvement of stipends, supply of assistant-clergy, for widows and orphans of clergy, for preaching seminaries, &c. Then there are endowments or bequests of various kinds, twenty-four such in Prussia alone, administered by the Supreme Council; these relate to foreign missions, pensions of aged clergy, supply of books to clergy, &c. A third source of income are the various voluntary collections, which in England are made by the Church societies and even by individual appeals, such as those for building churches, parsonages, mission-rooms, institutes, &c.; these are in Germany all swept into the common income of the national churches, and are regulated by the Supreme Council or Consistory. Fourthly, each parish is entitled by law to levy a church rate upon its adherents, and the proceeds are applied to certain objects defined by the same law.

Appointment to benefices lies in the hands of the state (with sometimes the consent of parishes), of private patrons, and of local parish councils. The number of benefices increases yearly; in 1897 there were in all Germany 16,400, or 300 more than in 1890. Of these the state appoints to 56 per cent., private and municipal patrons to 34 per cent., the local congregations to 10 per cent. Customs vary in different states; *e.g.*, in Schleswig-Holstein, although the parish elects, the state nominates; in Alsace and Lorraine all clergy are appointed by the consistory (here called the *Directorium*), with the approval of the statthalter or viceroy; and in Baden, although the state appoints, the congregation elects one out of six names put forward by the Government.

Aspirants for the Evangelical ministry, having passed through the secondary schools and the customary matriculation examination, attend at least six lecture terms in the theological department of a university. They then pass the examination for a preaching licence ("*pro licentia concionandi*"), after which two years elapse, during one of which the "candidates" study at a preachers' seminary. Then follows the examination "*pro ministerio*," after which they are eligible for election to cures or assistant-cures of souls. Before entering upon work they are ordained at a public service in church, with laying on of hands by the general superintendent and one other minister. About 27 per cent. of the clergy come from families of better position, but there is a great falling off in general in the number of candidates. In Old Prussia the number of *students* during the decade 1888–98 went down by one-half, and the number of *ordinations* showed a decrease of 28 per cent.

The union of two forms of Protestant Christianity in the Evangelical churches has resulted in vagueness of teaching and principle in most cases, and in a very widespread freedom of thought. Many of both clergy and laity do not believe in the miraculous birth of Christ; many criticize very freely the narrative of the New Testament, and cannot accept the statements of the Apostles' Creed. Under the name of Higher Criticism many sceptical views are published and preached, denying the doctrine of the Holy Trinity. From this arises a general vagueness which is a source of weakness to the Evangelical religion. On the one hand, there is a general unity in promoting good works: hospitals, homes, refuges, nursing societies, associations for assisting the young of both sexes and the like, for which Germany is conspicuous. But, on the other hand, in respect of faith evidences are less clear. Thus church-going is looked upon more as a duty to one's neighbour than as worship of God, and attendance on ordinary Sundays varies from 14 per cent. to a mere 2 per cent. of the population. Baptisms, marriages, and burials keep up their due proportion; there is only a slight falling off in confirmation (which must not be mistaken in any way for the English or Roman rite); but these things are so much required by law and system that they lose their voluntary character. The number of communicants, however, is seldom more than half of those entitled to receive the Holy Sacrament, even at great feasts; and it often goes below one-tenth. Of the communicants, men are fewer than women, being in some cases much less than one-third of the whole number.

See also PIEPER, *Kirchliche Statistik*, 1899. (E. J. T.)

Luton, a municipal borough (extended 1896) and market town in the Luton parliamentary division of Bedfordshire, England, 30 miles north-north-west of London by rail. Modern erections are two churches, a Baptist and three Methodist chapels, a theatre, and a children's sick and convalescent home. There are public baths, a free library, and a technical school, supported by the town and county councils, and devoted partly to teaching the straw-plait industry. Electric light was installed in 1901, and in the same year a new sewage scheme was completed. Population on 2613 acres (1881), 23,960; (1891), on extended area of 3134 acres, 30,056; (1901), 36,404.

Lüttringhausen, a town of Prussia, in the Rhine province, 6 miles south-east of Elberfeld by rail. It is the seat of various iron and other metal industries, and cloth, calico, and silk mills. Population (1885), 10,216; (1900), 11,261.

Luxembourg, province of Belgium, bordering on Rhenish Prussia, the grand-duchy of Luxemburg, France, and the Belgian provinces of Namur and Liège. It comprises a part of the mediæval duchy of Luxemburg, which, under French domination (1795–1814), constituted the department des Forêts, and in 1815, under the title of the grand-duchy, was conferred on the prince of Orange, king of the Netherlands, and, lastly, in 1831 was divided into two parts—a western part forming the present province of the kingdom of Belgium, and an eastern part remaining, under the title of the grand-duchy of Luxemburg, in the possession of the House of Orange. In its entirety the most elevated of the provinces of Belgium, Luxembourg is in large part included in the region of the Ardennes. It presents elevated plateaux of from 1300 to 2300 feet high, stretching towards the north-east; some wooded, others marshy or covered with heath, and intersected by deep and picturesque valleys such as those of the Semois, the Lesse, the Ourthe, affluents of the Meuse, and of the Sure (in German, Sauer), an affluent of the Moselle. In general of scant fertility, the soil of the province is calcareous in the north, schistose in the zone of the Ardennes, calcareous, clayey, and sandy in the south. Its products are iron in small quantity and manganese; slate, the quarrying of which employs 900 workmen; building, paving, and limestone. It rears the Ardennes horse, small in size, but very hardy. Of wild animals there are the boar, wolf, and deer. Woods cover 34 per cent. of the surface of the province. Its industry is not of much account. There are steel-works and blast-furnaces in the arrondissement of Arlon. Saw-mills and the making of wooden shoes employ 400 workers. The province is divided into five administrative arrondissements. The towns are of scant population. The principal are Arlon (8000), the capital; Bastogne (3600); and Marche (3600). This province has the largest extent of territory among the provinces of Belgium—1706 square miles—and is the least populated, having only 222,154 inhabitants in 1900, or 130 to the square mile. The arrondissement of Arlon has the densest population—259 inhabitants to the square mile. The population increased from 209,472 in 1875, that is, an increase of 5·1 per cent., against an increase of 25 per cent. in the same time in the whole kingdom.

Luxemburg, Grand-Duchy of, a neutral and independent state of Europe, bounded on the E. and N.E. by Prussia, S. by Alsace-Lorraine, and W. by the Belgian province of Luxembourg. It had in 1900 a population of 236,543 (of whom 122,002 were males and 114,541 females), showing a density of 237 persons to the square mile. The increase over the population in 1895 (18,960 in all) was exclusively in the mining districts, whereas in certain communes of the Ardennes there was an actual decrease. In 1900 the population included 14,240 Germans, 6700 Italians, 4250 Belgians, and 3500 French. All except about 1 per cent. are adherents of the Roman Catholic Church. The House of Representatives now consists of forty-five members, elected directly by the cantons, one-half every three years. The state revenue was in 1901 estimated at £483,960, and the expenditure at £498,880; and the public debt amounted to £462,420 in 1900. The state possesses 294 miles of railway, and 596 miles of telegraph line, with 1187 miles of wire. In 1899 the iron-mines (71 worked), blast-furnaces (28), and foundries (7) employed 10,600 work-people, and gave an output of 5,995,400 tons of iron ore, 982,930 tons of cast iron, and 166,210 tons of steel.

The Grand Duke, ADOLPHUS WILLIAM AUGUST CHARLES FREDERICK, was born at Biebrich 24th July 1817, succeeding his father as duke of Nassau 20th August 1839. He showed himself imbued with Liberal ideas, and skilfully steered his land through the troubles of the revolutionary period of 1848. In 1849 he took part in the campaign against Denmark at the head of a contingent. After the conclusion of this war he took a serious interest in German federal politics, and in the fateful year 1866 openly sided with Austria. As a result, the duchy of Nassau was annexed by Prussia, the duke unwillingly receiving a sum of about £1,275,000 as compensation for the loss of his dominions. Owing to the marriage of his daughter Hilda to the hereditary grand duke of Baden in 1885, his feud with the Prussian royal house may be said to have come to an end, and the *rapprochement* was finally sealed by a meeting with the Emperor William II. at Mainau in 1888. On the death of King William III. of the Netherlands on 23rd November 1890, Duke Adolphus, as nearest agnate of the House of Orange, became reigning grand duke of Luxemburg. He was twice married: (*a*) to Elizabeth, daughter of the Grand Duke Michael of Russia, and (*b*) to Adelaide, daughter of Prince Frederick of Anhalt, by whom he had a son, William, born 22nd April 1852, who married Princess Anna of Braganza.

Luxemburg, or LÜTZELBURG, capital of the independent grand-duchy of the same name, and an episcopal see, 43 miles by rail north of Metz. The public institutions include an athenæum, a theological seminary, a collection of antiquities, a small picture-gallery, normal schools, a deaf and dumb asylum, a library, and an equestrian statue of Grand Duke William II. (1884). Amongst the industries may be mentioned tanneries, breweries, distilleries, glove, hat, tobacco, cotton, and linen factories. Population (1881), 17,964; (1900), 20,928.

Luxeuil-les-Bains, a French town in the arrondissement of Lure, department of Haute-Saône, 17 miles north-east of Vésoul, on the railway from Lure to Aillevillers, and on the Breuchin. It has a church dating from the 14th century, containing a curious 17th-century organ loft in the form of an immense bracket supported by a colossal figure of Hercules. There are also several mansions and houses dating from various periods from the 14th to the 16th century. The Maison Carrée, or Hôtel de Ville, an interesting specimen of 15th-century architecture, was built by the father of Cardinal Jouffray (died 1473), a native of the town. The fine modern Grammont Hospital is in the style of Louis XIII. Luxeuil is renowned for its mineral springs, of which there are eighteen, two being ferruginous, and the rest charged with chloride of sodium, yielding together about 14,000 gallons in the twenty-four hours, and of temperatures ranging from 70° to 156° Fahr. The water is employed for medicinal drinks and for baths. The bathing establishment is well appointed and stands in a fine park. Luxeuil, the ancient *Lixovium*, was frequented for bathing by the Romans, and contained many fine buildings at the time of its destruction by the Huns under Attila in 451. In 590 St Columban founded here a monastery, which rose rapidly to importance, but in the 8th century it was destroyed by the Saracens; afterwards rebuilt, monastery and town were again devastated by the barbarian hordes in the 9th century. In the 18th century the present bathing establishment was inaugurated by the ecclesiastics. Population (1881), 4153; (1901), 5294.

Luzon. See PHILIPPINE ISLANDS.

Luzzatti, Luigi (1841–——), Italian economist and financier, was born at Venice on 11th March 1841. After completing his studies at Padua University, he attracted the attention of the Austrian police by his lectures on political economy, and was obliged to emigrate. In 1863 he obtained a professorship at the Milan Technical Institute, in 1867 was appointed professor of constitutional law at Padua, whence he was eventually transferred to the University of Rome. Gifted with eloquence and remarkable energy, he popularized in Italy the economic ideas of Schultze-Delitzsch, worked for the establishment of a commercial school at Venice, and, by indefatigable propaganda, contributed greatly to the spread of people's banks throughout the country. In 1869 he was appointed by Minghetti secretary-general of the ministry of agriculture and commerce, in which capacity he abolished Government control over commercial companies and promoted a state inquiry into the condition of industry. Though theoretically a free trader, he was largely instrumental in creating the Italian protective system. In 1877 he participated in the commercial negotiations with

France, in 1878 compiled the Italian customs tariff, and subsequently took a leading part in the negotiation of all the commercial treaties between Italy and other countries. Appointed Treasury minister in the first Rudini cabinet of 1891, he endeavoured to grapple with the difficult financial situation, but imprudently abolished the system of frequent clearings of bank-notes between the state banks, a measure which inadvertently facilitated the duplication of part of the paper currency and hastened the bank crisis of 1893. In 1896 he entered the second Rudini cabinet as Treasury minister, and by timely legislation helped to save the Bank of Naples from failure. After his fall from office in June 1898, his principal achievement was the negotiation of the Franco-Italian commercial treaty, though, as deputy, journalist, and professor, he continued to take an exceedingly active part in all the political and economic manifestations of Italian public life.

Lycaonia.—After the defeat of Antiochus the Great, Lycaonia was given by the Romans to Eumenes II., king of Pergamos. About 160 B.C. part of it, the "Tetrarchy of Lycaonia," was added to Galatia; and in 129 B.C. Lycaonia proper was given to Cappadocia as an eleventh strategia. In the readjustment of the Provinciæ, 64 B.C., by Pompey after the Mithradatic wars, he gave the northern part of the tetrarchy to Galatia and the eastern part of the eleventh strategia to Cappadocia. The remainder was attached to Cilicia. In 371 Lycaonia was first formed into a separate province. It now forms part of the Konia viláyet.

See RAMSAY, *Historical Geography of Asia Minor. Historical Commentary on the Galatians.*

Lyck, or LYK, a town of Prussia, province of East Prussia, 112 miles by rail south-east of Königsberg, and close to the frontier of Poland, beside a lake of the same name. It is the chief town of the region known as Masuria, and has a new parish church and an old castle (on an island in the lake) of the Teutonic order, dating from 1273, but now used as a prison. The industries embrace iron foundries, distilleries, breweries, tanneries, paper mills, flour mills, &c. Population (1885), 8624; (1900), 11,419.

Lynchburg, a city of Virginia, U.S.A., on the south bank of the James river, at an altitude of 524 feet. Though within the limits of Campbell county, and containing the court-house, it is independent of county government. It is situated partly on the bottom-land of the river, and partly on the slopes and summit of the bluffs, which afford fine and commanding building sites for the many beautiful private residences of the city. The railways entering Lynchburg are the Southern, the Norfolk and Western, and the Chesapeake and Ohio. The manufactures are important and varied. Lynchburg has long been one of the chief points of tobacco manufacture, and iron manufacture has also become of great importance. The Norfolk and Western railway has works here. It is the seat of Randolph-Macon Women's College. Population (1890), 19,709; (1900), 18,891, of whom 251 were foreign-born and 8254 were negroes.

Lynmouth. See LYNTON.

Lynn, KING'S LYNN, or LYNN REGIS, a municipal borough, parliamentary borough (co-extensive, since 1885 returning only one member), market town, and seaport of Norfolk, England, on the Great Ouse, 97 miles north by west of London by rail. Modern erections are the Stanley Library and the municipal buildings. An inner dock was constructed in 1884. The harbour has an area of 30 acres, with an average depth of 10 feet. There is also good anchorage in the roads leading from the Wash to the docks. The registered shipping in 1888 consisted of 90 vessels of 7055 tons; in 1900, of 58 vessels of 3501 tons. In 1888, 1031 vessels of 146,669 tons entered and 1002 of 142,628 tons cleared; in 1900, 962 vessels of 224,869 tons entered and 980 of 226,854 tons cleared. In the latter year the imports (timber, minerals, coal, grain, and seeds) were valued at £1,141,867 and the exports at £130,469. Area, 3100 acres. Population (1881), 18,539; (1891), 18,360; (1901), 20,289.

Lynn, a city and seaport of Essex county, Massachusetts, U.S.A., on the north shore of Massachusetts Bay, 9 miles north-east of Boston, in the north-eastern part of the state. It is on a branch of the Boston and Maine railroad, and the Boston, Revere Beach, and Lynn railroad. The more closely built portions are on level ground, while the suburbs are rocky and broken. The plan is very irregular, the streets narrow and paved with macadam or gravelled, the water-supply is drawn from ponds in the neighbourhood by pumping, and the city is divided into seven wards. Lynn is chiefly known for its manufacture of boots and shoes, an industry to which the place is as completely devoted as Gloucester is to fishing, and, indeed, a large proportion of the footgear of the people of the United States is made here. The total number of manufacturing establishments in the city in 1900 was 776. They had a capital of $17,011,761, employed 17,492 hands, and turned out products valued at $41,633,845. There were 123 boot and shoe factories, with $5,570,928 capital, 8652 hands, and products valued at $16,830,733, besides 60 factories manufacturing cut stock for boots and shoes, which employed 1049 hands, and turned out products valued at $7,385,106. There were also 12 leather factories, with a capital of $1,031,025 and products valued at $2,451,423. There were 3 factories for electrical apparatus and supplies, which employed 3166 hands and turned out products valued at $5,840,668. The patent medicines and compounds manufactured were valued at $1,338,833. The rocky, picturesque peninsula of Nahant, a part of Lynn, is a fashionable resort for the people of Boston and neighbouring cities, many of whom have summer homes there. The assessed valuation of real and personal property in 1900 was $51,655,186, the net debt was $3,632,398, and the rate of taxation $18 per $1000. Population (1890), 55,727; (1900), 68,513, of whom 17,742 were foreign-born and 784 were negroes. The death-rate was 16·4.

Lynn Canal, a noble fjord in Alaska, forming orographically a continuation of the trough of Chatham Strait, between 58° 12′ and 60° N. Its width averages 6 miles, and its length about 100 miles. It is divided by islands near its entrance, and at the north by a long peninsula, named by Vancouver in 1793 Seduction Tongue. Its shores are for the most part mountainous, with numerous glaciers, of which Eagle, in 58° 30′ N. on the east shore, and Davidson, in 59° 05′ N. on the west, are the most important. Berners Bay, in 58° 40′ N., indents the mainland shore, and is the seat of some mining operations. To the west of Seduction Tongue the fork of Lynn Canal is known as Chilkat Inlet. It receives at its head, over broad flats, the waters of the Chilkat river; and on its western extremity is a snug anchorage known as Pyramid Harbour, the seat of a salmon cannery. The valley of the Chilkat, inhabited by Indians of the same name, is the entrance to a practicable trail, known as the Dalton trail, to the Yukon, over which cattle are taken to the Klondike region. East of Seduction Tongue the fjord is continued as Chilkoot Inlet, and farther on as Taiya (Dyea) Inlet, terminating in two small bays, Skagway and Taiya. These are the entrances to the two passes over the range to the head-waters of the Yukon, the White and the Chilkoot passes. The latter is the shorter and about 1000 feet higher. Wide flats make the access by water to Dyea less easy than to Skagway. A telpherage line was constructed in 1898 to carry goods over the summit, and many thousands of men and animals passed by this route over the range in 1896–99, bound for the Klondike. Now that Skagway has been connected by the Yukon and White Pass railway with Lake Bennett, all inward Klondike traffic passes by this route over the range. The principal settlements on Lynn Canal and its branches are Seward City, near Berners Bay; Pyramid Harbour; the Haines Mission at the northern end of Seduction Tongue; Skagway, and Dyea. The region is alpine in character, and subject to storms of extraordinary violence in winter, but not so cold that navigation is interrupted by ice at any time.

Lynton and **Lynmouth,** seaside villages of Devonshire, England, on the shore of the Bristol Channel, 17 miles by coach east of Ilfracombe, and 27 miles by railway north-east of Bideford. Lynmouth lies on the sea, at the mouth of the little rivers East Lyn and West Lyn, and Lynton stands on the edge of the cliffs, 430 feet above. The two are connected by a cliff railway or lift, and are lighted by electricity. The local improvements owe much to Sir George Newnes. A short distance up the Lyn is the picturesque Watersmeet, and the Doone Valley is not far off. Lynton is approached by a railway from Barnstaple. Population of Lynton (1901), 1641.

Lyons, the second town, in respect of population, of France, capital of the department of the Rhône, at the confluence of the Rhône and Saône, 311 miles from Paris by rail. Notwithstanding the competition of Milan, it is the chief silk market. In 1893 the special office which determines the weight and nature of the silk examined nearly 6000 tons of silk in 90,000 bales. France furnished barely one-tenth of this quantity; two-thirds came from China and Japan, the rest from Italy and the Levant. The traders of Lyons re-export seven-twelfths of these silks, the industries of the town employing the remainder. An almost equal quantity of cotton, wool, and waste-silk threads is mixed with the silk. A large proportion of the silk workers have left the town for its environs. Sixteen or seventeen thousand hand-looms are still worked in the town, more especially producing the richest materials, 50,000 or 55,000 in the surrounding districts, and 20,000 or 22,000 machine looms in the suburbs and environs. The total value of these looms is £4,000,000. Allied industries, such as dyeing, finishing, and printing, employ 12,000 workers. With the weavers, loom-builders, and other indispensable workers, 300,000 workpeople depend upon the silk industry. The value of the manufacture in 1899 was apportioned thus:—

Pure silk textures, plain	£5,028,000
do. do. figured	956,000
Textures of silk mixed with gold and silver, for the Levant	204,000
Textures of silk mixed with other materials, plain	4,714,000
Textures of silk mixed with other materials, figured	818,000
Textures of floss-silk and silk handkerchiefs	2,240,000
Coarse silk (*bourrettes*) for furniture . .	60,000
Gauzes and grenadines	220,000
Crapes, summer shawls (*crêpes de Chine*), and muslins	2,260,000
Nets (tulles) and laces	880,000
Passementerie	640,000
Embroidery	20,000
Total . .	£18,040,000

In 1898 the total value was £16,600,000. The raw material represents half the value, and the value of the labour the remaining half. Thirty or forty per cent. of the silk goods of Lyons finds a market in France. Great Britain imports them to the value of £4,000,000, and the United States to the value of £2,400,000, notwithstanding the heavy duty. The dyeing industry and the manufacture of chemicals have both developed considerably to meet the requirements of the silk trade. The annual production of chemicals is as follows:—Mineral colouring matters, £240,000; vegetable colouring matters, £200,000; glue and gelatine, £240,000; superphosphates for manure, £240,000; phosphorus (the only French source of supply), £100,000; picric acid, £200,000; tartaric acid, £80,000; sulphuric and hydrochloric acids, sulphates of iron and copper, salts of soda, and manure, £680,000; pharmaceutical products, £240,000. Lyons does a large trade in metals, iron, and copper, and utilizes them in numerous workshops in the manufacture of iron buildings, framework, bridges, machinery, railway material, scales, metal cables, pins and needles, copper-founding, and the making of clocks and bronzes, the entire metallurgical industry employing 12,000 workmen and producing £3,000,000. Gold and silver working is of importance, especially for articles used in religious ceremonies. Other flourishing industries are those of printing, the manufacture of glass windows, the preparation of hides and skins (occupying 20,000 workmen), those connected with the miller's trade, the manufacture of various forms of dried flour-paste (macaroni, vermicelli, &c.), brewing, hat-making, the manufacture of chocolate, and the pork-butcher's industry. Apart from the railway traffic, the river traffic is important—in 1899 amounting to 600,000 tons on the Rhône and 725,000 tons on the Saône.

Lyons is the seat of important financial companies; of the Crédit Lyonnais, which does business to the amount of £200,000,000 annually in Lyons alone; also of coal and metallurgical companies and gas companies, the former extending their operations as far as Russia, the latter lighting numerous towns in France and foreign countries. There are several important technical schools, schools of weaving and industrial chemistry, and a school of the fine arts. Since 1870 the fortifications have been reconstructed, and form an entrenched camp 43 miles in circumference. The old wall of 1840, on the left bank of the Rhône, has been carried farther back. It describes a semicircle more than 7 miles long, which encloses the commune of Villeurbanne and part of the communes of Brou and Vénissieux. An iron bridge, 262 feet high and 655 feet long, will unite Fourvière and La Croix Rousse. Perhaps the most interesting modern enterprise has been the building of the new church of Fourvière. In 1872 it was begun, and in 1884 completed as regards the masonry, but its decoration was not finished until 1894. The total cost exceeded £320,000. The style recalls the Byzantine and Sicilian. It is flanked at each of the four corners by an octagonal tower, and ends in an apse shaped like a horse-shoe, surrounded by a porch which opens on the town to the east. From the *loggia* the archbishop of Lyons solemnly blesses the town on the 8th of September, the day of the Nativity of the Virgin. The 8th of December is also a *fête,* when all the streets are illuminated. The roof above the apse is surmounted by a colossal bronze group, 23 feet high, representing St Michael slaying the dragon. The towers are 159 feet high. The north-western is used as an observatory by the Free Faculty of Science. The north-eastern is furnished with a circular painting on lava, showing all the points visible on the horizon, with their distance and height. In clear weather a fine panorama of the Alps is visible from this tower.

The south-eastern tower contains a great bell weighing 6½ tons, and the south-western, a carillon of thirteen bells. The church is 282 feet long from end to end, and 62 feet across the interior, and 88 feet high under the vaulting. A crypt, dedicated to St Joseph, and divided into three vaulted bays, extends under the church, which is built of magnificent materials and adorned on both the inside and outside with a profusion of marble and costly works of art. The high altar is of Carrara marble, supported by four angels; the mural decoration is of Venetian mosaic. In the park of Tête d'Or, a fine promenade, universal exhibitions were held in 1872 and 1894. Population (1886), 344,124; (1896), 398,867; (1901), 453,145.

Lyons, Richard Bickerton Pemell Lyons, 1st Earl (1817–1887), British diplomatist, was the son of the first Baron Lyons, the celebrated admiral, and was born at Lymington, 26th April 1817. He entered the diplomatic service, and in 1858 became British minister at Washington, where, after the outbreak of the Civil War, the extremely important negotiations connected with the arrest of the Confederate envoys on board the British mail-steamer *Trent* devolved upon him. After a brief service at Constantinople, he succeeded Lord Cowley at the Paris embassy in 1867. In the war of 1870 he used his best efforts as a mediator, and accompanied the provisional government to Tours. He continued to hold his post with universal acceptance until November 1887, but succumbed to a paralytic stroke on 1st December 1887, the title becoming extinct.

Lyttelton, seaport, Selwyn county, Canterbury district, South Island, New Zealand, 5 miles south-east by east of Christchurch, with which it is connected by rail, on the inlet called Port Lyttelton, in the north side of Banks Peninsula. The harbour accommodation has been very much improved, and vessels of any size can anchor beside the wharves, where the depth of water is 26 feet. The harbour has an area of over 105 acres, and possesses a graving dock which can be entered by vessels of 6000 tons. The tonnage of shipping entered inwards in 1900 was 55,308; outwards, 118,333. The harbour board's receipts for 1899 were £32,392; expenditure, £36,859. The total trade for 1883 was £3,344,141; for 1893, £3,135,973; for 1900, £4,293,641. Population (1881), 4127; (1901), 4023.

Lytton, Edward Robert Bulwer-Lytton, 1st Earl of (1831–1891), English diplomatist and poet, was the only son of the first Baron Lytton (*Ency. Brit.* vol. xv. p. 121). He was born in Hertford Street, Mayfair, on 8th November 1831. Robert Lytton and his sister were brought up as children principally by a Miss Green. In 1840 the boy was sent to a school at Twickenham, in 1842 to another at Brighton, and in 1845 to Harrow. From his earliest childhood Lytton read voraciously and wrote copiously, quickly developing a genuine and intense love of literature and a remarkable facility of expression both in prose and verse. His letters to his father from school show maturity of thought and of style unusual at that age, and his wish at this period was to devote his life to literary studies and the production of poetry. He had little taste for the ordinary amusements of boyhood, and obtained no scholastic distinction. In 1849 he left Harrow, and studied for a year at Bonn with an English tutor, and on his return with another tutor in England. In 1850 he entered the diplomatic service as unpaid *attaché* to his uncle, Sir Henry Bulwer, who was then minister at Washington. His advance in the diplomatic service was continuous, his successive appointments being: as second secretary—1852, Florence (under Lord Normanby); 1854, Paris (Lord Cowley); 1857, The Hague; 1859, Vienna (Lord Bloomfield); as first secretary or secretary of legation—1863, Copenhagen (Sir A. Paget); 1864, Athens (Mr Erskine); 1865, Lisbon (Sir A. Magennis); 1868, Madrid; 1868, Vienna; 1873, Paris (Lord Lyons); as minister—1875, Lisbon. In 1887 he was appointed to succeed Lord Lyons as ambassador at Paris, and held that office until his death in 1891. This rapid promotion from one European court to another for a period of twenty-three years indicates the esteem in which Lytton was held by successive foreign secretaries. In 1864, immediately before taking up his appointment at Athens, he married Edith, daughter of Edward Villiers, brother of the earl of Clarendon, and in 1873, upon the death of his father, he succeeded to the peerage and the estate of Knebworth in Hertfordshire, devised to his father by his grandmother, the last heiress of the family of Lytton.

Early in 1875 Lord Lytton declined an offer of appointment as governor of Madras, and in November of that year he was nominated governor-general of India by his father's old friend and colleague, Mr Disraeli. The moment was critical in the history of India. Disraeli, securely established in power for the first and last time, was set upon reversing the tradition of the preceding ten years, and proving to the world that Great Britain was not afraid either of imperial greatness or international responsibility. In Central Asia the advance of Russia had continued so steadily and so rapidly that Sher Ali, the Amir of Afghanistan, had determined to seek safety as the vassal of the Tsar as quickly as circumstances should permit. Lytton went out to India with express instructions from the British Government to recover the friendship of the Amir if possible, and if not so to arrange matters on the North-West frontier as to be able to be indifferent to his hostility. For eighteen months Lytton and his Council made every effort to conciliate the friendship of the Amir, but when a Russian agent was established at Kabul, while the mission of Sir Neville Chamberlain was forcibly denied entrance into the Amir's dominions, no choice was left between acknowledging the right of a subsidized ally of Great Britain to place himself within Russian control and depriving him of the office which he owed to British patronage and assistance. The inevitable war began in November 1878, and by the close of that year the forces prepared by Lytton for that purpose had achieved their task with extraordinary accuracy and economy. Sher Ali fled from Kabul, and shortly afterwards died, and once more it fell to the Indian Government to make provision for the future of Afghanistan. By the treaty of Gundamuk in May 1879 Yakub Khan, a son of Sher Ali, was recognized as Amir, the main conditions agreed upon being that the districts of Kuram, Pishin, and Sibi should be "assigned" to British administration, and the Khyber and other passes be under British control; that there should be a permanent British Resident at Kabul, and that the Amir should be subsidized in an amount to be afterwards determined upon. The endeavour of the Indian Government was to leave the internal administration of Afghanistan as little affected as possible, but considerable risk was run in trusting so much, and especially the safety of a British envoy, to the power and the goodwill of Yakub Khan. For the conclusion of this treaty Lytton received the thanks of both Houses of Parliament in August of the same year. Sir Louis Cavagnari, the British envoy, entered Kabul at the end of July, and was, with his staff, massacred in the rising which took place on the 3rd September. The war of 1879–80 immediately began, with the occupation of Kandahar by Stewart and the advance upon and capture of Kabul by Roberts, and the military operations which followed were not concluded when Lytton resigned his office in April 1880.

A complete account of Lytton's viceroyalty, and a lucid exposition of the principles of his government and the main outlines of his policy, may be found in *Lord Lytton's Indian Administration*, by his daughter, Lady Betty Balfour (London, Longmans, 1899). The frontier policy which he adopted, after the method of a friendly and united Afghanistan under Yakub Khan had been tried and had failed, was that the Afghan kingdom should be destroyed. The province of Kandahar was to be occupied by Great Britain, and administered by a vassal chief, Sher Ali Khan, who was appointed "Wali" with a solemn guarantee of British support (unconditionally withdrawn by the Government succeeding Lytton's). The other points of the Indian frontier were to be made as secure as possible, and the provinces of Kabul and Herat were to be left absolutely to their own devices. In consequence of what had been said of Lytton by the leaders of the Parliamentary Opposition in England, it was impossible for him to retain his office under a Government formed by them, and he accordingly resigned at the same time as the Beaconsfield ministry. This part of his policy was thereupon revoked. Abdur Rahman, proving himself the strongest of the claimants to the throne left vacant by Yakub Khan's deposition, became Amir as the subsidized ally of the Indian Government.

The two most considerable events of Lytton's viceroyalty, besides the Afghan wars, were the assumption by Queen Victoria of the title of Empress of India on the 1st January 1877, and the famine which prevailed in various parts of India during the same year. The Durbar at Delhi, at which the Queen was proclaimed empress, was the dramatic completion of the transfer of the Indian government in 1858 from the East India Company to the sovereign of the United Kingdom. It was a pageant of unprecedented splendour, and at the same time a gathering of more or less dependent native princes and chiefs such as had never previously been held. To the famine of 1876–78 Lytton devoted a great part of his time and thoughts. Having personally witnessed in different parts of India the application of the methods then adopted for dealing with such a catastrophe, he satisfied himself that periodical famines must be expected in Indian history, and that constant preparation during years of comparative prosperity was the only condition whereby their destructiveness could be modified. Accordingly he proposed and obtained the appointment of the Famine Commission of 1878, to inquire, upon lines laid down by him, into available means of mitigation. Their report, made in 1880, is the foundation of the later system of irrigation, development of communications, and "famine insurance." The equalization and reduction of the salt duty were effected, and the abolition of the cotton duty commenced, during Lytton's term of office, and the system of Indian finance profoundly modified by decentralization and the regulation of provincial responsibility, in all which matters Lytton enthusiastically supported Sir John Strachey, the financial member of his Council.

Upon Lytton's resignation in 1880 an earldom was conferred upon him in recognition of his services as viceroy. He returned home, and lived at Knebworth until 1887, in which year he was appointed to succeed Lord Lyons as ambassador at Paris. For this great office it was considered that his wide knowledge of European diplomacy and remarkable command of the French language gave him altogether exceptional qualifications, and the general expectation of his success was not disappointed. British diplomatic relations with France were never on a more thoroughly satisfactory footing than during the four years of Lytton's embassy. They were the last years of his life. He died at Paris on 24th November 1891, of a clot of blood in the heart, when apparently recovering from a serious illness.

Lytton is probably better known as a poet—under the pen-name of "Owen Meredith"—than as a statesman. The list of his published works is as follows: *Clytemnestra, and other Poems*, 1855; *The Wanderer*, 1858; *Lucile*, 1860; *Serbski Pesme, or National Songs of Servia*, 1861; *Tannhäuser* (in collaboration with Mr Julian Fane), 1861; *Chronicles and Characters*, 1867; *Orval, or The Fool of Time*, 1868; *Fables in Song* (2 vols.), 1874; *Glenaveril, or The Metamorphoses*, 1885; *After Paradise, or The Legends of Exile, and other Poems*, 1887; *Marah*, 1892; *King Poppy*, 1892. The two last-mentioned volumes were published posthumously. A few previously unpublished pieces are included in a volume of *Selections* published, with an introduction by Lady Betty Balfour, in 1894 (Longmans and Co.). His metrical style was easy and copious, but not precise. It often gives the impression of having been produced with facility, because the flow of his thought carried him along, and of not having undergone prolonged or minute polish. It was frequently suggestive of the work of other poets, especially in his earlier productions. The friend who wrote the inscription for the monument to be erected to him at St Paul's described him as "a poet of many styles, each the expression of his habitual thoughts." *Lucile*, a novel in verse, presents a romantic style and considerable wit; and *Glenaveril*, which also contains many passages of great beauty and much poetic thought, has much of the same narrative character. Beside his volumes of poetry, Lytton published in 1883 two volumes of a biography of his father. The second of these contains the beginning of the elder Lytton's unfinished novel, *Greville*, and his life is brought down only to the year 1832, when he was twenty-six years of age, so that the completion of the book upon the same scale would have required at least four more volumes. The executrix of Lytton's mother chose to consider that the publication was injurious to that lady's memory, and issued a volume purporting to contain Bulwer-Lytton's letters to his wife. This Lytton suppressed by injunction, thereby procuring a fresh exposition of the law, that the copyright in letters remains in the writer or his representatives, though the property in them belongs to the recipient. Lytton's appointment to the Parisian embassy caused the biography of his father to be finally laid aside.

Lytton was physically well-proportioned, delicately made, and rather below than above the average size. He had no aptitude for outdoor sports, and was probably at no time robust in health or given to any considerable bodily activity. As a young man he was extremely handsome, his head being well-shaped and thickly covered with closely curling hair, which he retained all his life. In middle age the marked characteristics of his features were intelligence and extreme vitality. His ordinary conversation arrested notice at once by its humour, its wide comprehensiveness, its flexibility, and its startling candour. But in business matters the vigour and swiftness of his intellect were what most distinguished him. The promptness with which he seized and mastered the essential points of the matter under discussion, and the incisive force with which his own view of it was expressed, demonstrated at once and without question that he was a man of the highest ability. With a strong regard for all the conventions of life as such, he entirely refused to govern his conduct by those which he conceived not to be applicable to himself, and there were people who resented this side of his character. His dress, without being startling, was usually distinctive, and his choice of clothes in private life was regulated principally by a regard for his own comfort. He would address any one, in any station of life, for whom he felt a regard, as "dear ——," and both in conversation and in correspondence made far more frequent use of the superlative "dearest" than is at all usual in England. Though he had considerable eloquence, his main methods of expression were conversation and writing. His prose style was extraordinarily lucid and powerful, but his minutes and despatches were very seldom short. During the interval between his Indian government and his embassy at Paris he lived at Knebworth, where, out of filial affection, he preserved sedulously much of his father's embellishment of the house, and added considerably to the fabric. (H. S*.)

Maasin, a town on the coast in the extreme south-western portion of the island of Leyte, Philippine Islands. It is an important port for the shipment of abacá (*Musa textilis*), and the low, fertile plains in its vicinity also produce cotton, pepper, tobacco, and rice in considerable quantities. It is the only point on the western coast of Leyte where a court of justice is held. The language is Visayan. Population, 18,000.

Macao, a Portuguese possession, situated near the estuary of the Canton river, China. During the south-west (summer) monsoon great quantities (67 inches) of rain fall, especially in July and August. The mean temperature is 74·3° Fahr.; in July, the hottest month, the temperature is 84·2°; in February, the coldest, it is 59°. On the whole the climate is moist. Hurricanes are frequent. Its area is 4 square miles. Population (1896), Chinese, 74,568; Portuguese, 3898; and other nationalities, 161—total, 78,627. Of the Portuguese more than three-fourths were natives of Macao—a race very inferior in point of physique to their European ancestors. Macao is connected with the colony of Hong-Kong by a daily steamer. Being open to the south-west sea breezes, it is a favourite place of resort from the oppressive heat of Hong-Kong. It is ruled by a governor, and, along with Timor (East Indies), constitutes a bishopric, to which belong also the Portuguese Christians in Malacca and Singapore. There are a lyceum, seminary, and college (Santa Rosa de Lima). Silks, mats, tobacco, paper, preserved foods, rugs, timber, opium, and goldsmiths' work are the principal articles manufactured or prepared. The trade, mostly transit and in Chinese hands, increased in value from £2,259,250 in 1880 to £3,771,615 in 1898, the commodities mostly dealt in being opium, tea, rice, oil, raw cotton, fish, and silk. Macao is hardly of any account, however, as a port of foreign trade. In fishing 920 boats and 8700 men and boys are employed. Fish was exported to the value of £882,200 in 1895.

Although Macao is, *de facto*, a colonial possession of Portugal, the Chinese Government persistently refused to recognize the claim of the Portuguese to territorial rights, alleging that they were merely lessees or tenants at will. This diplomatic difficulty prevented the conclusion of a commercial treaty between China and Portugal for a long time, but an arrangement for a treaty was come to in 1887 on the following basis:—(1) China confirmed perpetual occupation and government of Macao and its dependencies by Portugal. (2) Portugal engaged never to alienate Macao and its dependencies without the consent of China. (3) Portugal engaged to co-operate in opium revenue work at Macao in the same way as Great Britain at Hong-Kong. The formal treaty was signed in the same year, and arrangements were come to whereby the Chinese Imperial Customs were able to collect duties on vessels trading with Macao in the same way as they had already arranged for their collection at the British colony of Hong-Kong.

Macarsca (also spelt *Makarska*), a seaport town in the Austrian crownland of Dalmatia, opposite the island of Brazza, and about 32 miles south-east of Spalato. Some of the best Dalmatian wine is grown in the district, and the town has a considerable trade in corn, figs, and other fruit. It is a station of the Austrian Lloyd. In 1890 it had a population of 10,309, and in 1900, 11,016, chiefly Serbo-Croatian.

Macassar. See CELEBES.

M‘Carthy, Justin (1830-——), Irish politician, historian and novelist, was born in Cork, 22nd November 1830, and was educated at a school in that town. He began his career as a journalist at the age of eighteen, in Cork. From 1853 to 1859 he was in Liverpool, on the staff of the *Northern Daily Times*, during which period he married (in March 1855) Miss Charlotte Allman. In 1860 he removed to London, as parliamentary reporter to the *Morning Star*, of which he became editor in 1864. In 1868 he gave up this post, and, after a lecturing tour in the United States, joined the staff of the *Daily News* as leader-writer in 1870. He lectured again in America in 1870–71, and again in 1886–87. He represented Co. Longford in Parliament as a Liberal and Home Ruler from 1879 to 1885; North Longford, 1885–86; Londonderry, 1886–92; and North Longford from 1892 to 1900. He was chairman of the Anti-Parnellites from the fall of Mr Parnell in 1890 until January 1896; but his Nationalism was of a temperate and orderly kind, and though his personal distinction singled him out for the nominal chairmanship he was in no sense the political leader. His real bent was towards literature. His earliest publications were novels, some of which, such as *A Fair Saxon* (1873), *Dear Lady Disdain* (1875), *Miss Misanthrope* (1878), *Donna Quixote* (1879), attained considerable popularity. His most important work is his *History of Our Own Times* (vols. i.–iv. 1879–80; vol. v. 1897), which treats of the period between Queen Victoria's Accession and her Diamond Jubilee. Easily and delightfully written, these volumes form a brilliant piece of narrative from a Liberal standpoint. He also started on a *History of the Four Georges* (1884–1901), of which the latter half was written by his son, Justin Huntly M‘Carthy (born 1860), who is the author of various novels, plays, and short histories. Justin M‘Carthy, amongst other works, wrote biographies of Sir Robert Peel (1891), Pope Leo XIII. (1896), and W. E. Gladstone (1898), and published his *Reminiscences*, in 2 vols., in 1899.

McClellan, George Brinton (1826–1885), soldier and author, was born in Philadelphia, Pa., 3rd December 1826. After passing two years (1840–42) in the University of Pennsylvania, he entered the U.S. military academy, from which he graduated with high honours, July 1846. Sent as a lieutenant of engineers to the Mexican war, he took part in the battles under General Scott, and won brevets of first lieutenant and captain for gallantry; he was afterwards detailed as assistant-instructor at West Point, and upon explorations at the south-west and in Oregon. Promoted in 1855 to captain of cavalry, he served on a military commission sent to Europe to study the Crimean war, and furnished an able and interesting report. Resigning his commission in 1857, McClellan became successively chief engineer and vice-president of the Illinois Central railroad (1857–60) and president of the St Louis and Cincinnati railroad, with his residence in Cincinnati. When the Civil War broke out, he was, in April 1861, made major-general of three months' militia by the governor of Ohio; but General Scott's favour at Washington promoted him rapidly, 14th May, to major-general, U.S.A., with a military department north of the Ohio river. Pursuant to orders, 26th May, McClellan sent a small force across the Ohio river to Philippi, dispersed the Confederates there in early

June, and aided immensely the movement of the Unionist forces in that region by rapid and brilliant military successes, gained, 11th to 13th July, with Rosecrans next in command, at Rich Mountain and Carrick's Ford. These operations, though comparatively trivial as the Civil War developed, brought great results, in permanently dividing old Virginia, by the erection of the loyal state of West Virginia, and in presenting the first sharp, short, and wholly successful campaign of the war. Soon after the Bull Run disaster, he was summoned to Washington, and the Union hailed him as chieftain and preserver. Only thirty-four years old, and with military fame and promotion premature and quite in excess of positive experience, he reached the capital, 26th July, and assumed command. At first all was deference and compliance with his wishes. The veteran Scott retired that this young hero might have the operations of the whole Union within his closer control. McClellan proved himself a grand organizer, and created that famous army of the Potomac, which idolized him with the devotion of a first faith. But he soon showed petulance towards the civil authorities, from whom he came to differ concerning the political ends in view. His army grew rapidly in numbers and discipline but did not go forward. Autumn and winter passed, and nothing was done until the spring of 1862. McClellan now found severe critics who doubted his capacity for the aggressive; but the Government yielded to his plans for an oblique instead of direct movement upon Richmond and the opposing army. By 5th April his invading column of 121,500 was safely transported to Fortress Monroe; and other troops were sent later at his earnest request, some being retained to cover Washington. McClellan laid slow siege to Yorktown, not breaking the thin line first opposed to him, but giving Johnston full time to reinforce and then evacuate. Next at Williamsburg, 5th May, came an undirected battle, accidentally brought on during his pursuit. Richmond was in danger; but McClellan had made the York rather than the James river his line of approach, and with White House Landing for a base of supplies, he found himself compelled to divide his immense force by the malarial stream of the Chickahominy. At "Seven Pines" (or "Fair Oaks") was fought, 31st May, a bloody battle, ending the following day in a Confederate repulse. Johnston being severely wounded, Lee came to command on the southern side. Long storms now hindered operations, until, with a newly recruited army, Lee despatched two-thirds of his entire force to the north of the Chickahominy to strike McClellan's isolated right wing. The Seven Days' Battles began 26th June, with Lee's assault strenuously resisted by General Fitz-John Porter at Mechanicsville, and then at Gaines's Mill, after which, on the night of the 27th, McClellan announced his purpose to transfer his base to the James river. This change was promptly executed in a masterly manner, but at Glendale and Malvern Hill fierce battles were fought, and all was retreat, without effort to outflank Lee or move by the inner line upon Richmond. Operations nearer Washington having changed the theatre of conflict, General Halleck, who was now general-in-chief, ordered McClellan and his army back from the peninsula to reinforce General Pope in the region of Manassas. The order was obeyed reluctantly. Pope's disastrous defeat (29th and 30th August) brought McClellan a new opportunity to retrieve his fame, for President Lincoln, against the earnest remonstrance of Stanton and others of his cabinet, now placed him once more in command, and sent him to oppose Lee, who crossed the Potomac into Maryland in early September. At Antietam, on the 17th, was fought a great battle, in which Lee was worsted, McClellan having profited by an order which fell into his hands, disclosing his enemy's whole plan of invasion. But the Confederates safely recrossed the Potomac, and McClellan showed his former faults in a tardy pursuit and aggression. Having by 7th November reached the full limit of experiment, President Lincoln now superseded McClellan in command of the army of the Potomac. McClellan was never again ordered to active command, and the political elements opposed to the general policy of this administration united on him for President in 1864, on a platform which denounced the war as a failure and proposed negotiating with the South for peace. McClellan, while accepting his candidacy, repudiated the platform, like a soldier and patriot. At the polls, 8th November, Lincoln was triumphantly re-elected President. On the day of election McClellan resigned his high commission in the army, and soon afterwards went to Europe, where he remained until 1868. Upon his return he took up his residence in New York City, where (1868–69) he engaged in superintending the construction of an experimental floating battery. In 1870–72 he was engineer-in-chief of the city's department of docks. With Orange, N.J., next as his principal residence, he became Democratic governor of New Jersey (1878–81). During his last years he made several tours of Europe, visited the East, and wrote much for the magazines. He also prepared monographs upon the Civil War, defending his own action. He died suddenly at Orange, of heart disease, 29th October, 1885.

McClellan was a clear and able writer and effective speaker, and his *Own Story*, edited by a friend and published soon after his death, discloses an honourable character, sensitive to reproach, and conscientious, even morbidly so, in his patriotism. He carried himself well while in civil station and was of irreproachable private conduct. During the Civil War, however, he was promoted too early and rapidly for his own good, and the strong personal magnetism he inspired while so young developed an inordinate self-esteem and exaltation, injurious to a full measure of success and usefulness, despite his splendid opportunities. The reasons for his final displacement in 1862 were both civil and military, and the President had been forbearing with him. As a soldier McClellan was a marvellous organizer and moulder of the raw material of an army, and could inspire those under him to fight. But he was slow and feeble, perhaps too tender-hearted, in handling armed masses for action; and though admirable for defensive war and a safe strategist, he showed himself unfitted to take the highly essential initiative, both because of temperament and his habitual exaggeration of obstacles and opposing numbers. (J. SCH.)

Macclesfield, a municipal borough and market town in (since 1885) the Macclesfield parliamentary division of Cheshire, England, on the river Bollin, 17 miles south by east of Manchester by rail. The County Lunatic Asylum has been enlarged to accommodate epileptic patients, and in 1894 the town was presented with the Victoria Park (13 acres). There is a technical school. "Macclesfield Forest" is now nearly treeless. Hand-looms are still largely used in the silk-throwing mills. Population (1881), 37,514; (1901), 34,635. The parish of Sutton stretches 4 miles south-south-east of the town, and is partly contained in the municipal borough.

M'Clintock, Sir Francis Leopold (1819–——), Arctic explorer, was born at Dundalk in 1819. He entered the navy at the age of twelve, and spent some fifteen or sixteen years on foreign service. His first experience of Arctic travel was gained on H.M.S. *Enterprise*, in an expedition despatched by the Admiralty in 1848, at the time when the greatest anxiety was entertained concerning the fate of Sir John Franklin's expedition. In 1850 he served with a similar expedition, on H.M.S. *Assistance*, and in the summer of that year saw, at Cape Riley, some traces of the lost explorers. In the following spring he made a sledge journey of 760 miles, and reached the most westerly point then explored in the Arctic. On his return, in 1851, he was promoted to the rank of commander, and in 1852 returned to the Arctic in command of H.M.S. *Intrepid*, one of five vessels sent in that year to continue the search for Franklin. This time he was away for two years, in the course of which he distinguished himself by another long sledge journey of exploration, and by the discovery and rescue of a body of explorers who, under Captain M'Clure, had been missing for three years. In 1857, having now reached the rank of captain, he took command of the search expedition equipped by Lady Franklin, and, in the ship *Fox*, succeeded in discovering on the shore of King William Land a record of the death of Sir John Franklin and the fate of his men and ships. For his services in this connexion he was knighted (in 1859), and received the freedom of the City of London as well as marks of honour from various universities. From 1859 to 1865 he was on foreign service, and from 1865 to 1868 was commodore at Jamaica. From 1868 to 1871 (when he was promoted to rear-admiral) he was a naval aide-de-camp to Queen Victoria; from 1872 to 1877 admiral superintendent of Portsmouth dockyard; after which, reaching the rank of vice-admiral, he served as commander-in-chief of the North American and West Indian station from 1879 to 1882. In 1884 he retired as full admiral, and became an elder brother of the Trinity House. In 1887 he was awarded a special pension for his services, and was created K.C.B. in 1891. He published, in 1859, his narrative of his search for Sir John Franklin, under the title of *The Voyage of the "Fox"*; it reached a fifth edition in 1881. He married, in 1870, Annette Elizabeth Dunlop.

Mac Cormac, Sir William, Bart. (1836–1901), Irish surgeon, was born at Belfast, 17th January 1836, being the son of Dr Henry Mac Cormac. He was educated in medicine and surgery at Belfast, Dublin, and Paris, and graduated in arts, medicine, and surgery at the Queen's University of Ireland, in which he afterwards became an examiner in surgery. He started practice in Belfast, where he became surgeon to the General Hospital, but left it for London on his marriage in 1861 to Miss Katherine M. Charters. In the Franco-German war of 1870 he was surgeon-in-chief to the Anglo-American Ambulance, and was present at Sedan; and he also went through the Turco-Servian war of 1876. He became in this way an authority on gun-shot wounds, and besides being highly successful as a surgeon was very popular in society, his magnificent physique and Irish temperament making him a notable and attractive personality. In 1881 he was appointed assistant-surgeon at St Thomas's Hospital, London, and for twenty years continued his work there as surgeon, lecturer, and consulting surgeon. In 1881 he acted as hon. secretary-general of the International Medical Congress in London, and was knighted for his services. In 1883 he was elected member of the Council of the College of Surgeons, and in 1887 a member of the Court of Examiners; in 1893 he delivered the Bradshaw lecture, and in 1896 was elected president, being re-elected to this office in 1897, 1898, 1899, and 1900 (the centenary year of the College), an unprecedented record. In 1897 he was created a baronet, and appointed surgeon-in-ordinary to the prince of Wales; and in 1898, in recognition of his attendance on the prince at the time of an accident to H.R.H.'s knee-cap, he was made K.C.V.O. His foreign distinctions and orders were also numerous. In 1899 he was Hunterian Orator. In the same year he volunteered to go out to South Africa as consulting surgeon to the forces, and from November 1899 to April 1900 he saw much active service both in Cape Colony and Natal, his assistance being cordially acknowledged on his return. In 1901 he was appointed honorary serjeant-surgeon to the King. But during 1898 he had suffered from a prolonged illness, and he had perhaps put too much strain on his strength, for on 4th December 1901 he died somewhat suddenly at Bath. Besides treatises on *Surgical Operations* and *Antiseptic Surgery*, and numerous contributions to the medical journals, Sir William Mac Cormac was the author of *Work under the Red Cross* and of an interesting volume commemorating the centenary of the Royal College of Surgeons in 1900. The latter contains biographical notices of all the masters and presidents up to that date. (H. CH.)

McCormick, Cyrus Hall (1809–1884), American inventor of grain-harvesting machinery, was born at Walnut Grove, Rockbridge county, Va., U.S.A., 15th February 1809. His father was a farmer who had invented numerous labour-saving devices for farm work, but after repeated efforts had failed in his attempts to construct a successful grain-cutting machine. In 1831, Cyrus, then twenty-two years old, took up the problem, and after careful study constructed a machine which was successfully employed in the late harvest of 1831 and patented in 1834. The McCormick reaper came into use slowly for many years, but after further improvements proved a complete success; and in 1847 the inventor removed to Chicago, where he established large works for manufacturing his agricultural machines. William H. Seward has said of McCormick's invention, that owing to it "the line of civilization moves westward thirty miles each year." Numerous prizes and medals were awarded for his reaper, and he was elected a corresponding member of the French Academy of Sciences, "as having done more for the cause of agriculture than any other living man." He died in Chicago, 13th May 1884.

M'Cosh, James (1811–1894), educator and philosophical writer, was born at Carskeoch, in Ayrshire, on the 1st of April 1811. He studied at Glasgow and Edinburgh, receiving at the latter his M.A., at the suggestion of Sir William Hamilton, for an essay on the Stoic philosophy. He became a minister of the Established Church of Scotland, and took part in the Free Church movement of 1843. In 1852 he was appointed professor of logic and metaphysics in Queen's College, Belfast; and in 1868 was chosen president of the College of New Jersey, at Princeton, a post which he filled with much acceptance until his resignation in 1888. The list of his philosophical, religious, and controversial (against Mill, Huxley, and Tyndall, in particular) writings began with *The Method of the Divine Government, Physical and Moral* (1850), which was cordially received by conservative theologians, and ended with *The Religious Aspects of Evolution* (1888). His general philosophical attitude and method were Hamiltonian; he insisted on severing religious and philosophical data from merely physical; and though he added little to original thought, he clearly restated and vigorously used the conclusions of others. He died at Princeton on the 16th of November 1894. (C. F. R.)

M'Culloch, Sir James (1819–1893), Australian statesman, son of George M'Culloch, was born in Glasgow in 1819. He entered the house of Dennistoun Brothers, became a partner, and went to Melbourne to open a branch. In 1854, shortly after his arrival in Victoria, he was appointed a nominee member of the Legislative Council, and in the first Legislative Assembly under the new constitution was returned for the electorate of the Wimmera. In 1857 he was appointed Minister of Trade and Customs in the second ministry of Mr Haines, which lasted till 1858, and subsequently, while representing East Melbourne, he became Treasurer in the Nicholson administration, which held office from October 1859 to November 1860. After its resignation Mr M'Culloch revisited Europe, and on his return to Victoria he re-entered the Assembly as member for Mornington. In June 1862 the third O'Shanassy ministry was defeated by a combination between a section of its supporters led by Mr M'Culloch and the Opposition proper under Mr Heales, and Mr M'Culloch became Premier and Chief Secretary. Hitherto he had been regarded as a Conservative, and a supporter of the landed, squatting, and importing interests, but the coalition ministry introduced a number of measures which at the time were regarded by the propertied classes in the colony as revolutionary. In addition to passing a land Bill, which extended the principle of free selection and deferred payments, the ministry announced their intention of reducing the duties on the export of gold and the import duties upon tea and sugar, and of supplying the deficiency by the imposition of duties ranging from 5 to 10 per cent. upon a number of articles which entered into competition with the local industries, thus introducing protection. The mercantile community took alarm at the proposal, and at the general election of 1864 the ministerial policy was warmly opposed. But a majority was returned in its favour, and a new tariff was carried through the popular branch of the Legislature. There was no probability of its being assented to by the Council, which, under the constitution, had the power of rejecting, although it could not amend, any money Bill. The Government therefore decided upon tacking the tariff to the Appropriation Bill, and compelling the Council either to agree to the new fiscal proposals or to refuse to pay the public creditors and the civil servants. The Council accepted the challenge, and rejected the tacked Appropriation Bill. But Mr M'Culloch and his colleagues would not give way. They continued to collect the new duties under the authority of the Assembly, and took advantage of a clause in the Audit Act which directed the Governor to sign the necessary warrants for the payment of any sum awarded by verdicts in the Supreme Court in favour of persons who had sued the Government. Mr M'Culloch borrowed £40,000 from the London Chartered Bank, of which he was a director, to meet pressing payments, and the bank at his instigation sued the Government for the amount of the advance. The Attorney-General at once accepted judgment, and the Governor, who had placed himself unreservedly in the hands of his ministers, signed the necessary warrant, and the Treasury repaid to the bank the amount of its advance, plus interest and costs. In the next session of Parliament the tariff was again sent up to the Council, which promptly rejected it, whereupon the ministry dissolved the Assembly and appealed to the country. The result of the general election was to increase Mr M'Culloch's majority, and the tariff was again sent to the Council, only to be again rejected. Mr M'Culloch resigned, but no member of the Opposition was willing to form a ministry, and he resumed office. Eventually a conference between the two Houses was held, and the Council passed the tariff, after a few modifications in it had been agreed to by the Assembly. Just at the moment that peace was restored, the Governor, Sir Charles Darling, was recalled by the Home Government, on the ground that he had displayed partisanship by assisting Mr M'Culloch's Government and their majority in the Assembly to coerce the Council. In order to show their gratitude to the dismissed Governor, the Assembly decided to grant a sum of £20,000 to Lady Darling. The Home Government intimated that Sir Charles Darling must retire from the Colonial service if this gift were accepted by his wife, but Mr M'Culloch included the money in the annual Appropriation Bill, with the result that it was rejected by the Council. The new Governor, Viscount Canterbury, was less complaisant than his predecessor, but after an unsuccessful attempt to obtain other advisers, his Excellency agreed to recommend the Council to pass the Appropriation Bill with the £20,000 grant included. The Upper House declined to adopt this course, and again rejected the Bill. A long and bitter struggle between the two Chambers ended in another general election in 1868, which still further increased the ministerial majority; but Lord Canterbury, in obedience to instructions from the Colonial Office, declined to do anything to facilitate the passage of the Darling grant. Mr M'Culloch resigned, and after protracted negotiations Sir Charles Sladen formed from the minority in the Assembly a ministry which only lasted two months. The deadlock seemed likely to become more stringent than ever, when a communication was received from Sir Charles Darling, that neither he nor his wife could receive anything like a donation from the people of Victoria. The attempt to pass the grant was therefore abandoned, and in July 1868 Mr M'Culloch resumed office with different colleagues, but resigned in the following year, when he was knighted. He formed a third ministry in 1870. During this third administration he passed a measure through both Houses which secured a life annuity of £1000 per annum to Lady Darling. Additional taxation being necessary, Sir James M'Culloch was urged by his protectionist supporters to increase the import duties, but he refused, and proposed to provide for the deficit by levying a tax upon town, suburban, and country property. This proposal was defeated in the Assembly; Sir James resigned in June 1871, and was appointed Agent-General for Victoria in London. He held that appointment till 1873, was created K.C.M.G. in 1874, returned to the colony the same year, and was elected for Warrnambool. In 1875 he formed his fourth and last ministry, which kept power till May 1877, when his party was defeated at the general election. During his eighteen months of office he had to encounter a persistent opposition from Mr Berry and his followers, who systematically obstructed the business of the Assembly, on the ground that the Acting Governor, Sir William Stawell, had improperly refused a dissolution. Sir James M'Culloch, to counteract this obstruction, invented the closure, which was afterwards introduced with some modification into the House of Commons. After his defeat in 1877 Sir James retired from public life and returned to England, where he died on 30th January 1893 at Ewell, Surrey. He was twice married—first, in 1841, to Susan, daughter of the Rev. James Renwick, of Muirton, Scotland; secondly, in 1867, to Margaret, daughter of William Inglis, of Walflat, Dumbartonshire. He left the house of Dennistoun Brothers in 1862, and founded a new firm at Melbourne in conjunction with Leishman, Inglis and Co. of London, under the title of M'Culloch, Sellars and Co. He held several important commercial positions, and was President of the Melbourne Chamber of Commerce. (G. C. L.)

Macdonald, George (1824– ——), Scottish novelist and poet, was born at Huntly, Aberdeenshire, in 1824; his father, a farmer, was one of the Macdonalds of Glencoe, and a direct descendant of one of the families that suffered in the massacre. Macdonald's youth was passed in his native town, under the immediate influence of the Congregational Church, and in an atmosphere strongly impregnated with Calvinism. He took his degree at Aberdeen University, and migrated thence to London, studying at Highbury College for the Congregational ministry. In 1850 he was appointed pastor of Trinity Congregational Church, Arundel, and, after resigning his cure there, was engaged in ministerial work in Manchester. His health, however, was unequal to the strain, and after a short sojourn in Algiers he settled in London and adopted the profession of literature. In 1856 he published his first book, *Within and Without,* a dramatic poem; following it in 1857 with a volume of *Poems,* and in 1858 by the delightful "faerie romance" *Phantastes.* His first conspicuous success was achieved in 1862 with *David Elginbrod,* the forerunner of a number of popular novels, which include *Alec Forbes of Howglen* (1865), *Annals of a Quiet Neighbourhood* (1866), *Robert Falconer* (1868), *Malcolm* (1875), *The Marquis of Lossie* (1877), and *Donal Grant* (1883). He was for a time editor of *Good Words for the Young,* and lectured successfully in America in 1872–73. He also wrote several stories for the young, and published some striking volumes of sermons. Both as preacher and as lecturer on literary topics (notably on Shakespeare—his study of *Hamlet* being particularly interesting) George Macdonald's great sincerity and moral enthusiasm, amounting at times to something akin to inspiration, exercised great influence upon thoughtful minds. His verse is homely and direct, and marked by religious fervour and simplicity. As a portrayer of Scottish peasant-life in fiction he was the precursor of a large school, which has benefitted by his example and surpassed its original leader in popularity. The religious tone of his novels is relieved by tolerance and a broad spirit of humour, and the simpler emotions of humble life are sympathetically treated. They show considerable insight into character, and several of his stories turn upon the development of the individual nature under the sway of spiritual ascendancy. Their tone throughout is wholesome and elevating. In 1877 George Macdonald was given a Civil List pension.

Macdonald, Sir John Alexander (1815–1891), first Premier of the Dominion of Canada, and the most conspicuous figure that Canadian politics produced in the 19th century, was born in Glasgow on the 11th of January 1815. His father was Hugh Macdonald, a native of Sutherlandshire; his mother's maiden name was Helen Shaw; among the five children of their family the future statesman was the third. The family emigrated to Canada in 1820, settling first at Kingston, Ontario, and later, on the failure of various undertakings, removing in succession to two of the small neighbouring towns. The father, an unpractical man in matters of business, died in 1841. The energy and capacity displayed by the mother in holding the family together seem to have made a deep impression on her brilliant son. Five years spent at the Kingston Grammar School constituted the lad's only formal education. At the age of fifteen he entered the law office of Mr George Mackenzie of Kingston; he studied there for six years, was called to the bar in 1836, and began in the same town the practice of his profession. This was a particularly critical period in the history of Canada, and one calculated to stimulate political thought in a young and active mind. It was the year before the rebellion of 1837: the condition of the whole country was very unsettled, and it seemed well-nigh impossible to reconcile the differences arising from racial and political antagonisms. During the rebellion young Macdonald volunteered for active service, but the uprising was easily crushed, and his military career never went farther than drilling and marching. The year 1844 saw his entry into political life. In his first address to the electors of Kingston a sentence occurs which strikes the dominant note of his subsequent political faith and public career:—"I therefore need scarcely state my firm belief that the prosperity of Canada depends upon its permanent connexion with the mother country, and that I shall resist to the utmost any attempt (from whatever quarter it may come) which may tend to weaken that union." For forty-six years of public life this idea gave the main direction to his policy. He was elected by a large majority, and took his seat on 28th November 1844 as a supporter of the Draper Government. In 1847 he was made Receiver-General, with a seat in the Executive Council. The Government of which he thus became a member held office for only ten months, and then, on appealing to the country, was placed in a hopeless minority. The Rebellion Losses Bill, passed by the victorious Liberals and assented to by Lord Elgin in circumstances that provoked a riot ending in the burning of the Houses of Parliament, caused much indignation among the hitherto ultra-loyal Conservative party, and many of its members at this period signed a document favouring annexation to the United States. Macdonald, on the other hand, took steps to form a British American League, having for its object the confederation of all the provinces, the strengthening of the connexion with the mother country, and the adoption of a national commercial policy. He remained in Opposition till 1854, and then, as a consequence of the fierce dissensions connected with the secularization of the clergy reserves in Ontario and the abolition of seigniorial tenure in Quebec, he planned a coalition of the Conservatives and the moderate Reformers, among whom was a large French Canadian element. Out of this union grew the Liberal-Conservative party, of which until his death Macdonald continued to be the most prominent figure. He was Attorney-General for Upper Canada from 1854 to 1857, and then, on the retirement of Colonel Taché, he was himself called on to form a ministry. So closely were parties divided at this time that defeat and reinstatement of Governments followed each other in rapid succession.

The experiment of applying responsible government on party lines to the two Canadian provinces at last seemed to have come to a deadlock. Two general elections and the defeat of four ministries within three years had done nothing to solve the difficulties of the situation. At this critical period a proposal was made for a coalition of parties in order to carry out a broad scheme of British American confederation. The immediate proposal is said to have come from George Brown; the large political idea had long been advocated by Macdonald and Alexander Galt in Upper Canada—by Joseph Howe and others in the Maritime Provinces. The close of the American Civil War, the Fenian raids across the American border, and the dangers incident to the international situation, gave a decisive impulse to the movement. Macdonald, at the head of a representative delegation from Ontario and Quebec, met the public men of the Maritime Provinces in conference at Charlottetown in 1864, and the outline of confederation then agreed upon was filled out in detail at a conference held at Quebec soon afterwards. The constitution then framed was submitted to the Imperial Parliament in the autumn of 1866, and passed early in the following year. On 1st July 1867 the Act by which Canada was confederated as a Dominion under the Crown was proclaimed. In all the discussions leading up to this great step in colonial development Macdonald took the leading part, and thus he naturally became the first Premier of the Dominion. He was made at this time K.C.B. in recognition of his services to the empire.

The difficulties of organizing the new Dominion, the questions arising from diverse claims and the varied conditions of the country, called for infinite tact and resource on the part of the Premier. Federal rights were to be safeguarded against the provincial governments, always jealous of their privileges. The people of Nova Scotia in particular, dissatisfied with the way in which their province had been drawn into the Union, maintained a fierce opposition to the Ottawa Government, until their leader, Joseph Howe, fearing an armed rising, came to an agreement with Macdonald and accepted a seat in his cabinet. The establishment of a supreme court also occupied the attention of Sir John, who had a strong sense of the necessity of maintaining the purity and dignity of the judicial office. The pledge made at confederation with regard to the building of the Intercolonial railway was fulfilled. The North-West Territories were secured as a part of confederated Canada by the purchase of the rights of the Hudson Bay Company, and the establishment of Manitoba as a province in 1870. Canada's interests were protected during the negotiations which ended in the Treaty of Washington in 1871, and in which Sir John took part as one of the British delegates. In this year British Columbia entered the confederation, one of the provisions of union being that a transcontinental railroad should be built within ten years. This was declared by the Opposition to be impossible. It was possible only to a leader of indomitable will. Charges of bribery against the Government in connexion with the contract for the building of this line led to the resignation of the cabinet in 1874, and for four years Sir John was in Opposition. But he was by no means inactive. During the summer of 1876 he travelled through Ontario addressing the people on the subject of a commercial system looking to the protection of native industries. This was the celebrated "National Policy" which had been in his thoughts as long ago as the formation of the British American League in 1850. The Government of Mr Alexander Mackenzie refused to consider a protection policy, and determined to adhere to Free Trade with a tariff for revenue only. On these strongly-defined issues the two parties appealed to the people in 1878. The Liberal party was almost swept away, and Sir John, on his return to power, put his policy into effect with a thoroughness that commanded the admiration even of his opponents. He also undertook the immediate construction of the Canadian Pacific railway, which had been postponed by the former Government. The line was begun late in 1880, and finished in November 1885 —an achievement which Sir John ranked among his greatest triumphs. "The faith of Sir John," says one of his biographers, "did more to build the road than the money of Mount-Stephen."

During the remaining years of his life his efforts at administration were directed mainly towards the organization and development of the great North-West. From 1878 until his death in 1891 Sir John retained his position as Premier of Canada. For forty-six years of stormy political life he remained true to the cardinal policy that he had announced to the electors of Kingston in 1844. "A British subject I was born; a British subject I will die," says his last political manifesto to the people of the Dominion. At his advanced age the anxiety and excitement of the contested election of 1891 proved too great. An illness followed from which he never recovered. On the 29th of May he suffered a stroke of paralysis, which caused his death eight days later (6th June).

Sir John A. Macdonald.
(From a photograph by Wm. Notman and Son, Montreal.)

An intelligent view of the career of Sir John Macdonald is only possible when considered in connexion with the political history of Canada and the conditions of its government during the latter half of the 19th century. Trained in a school where the principles of responsible government were still in an embryonic state, where the adroit management of coalitions and cabals was essential to the life of a political party, and where plots and counterplots were looked upon as a regular part of the political game, he acquired a dexterity and skill in managing men that finally gave him an almost autocratic power among his political followers. But great personal qualities supplemented his political dexterity and sagacity. A strong will enabled him to overcome the passionate temper which marked his youth and, later in his career, a habit of intemperance, which he at first shared with many public men of his time. He was a man of strong ambitions, but these were curbed by a shrewd foresight which led him for a long time to submit to the nominal leadership of other and smaller men. Politics he made his business, and to this he devoted all his energies. He had the gift of living for the work in hand, without feeling the distraction of other interests. He had a singular faculty for reading the minds and the motives of men, and to this insight he perhaps owed the power of adaptability (called by his opponents shiftiness) which characterized his whole career. To this power the successful guidance of the Dominion through its critical formative period must be ascribed. Few political leaders have ever had such a number of antagonistic elements to reconcile as presented themselves in the first Canadian Parliament after confederation. The man who could manage to rule a congeries of jealous factions, including Irish Catholics and Orangemen, French and English anti-federationists and agitators for independence, Conservatives and Reformers, careful economists and prodigal expansionists, was manifestly a man of unusual power, superior to small prejudices and without strong bias towards any creed or section. Such a man Sir John proved himself to be. His personality stands out at this period as the central power in which each faction chiefly reposed trust, and under which it could join hands with the others in the service of the State. His singleness of purpose, personal independence, and indomitable energy enabled him to achieve triumphs that to others seemed impossible. After the "Pacific Scandal" of 1874, the leader of the opposite party declared that "John A." (as he was generally called) "has fallen, never to rise again." Yet he not only cleared his own character from the charges laid against him, but succeeded four years later in achieving his most signal party triumph. His natural urbanity allowed him to rule without seeming to rule. When baffled in minor objects he gave way with a good-natured flexibility which brought upon him at times charges of inconsistency. Yet Canada has seen statesmen of more contracted view insist on such small points, fall, and drag down their party with them. He lived at a time when the exigencies of state seemed to require the peculiar talents which he possessed. Entering politics at the dreariest and least profitable stage in Canadian history, he took the foremost part in the movement which made of Canada a nation; he guided that nation through the nebulous stages of its existence, and left it united, strong and vigorous, a monument to his patriotic and far-sighted statesmanship. In the crypt of St Paul's Cathedral a memorial has rightly been placed to him as a statesman, not merely of Canada, but of the Empire. In unveiling that memorial, Lord Rosebery fitly epitomized the meaning of his life and work when he said: "We recognize only this, that Sir John Macdonald had grasped the central idea that the British Empire is the greatest secular agency for good now known to mankind; that that was the secret of his success; and that he determined to die under it, and strove that Canada should live under it."

The authorized and most trustworthy biography of Sir John A. Macdonald is one written by his private secretary, Joseph Pope (2 vols., Arnold). Others have been written by his nephew, Colonel J. Pennington Macpherson, and by Mr J. E. Collins. A bright and amusing anecdotal life has also been compiled by Mr E. D. Biggar (Montreal, J. Lovell and Sons). (G. R. P.)

McDowell, Irvin (1818–1885), American soldier, was born in Columbus, Ohio, on 15th October 1818, and after early training in France graduated at the United States Military Academy in 1838. He was adjutant and instructor at West Point, 1841–45, won brevet rank in the Mexican war, and served as adjutant-general, chiefly at Washington, until 1861, being promoted to major in 1856. While inspector on General Scott's staff and occupied in mustering volunteers at the capital, he was made brigadier-general in May 1861, and placed in command during the premature Virginian campaign of July, which ended in the defeat at Bull Run. Under McClellan he became a corps commander and major-general of volunteers (March 1862). When the Peninsular campaign began, McDowell's column was detained against McClellan's wishes, and, eventually united with General John Pope, engaged at Cedar Mountain, Rappahannock Station, and the second Bull Run. McDowell was relieved of duty in the field (September 1862), sharing Pope's odium, and served at the Pacific coast 1864–68. He became (November 1872) major-general of regulars, was retired in 1882, and died at San Francisco, California, on 4th May 1885. His military merits during the Civil War have provoked much discussion. He appears to have been a faithful, unselfish, energetic soldier, in patriotic sympathy with the Administration, and capable of the highest achievement as commander when well sustained. But he was perhaps too ready to brave great risks at the instance of his superiors, and hence lost instead of gained by his early opportunities. (J. SCH.)

Macduff, a police burgh, burgh of barony, seaport, watering-place, and railway station, 1¼ miles east of Banff, Scotland. It is an important centre for the herring fishing, and has a good bathing beach and a mineral well; also a town hall. The harbour, constructed by the duke of Fife, was transferred to the burgh in 1898. Population (1881), 3650; (1901), 3418.

MACEDONIA.

THE name Macedonia is now generally given to that portion of European Turkey which is bounded on the N. by the Kara-Dagh mountain range and the frontier of Bulgaria, on the E. by the river Mesta, on the S. by the Ægean Sea and the frontier of Greece, and on the W. by an ill-defined line coinciding with the chains of Shar, Grammos, and Pindus. The limits thus marked out do not correspond with those of any Turkish administrative division or with any ethnical boundary. In Macedonia are included the vilayets of Selanik (Salonica), the eastern and greater portion of the vilayet of Monastir (sanjaks of Monastir, Servia, and part of that of Kortcha), and the south-eastern portion of the vilayet of Kossovo (sanjak of Usküb). The coast-line is broken by the remarkable peninsula of Chalcidice, with its three promontories of Athos (anc. *Acte*), Longos (*Sithonia*), and Cassandra (*Pallene*). The country is divided into two almost equal portions by the river Vardar (anc. *Axios*), the valley of which has always constituted the principal route from Central Europe to the Ægean. The other important rivers are the Struma (*Strymon*) and Mesta (*Nestos*), to the east, running almost parallel to the Vardar, and the Bistritza (anc. *Haliacmon*) to the south, all falling into the Ægean. The Struma runs through a narrow defile till within a short distance of the sea; the valleys of the other rivers and their tributaries broaden here and there into fertile upland basins, which were formerly lakes. Of these the extensive plateau of Monastir (*Vitolia*), drained by the Tcherna, is the most remarkable. The principal lakes are Ochrida, on the confines of Albania; Prespa, separated from Ochrida by the Galinitza mountains; Ostrovo, midway between Prespa and the Vardar; Tachino, on the lower course of the Struma; and Beshik (*Bolbe*), separating the Chalcidian peninsula from the mainland. The surface of the country is generally mountainous. The great chain of Rhodope, continued to the north by the Rilska and Osogovska Planina, forms a natural boundary on the north; the principal summit, Musallá (2924 metres), is just over the Bulgarian frontier. Between the upper courses of the Mesta and Struma is the Perim Dagh, or Pirin Planina (anc. *Orbelos*), with Elin (2681 metres), continued to the south by the Bozo Dagh; between the Struma and the Vardar are the Belasitza, Krusha, and other ranges; west of the Vardar the lofty Shar chain, terminating at its eastern extremity in Liubotrn, supposed to be the highest mountain in the peninsula (3050 metres), continues the natural boundary, which is prolonged towards the south by the Grammos and Pindus ranges. Between the Vardar and the plain of Monastir the Nija range culminates in Kaimakzolan (2317 metres); south-west of Monastir is Mount Peristeri (2350 metres), overlooking Lake Prespa; between Lake Ostrovo and the lower Bistritza are the Bermios and Kitarion ranges, with Doxa (1600 metres) and Turla (about 1000 metres). South of the Bistritza are the Cambunian mountains, forming the boundary of Thessaly, and terminating to the east in the imposing mass of Elymbos, or Olympus (2985 metres). Lastly, Mount Athos, at the extremity of the peninsula of that name, reaches the height of 1935 metres. The general aspect of the country is bare and desolate, especially in the neighbourhood of the principal routes; the trees have been destroyed, and large tracts of land remain uncultivated. Magnificent forests, however, still clothe the slopes of Rhodope and Pindus. The well-wooded and cultivated districts of Grevena and Kastoria, which are mainly inhabited by a Vlach population, are remarkably beautiful, and the scenery around Lakes Ochrida and Prespa is exceedingly picturesque. The climate is severe; the spring is often rainy, and the melted snows from the encircling mountains produce inundations in the plains. The natural products are in general similar to those of southern Bulgaria and Servia—the fig, olive, and orange, however, appear on the shores of the Ægean, and in the sheltered valleys of the southern region. The best tobacco in Europe is grown on the southern declivity of Rhodope in the Kavala district.

Population.

The population of Macedonia may perhaps be estimated at 2,200,000. Of this number about 1,300,000 are Christians, belonging to various churches and nationalities; more than 800,000 are Mahommedans, and about 75,000 are Jews. Of the Christians, the great majority profess the Eastern Orthodox faith, owning allegiance either to the Greek patriarchate or the Bulgarian exarchate. Among the Orthodox Christians are reckoned some 4000 Turks. The small Catholic minority is composed chiefly of "Uniate" Bulgarians (about 3600), occupying the districts of Kukush and Doiran; there are also some 2000 Bulgarian Protestants, principally inhabiting the valley of Razlog. The Mahommedan population is mainly composed of Turks (about 500,000). In addition to these there are some 130,000 Bulgars, 120,000 Albanians, 35,000 gypsies, and 14,000 Greeks, together with a smaller number of Vlachs, Jews, and Circassians, who profess the creed of Islam. The Turkish statistics, which are entirely untrustworthy, take religion, not nationality, as the basis of classification. All Moslems, to whatever race they may belong, are included in the *millet*, or nation, of Islam. The Rûm, or Roman (*i.e.*, Greek) *millet* comprises all those who acknowledge the authority of the Œcumenical Patriarch, and consequently includes, in addition to the Greeks, the Servians, the Vlachs, and a certain number of Bulgarians; the Bulgar *millet* comprises the Bulgarians who accept the rule of the exarchate; the other *millets* are the Katolik (Catholics), Ermeni (Gregorian Armenians), Musevi (Jews), and Prodesdan (Protestants). The population of Macedonia, at all times scanty, has undoubtedly diminished in recent years. The prevailing insecurity, the exactions of the Turkish officials, the severities practised by the authorities in the repression of political agitation, the prevalence of brigandage, authorized and unauthorized, and the ravages of Albanian marauders in the western districts, have all tended to this result. For many years there has been a continual outflow of the Christian population in the direction of Bulgaria, Servia, and Greece, and a corresponding emigration of the Turkish peasantry to Asia Minor. Many of the smaller villages are being abandoned by their inhabitants, who migrate for safety to the more considerable towns—the latter are usually situated at some point where a mountain pass descends to the outskirts of the plains. In the agricultural districts the Christian peasants, or *rayas*, are either small proprietors or cultivate holdings on the estates of Turkish landowners, receiving a certain portion of the product, after the payment of the tithe and other taxes to the Government. The upland districts are thinly inhabited by a nomad pastoral population.

Races: the Turks.

Inhabited by a variety of races, Macedonia possesses a peculiar importance as the principal theatre of the struggle of nationalities in Eastern Europe. All the races which dispute the reversion of the Turkish possessions in Europe are represented within its borders. Here are centred the rival aspirations of the various states which during the 19th century became detached from the Ottoman empire. The Macedonian problem may therefore be described as the quintessence of the Eastern Question. The Turks, the ruling race, form less than a quarter of the entire population, and their numbers are steadily declining. The first Turkish immigration from Asia Minor took place under the Byzantine emperors before the conquest of the country. The first purely Turkish town, Yenijé-Vardar, was founded on the ruins of Vardar in 1362. After the capture of Salonica (1430), a strong Turkish population was settled in the city, and similar colonies were founded in Monastir, Ochrida, Serres, Drama, and other important places. In many of these towns half or more of the population is still Turkish. A series of military colonies was subsequently established at various points of strategic importance along the principal lines of communication. Before 1360 large numbers of nomad shepherds, or Yuruks, from the district of Konieh, in Asia Minor, had settled in the country; their descendants are still known as Konariotes. Further immigration from this region took place from time to time up to the middle of the 18th century. After the establishment of the feudal system in 1397, many of the Seljuk noble families came over from Asia Minor; their descendants may be recognized among the beys or Moslem landowners in southern Macedonia. At the beginning of the 18th century the Turkish population was very considerable, but since that time it has continuously decreased. A low birth-rate, the exhaustion of the male population by military service, and great mortality from epidemics, against which Moslem fatalism takes no precautions, have brought about a decline which has latterly been hastened by emigration. On the other hand, there has been a considerable Moslem immigration from Bosnia, Servia, Bulgaria, and Greece, but the newcomers, or *mohajirs*, do not form a permanent colonizing element, and most of them remain housed in miserable dwellings on the outskirts of the larger towns. The Turkish rural population is found in three principal groups: the most easterly extends from the Mesta to Drama, Pravishta, and Orfano, reaching the sea-coast on either side of Kavala, which is partly Turkish, partly Greek. The second, or central, group begins on the sea-coast, a little west of the mouth of the Strymon, where a Greek population intervenes, and extends to the north-west along the Kara-Dagh and Belasitza ranges in the direction of Strumnitza, Veles, Shtip, and Radovisht. This long line of Turkish colonies was probably designed to protect the Vardar valley, and to separate the Christian population into two divisions. The third, or southern, group is centred around Kaïlar, an entirely Turkish town, and extends from Lake Ostrovo to Selfijé (Servia). The second and third groups are mainly composed of Konariot shepherds. Besides these fairly compact settlements there are numerous isolated Turkish colonies in various parts of the country. The Christian Turks already alluded to are resident at Zeliachovo, in the Bozo Dagh; they are probably descendants of the earliest colonists introduced by the Byzantine emperors. The Turkish rural population is quiet, sober, and orderly, presenting some of the best characteristics of the race. The urban population, on the other hand, has become much demoralized, while the official classes, from the gendarmes to the highest functionaries, are as a rule corrupt and avaricious, and seem to have parted with all scruple in their dealings with the

Christian peasantry. The Turks, though still numerically and politically strong, fall behind the other nationalities in point of intellectual culture, and the contrast is daily becoming more marked owing to the educational activity of the Christians. Originally a nomad race, they have never become rooted in the soil, and remigration to Asia Minor will probably be their ultimate destiny.

The Greeks and Vlachs.

The Greek and Vlach populations are not always easily distinguished, as a considerable proportion of the latter has been Hellenized. Both show a remarkable aptitude for commerce; the Greeks have maintained their language and religion, and the Vlachs their religion, with greater tenacity than any of the other races. From the date of the Ottoman conquest until comparatively recent times, the Greeks occupied an exceptional position in Macedonia, as elsewhere in the Turkish empire, owing to the privileges conferred on the patriarchate of Constantinople, and the influence subsequently acquired by the great Phanariot families. All the Christian population belonged to the Greek *millet* and called itself Greek; the bishops and higher clergy were exclusively Greek; Greek was the language of the upper classes, of commerce, literature, and religion, and Greek alone was taught in the schools. The supremacy of the patriarchate was consummated by the suppression of the autocephalous Slavonic churches of Ipek in 1766, and Ochrida in 1767. In the latter half of the 18th century Greek ascendancy in Macedonia was at its zenith; its decline began with the War of Independence, the establishment of the Hellenic kingdom, and the extinction of the Phanariot power in Constantinople. The patriarchate, nevertheless, maintained its exclusive jurisdiction over all the Orthodox population till 1870, when the Bulgarian exarchate was established, and the Greek clergy continued to labour with undiminished zeal for the spread of Hellenism. Notwithstanding their venality and intolerance, their merits as the only diffusers of culture and enlightenment in the past should not be overlooked. The process of Hellenization made greater progress in the towns than in the rural districts of the interior, where the non-Hellenic populations preserved their languages, which alone saved the several nationalities from extinction. The typical Greek, with his superior education, his love of politics and commerce, and his distaste for laborious occupations, has always been a dweller in cities. In Salonica, Serres, Kavala, Kastoria, and other towns in southern Macedonia the Hellenic element is strong; in the northern towns it is insignificant, except at Melnik, which is almost exclusively Greek. The Greek rural population extends from the Thessalian frontier to Kastoria and Verria (*Berœa*); it occupies the whole Chalcidian peninsula and both banks of the lower Strymon from Serres to the sea, and from Nigrita on the west to Pravishta on the east; there are also numerous Greek villages in the Kavala district. The Mahommedan Greeks, known as *Valachides*, occupy a considerable tract in the upper Bistritza valley near Grevena and Liapsista. The purely Greek population of Macedonia may possibly be estimated at a quarter of a million. The Vlachs, or Rumans, who call themselves *Aromuni* or *Aromâni* (*i.e.*, Romans), are also known as *Kutzovlachs* and *Tzintzars:* the latter two appellations are, in fact, nicknames, "Kutzovlach" meaning "lame Vlach," while "Tzintzar" denotes their inability to pronounce the Rumanian *cincĭ* (five). The Vlachs are styled by some writers "Macedo-Rumans," in contradistinction to the "Daco-Rumans," who inhabit the country north of the Danube. They are, in all probability, the descendants of the Thracian branch of the aboriginal Thraco-Illyrian population of the Balkan peninsula, the Illyrians being represented by the Albanians. This early native population, which was apparently Hellenized to some extent under the Macedonian empire, seems to have been Latinized in the period succeeding the Roman conquest, and probably received a considerable infusion of Italian blood. However this may be, the Latin origin of the Vlach language is indisputable. There is evidence to show that Latin was generally spoken by the peasantry of the interior before the Slavonic invasion. The Latin-speaking race was expelled from the plains by the Slavonic immigrants, and took refuge in the mountainous districts, where it still remains. The Vlachs are for the most part either highland shepherds or wandering owners of horses and mules. Their settlements are scattered all over the mountains of Macedonia: some of these consist of permanent dwellings, others of huts occupied only in the summer. The compactest groups are found in the Pindus and Agrapha mountains (extending into Albania and Thessaly), in the neighbourhood of Monastir, Grevena, and Kastoria, and in the district of Meglen. The Vlachs who settle in the lowland districts are excellent husbandmen. The urban population is considerable; the Vlachs of Salonica, Monastir, Serres, and other large towns are, for the most part, descended from refugees from Moschopolis, once the principal centre of Macedonian commerce. At the beginning of the 18th century this Vlach city numbered 80,000 inhabitants; it was plundered by the Albanians in 1769, and ultimately destroyed by Ali Pasha in 1788. The towns of Metzovo, on the confines of Albania, and Klisura, in the Bistritza valley, are almost exclusively Vlach. The urban and most of the rural Vlachs are bilingual, speaking Greek as well as Rumanian; a great number of the former have been completely Hellenized, partly in consequence of mixed marriages, and many of the wealthiest commercial families of Vlach origin are now devoted to the Greek cause. The Vlachs of Macedonia possibly number 90,000, of whom only some 3000 are Mahommedans. The Macedonian dialect of the Rumanian language differs mainly from that spoken north of the Danube in its vocabulary and certain phonetic peculiarities; it contains a number of Greek words which are often replaced in the northern speech by Slavonic or Latin synonyms.

The Albanians, Circassians, &c.

The Albanians, called by the Turks and Slavs *Arnauts*, by the Greeks Ἀρβανῖται, and by themselves *Shkyipetar*, have always been the scourge of western Macedonia; even before the Turkish conquest these predatory mountaineers were accustomed to devastate the fertile valleys inhabited by the agricultural Slavonic population. After the first Turkish invasion of Albania many of the chiefs or beys adopted Mahommedanism, but the conversion of the great bulk of the people took place in the 16th and 17th centuries. This change of faith was productive of serious consequences to their Christian neighbours. Professing the creed of the dominant Power and entitled to bear arms, the Albanians were enabled to push forward their limits at the expense of the defenceless population around them, and their encroachments have continued to the present day. They have not only advanced themselves, but have driven to the eastward numbers of their Christian compatriots and a great portion of the once-prosperous Vlach population of Albania. The indulgence extended to them by the Porte has been requited by constant rebellions: with the decline of the Ottoman power in the 18th century the arrogance of the Albanian chieftains increased, and their military energies were as often employed in combating the Turkish authority as in prosecuting local feuds or raiding the Christian peasantry. The ravages of Ali Pasha of Tepelen, who maintained a practically independent sovereignty at Iannina from 1788 to 1832, will long be remembered in Macedonia: in his time the

Albanians established themselves in the district of Kortcha and on the southern shores of Lake Ochrida, ejecting the Slavonic population. In 1830 Arslan Bey and other Albanian chiefs, who had revolted and invaded Macedonia, were invited to Monastir under pretext of an armistice by the Grand Vizier, Reshid Pasha, and were massacred with 500 of their followers as they were about to partake of a banquet prepared by their host. A little later an Albanian invasion under Mustafa Pasha of Scutari was repulsed by the Grand Vizier, and the Slavonic population was re-established in the district of Ochrida. In recent years Albanian revolts and disturbances have been frequent along the western confines of Macedonia, especially in the neighbourhood of Dibra: the Slavonic peasants have been the principal sufferers from these troubles, while the Porte, in pursuance of the "Islamic policy" adopted by the Sultan Abdul Hamid II., deals tenderly with the recalcitrant believers. An invincible repugnance to the payment of taxation, and an equally strong aversion from regular military service are the main causes of Albanian discontent and the principal obstacles to a farther advance of the race into Macedonia. While confined to their mountains the tribesmen escape both these obligations, and enjoy greater facilities for plundering the populations of the plains. In southern Macedonia the Albanians of the Tosk race extend over the upper Bistritza valley as far west as Kastoria, and reach the southern and western shores of Lakes Prespa and Ochrida: they are also numerous in the neighbourhood of Monastir. In northern Macedonia the Albanians are of the Gheg stock: they have advanced in large numbers over the districts of Dibra, Kalkandele, and Usküb, driving the Slavonic population before them. The total number of Albanians in Macedonia may be estimated at about 120,000, of whom some 10,000 are Christians (chiefly Orthodox Tosks). Without a national literature, a common religion, or any of the elements of unity, the Albanians, notwithstanding their remarkable self-assertiveness, cannot be regarded as an important political factor in Macedonia. (For the origin, language, and institutions of this singular race, see Albania, vol. xxv.) The Circassians, who occupy some villages in the neighbourhood of Serres, now scarcely number 3000: their predatory instincts may be compared with those of the Albanians. The Jews had colonies in Macedonia in the time of St Paul, but no trace remains of these early settlements. The Jews now found in the country descend from refugees who fled from Spain during the persecutions at the end of the 15th century: they speak a dialect of Spanish, which they write with Hebrew characters. They form a flourishing community at Salonica, which numbers more than half the population: their colonies at Monastir, Serres, and other towns are poor. A small proportion of the Jews, known as *Deunmé* by the Turks, have embraced Mahommedanism.

The Slavonic population.

With the exception of the southern and western districts already specified, the principal towns, and certain isolated tracts, the whole of Macedonia is inhabited by a race or races speaking a Slavonic dialect. If language is adopted as a test, the great bulk of the rural population must be described as Slavonic. The Slavs first crossed the Danube at the beginning of the 3rd century of our era, but their great immigration took place in the 6th and 7th centuries. They overran the entire peninsula, driving the Greeks to the shores of the Ægean, the Albanians into the Mirdite country, and the Latinized population of Macedonia into the highland districts, such as Pindus, Agrapha, and Olympus. Slavonic place-names, occurring in regions where every other trace of the immigration has now disappeared, bear witness to the multitude of the invaders and the permanency of their settlements. The Slavs, a primitive agricultural and pastoral people, were often unsuccessful in their attacks on the fortified towns, which remained centres of Hellenism. In the outlying parts of the peninsula they were absorbed, or eventually driven back, by the original populations, but in the central region they probably assimilated a considerable proportion of the Latinized races. The western portions of the peninsula were occupied by Serb and Slovene tribes: the Slavs of the eastern and central portions were conquered at the end of the 7th century by the Bulgarians, a Ugro-Finnish horde, who established a despotic political organization, but being less numerous than the subjected race, were eventually absorbed by it. The Mongolian physical type, which prevails in the districts between the Balkans and the Danube, is also found in central Macedonia, and may be recognized as far west as Ochrida and Dibra. In general, however, the Macedonian Slavs differ somewhat both in appearance and character from their neighbours beyond the Bulgarian and Servian frontiers: the peculiar type which they present is probably due to a considerable admixture of Vlach, Hellenic, Albanian, and Turkish blood, and to the influence of the surrounding races. Asiatic colonization under the Byzantine emperors from the 9th to the 13th century has perhaps in some degree affected the Slavs as well as the other races in the southern half of Macedonia. Almost all independent authorities, however, agree that the bulk of the Slavonic population of Macedonia is Bulgarian. The principal indication is furnished by the language, which, though resembling Servian in some respects (*e.g.*, the case-endings, which are occasionally retained), presents most of the characteristic features of Bulgarian (see Bulgaria, Part III. vol. xxvi.). Among these may be mentioned the suffix-article, the nasal vowels (retained in the neighbourhood of Salonica and Kastoria, but modified elsewhere as in Bulgarian), the retention of *l* (*e.g.*, *vulk* "wolf," *bel* "white"; Servian *vuk*, *beo*), and the loss of the infinitive. There are at least four Slavonic dialects in Macedonia, but the suffix-article, though varying in form, is a constant feature in all. The Slavs of western Macedonia are of a lively, enterprising character, and share the commercial aptitude of the Vlachs: those of the eastern and southern regions are a quiet, sober, hard-working agricultural race, more obviously homogeneous with the population of Bulgaria. In upper Macedonia large family communities, resembling the Servian and Bulgarian *zadruga*, are commonly found: they sometimes number over 50 members. The whole Slavonic population of Macedonia may be estimated at about 1,150,000, of whom about 1,000,000 are Christians of the Orthodox faith. The majority of the latter now own allegiance to the Bulgarian exarchate, but a certain minority still remains faithful to the Greek patriarchate. The Moslem Bulgarians form a considerable element: they are found principally in the valley of the upper Mesta and the Rhodope district, where they are known as *Pomaks* or "helpers," *i.e.*, auxiliaries to the Turkish army. Other groups exist in the neighbourhood of Usküb and Dibra. The conversion of the Pomaks took place at various intervals from the 15th to the 18th century: for a long period these mountaineers, a remarkably fine race, maintained a position of absolute independence under their beys and agas. One of their principal villages, Dospat, was destroyed by raiders from over the Bulgarian frontier in 1895.

The embittered struggle of the rival nationalities in Macedonia dates from the middle of the 19th century. Until that period the Greeks, owing to their superior culture and their privileged position, exercised an exclusive influence over the whole population professing the Orthodox

The racial propaganda.

faith. All Macedonia was either Moslem or Orthodox Christian, without distinction of nationalities, the Catholic or Protestant *millets* being inconsiderable. The first opposition to Greek ecclesiastical ascendancy came from the Bulgarians. The Bulgarian literary revival, which took place in the earlier part of the 19th century, was the precursor of the ecclesiastical and national movement which resulted in the establishment of the exarchate in 1870 (see BULGARIA, Parts II. and III.). In the course of the struggle some of the Bulgarian leaders entered into negotiations with Rome; a Bulgarian uniate church was recognized by the Porte, and the pope nominated a bishop, who, however, was mysteriously deported to Russia a few days after his consecration (1861). The first exarch, who was elected in 1871, was excommunicated with all his followers by the patriarch, and a considerable number of Bulgarians in Macedonia—the so-called "Bulgarophones"—fearing the reproach of schism, or influenced by other considerations, refrained from acknowledging the new spiritual power. Many of the recently converted uniates, on the other hand, offered their allegiance to the exarch. The firman of the 28th February 1870 specified a number of districts within the present boundaries of Bulgaria and Servia, as well as in Macedonia, to which Bulgarian bishops might be appointed; other districts might be subjected to the exarchate should two-thirds of the inhabitants so desire. In virtue of the latter provision the districts of Veles, Ochrida, and Usküb declared for the exarchate, but the Turkish Government refrained from sanctioning the nomination of Bulgarian bishops to these dioceses. It was not till 1891 that the Porte, at the instance of Stamboloff, the Bulgarian prime minister, whose demands were supported by the Triple Alliance and Great Britain, issued the *berat*, or exequatur, for Bulgarian bishops at Ochrida and Usküb; the sees of Veles and Nevrokop received Bulgarian prelates in 1894, and those of Monastir, Strumnitza, and Dibra in 1898. The Bulgarian position was further strengthened in the latter year by the establishment of "commercial agents" representing the principality at Salonica, Usküb, Monastir, and Serres. During this period (1891–1898) the Bulgarian propaganda, entirely controlled by the spiritual power and conducted within the bounds of legality, made rapid and surprising progress. In latter years the interference of the Macedonian committee at Sofia, in which the advocates of physical force predominate, has done much to injure the movement; the hostility of the Porte has been provoked and the sympathy of the Powers alienated by a series of assassinations and other crimes. According to the official figures, the Bulgarian schools, which in 1893 were 554, with 30,267 pupils and 853 teachers, were, in 1898, 762 (including 68 secondary schools), with 39,466 pupils and 1778 teachers. The Rumanian movement comes next to the Bulgarian in order of time. The Vlachs had shown greater susceptibility to Greek influence than any of the other non-Hellenic populations of Macedonia, and, though efforts to create a Rumanian propaganda were made as early as 1855, it was not till after the union of the principalities of Wallachia and Moldavia in 1861 that any indications of a national sentiment appeared amongst them. In 1886 the principal apostle of the Rumanian cause, a priest named Margaritis, founded a gymnasium at Monastir, and the movement, countenanced by the Porte, supported by the French Catholic missions, and to some extent encouraged by Austria, has made no inconsiderable progress since that time. There are now about forty Rumanian schools in Macedonia, including two gymnasia, and large sums are devoted to their maintenance by the ministry of education at Bucharest, which also provides qualified teachers. The Rumanian and Servian movements are at a disadvantage compared with the Bulgarian, owing to their want of an ecclesiastical organization, the orthodox Vlachs and Serbs in Turkey owning allegiance to the Greek patriarchate. The Governments of Bucharest and Belgrade have therefore endeavoured to obtain the recognition of Vlach and Servian *millets*, the former demanding the establishment of a Rumanian bishopric at Monastir, while the latter seeks the restoration of the patriarchate of Ipek and the appointment of a Servian metropolitan at Usküb. Their efforts, however, have hitherto been unsuccessful. The Servian movement in Macedonia is of comparatively recent date. Previously to 1878 the hopes of the Servians were centred on Bosnia, Herzegovina, and the vilayet of Kossovo; but when the Berlin Treaty assigned Bosnia and Herzegovina to Austria, the national aspirations were directed to Macedonia, the Slavonic population of which was declared to be Servian. The strained relations existing between Russia and Bulgaria from 1886 to 1895 were to the advantage of the Servian propaganda, which since 1890 has made remarkable progress. Great expenditure has been incurred by the Servian Government in the opening and maintenance of schools. At the beginning of 1899 there were stated to be 178 Servian schools in the vilayets of Usküb, Salonica, and Monastir (including fifteen gymnasia), with 321 teachers and 7200 pupils. The Albanian movement has not yet taken definite shape, and its future development seems doubtful. Some of the Albanian chiefs have demanded the establishment of schools in which their language will be taught, but their request has been persistently refused by the Porte. Notwithstanding the encroachments of their rivals, the impoverishment of the patriarchate, and the injury sustained by their cause in 1897, the Greeks still maintain a large number of schools; according to statistics prepared at Athens there were in 1901, 927 Greek schools in the vilayets of Salonica and Monastir (including five gymnasia), with 1397 teachers and 57,607 pupils. The great educational activity displayed by the proselytizing movements in Macedonia, while tending to the artificial creation of parties, daily widens the contrast between the progressive Christian and the backward Moslem populations, and must sooner or later bring about a change in the present system of government. Meanwhile the reforms stipulated by Article XXIII. of the Berlin Treaty have neither been carried out by the Porte nor insisted upon by the Powers.

Antiquities.

Macedonia, like the neighbouring Balkan countries, still awaits exploration; as yet we possess but scanty indications of the earlier developments of civilization in these regions. This is especially true with regard to the most primitive epoch, although there can be little doubt that the ancient indigenous population has left traces behind it which will one day be brought to light. The numerous tumuli which occur in the plains, more particularly in the valley of the Vardar, have not yet been systematically investigated; excavations, however, have been made by Körte and Franke at Niausta and near Salonica (see Kretschner, *Einleitung in die Geschichte der griechischen Sprache*, pp. 176, 421), and fragments of primitive pottery, with peculiar characteristics, have been found by M. Perdrizet at Tchepelje, on the left bank of Lake Tachino. The oldest archæological monuments of Macedonia are its coins, for which the mines of Crenides (the later Philippi), at the foot of Mount Pangæus, of Chalcidice, of the island of Thasos, and of the mountains between Lake Prasias and the ancient Macedonian kingdom (Herod. v. 17), furnished abundance of metal. From the reign of Alexander I., the epoch of the Persian wars, the Macedonian dynasty issued silver coins of a purely Greek style. The Thracian communities around Mount Pangæus also produced a variety of coins, especially at the beginning of the 5th century. The great octodrachms of this period were perhaps struck for the purpose of paying tribute to the Persians when the country between the Strymon and the Nestos was in their possession; most of the specimens have been found in Asia Minor. These large pieces present many characteristics of the Ionian style; it is evident that the Thracians derived the arts of minting and engraving from the neighbouring Thasos, itself a colony from the Ionian Paros. The monarchs of Pella were enthusiastic admirers of Hellenic culture, and their court was doubtless frequented by Greek sculptors as well as men of letters, such as Herodotus and Euripides. At Pella has been found a funerary *stele* of the late 5th or early 4th century representing a Macedonian *hetærus*—a beautiful specimen of the best Greek art, now preserved in the Imperial Ottoman Museum at Constantinople. To the Hellenic period belong the vaulted tombs under tumuli discovered at Pella, Pydna, Palatitza, and other places; the dead were laid in marble couches ornamented with sculptures, like those of the so-called sarcophagus of Alexander at Constantinople. These tombs doubtless received the remains of the Macedonian nobles and *hetœri;* in one of them a fresco representing a conflict between a horseman and a warrior on foot has been brought to light by Kinch. Similarly-constructed places of sculpture have been found at Eretria and elsewhere in Greece. At Palatitza the ruins of a remarkable structure, perhaps a palace, have been laid bare by Heuzey and Daumet. Unlike Greece, where each independent city had its acropolis, Macedonia offers few remnants of ancient fortification; most of the country towns appear to have been nothing more than open market-centres. The most interesting ruins in the country are those of the Roman and Byzantine epochs. Salonica (Thessalonica) in the time of the Low Empire was one of the greatest cities in the world. Of its two triumphal arches, one, the "Vardar Gate," which marked the end of the Via Egnatia, has been recently demolished; the other, which has been proved by Kinch to commemorate the victories of Galerus, is one of the largest structures of the kind in existence. Between these stood the beautiful monument with caryatides known as *Las Escantadas*, the fragments of which have been conveyed to Paris, and have latterly been put together at the Louvre. For the unique Byzantine churches of Salonica, with their interesting mosaics, the work of Texier and Pullan should be consulted. The celebrated marble *ambon* of the church of St George, with reliefs representing the adoration of the Magi, was removed to Constantinople in 1899. The conversion of these churches into mosques has preserved them from destruction, though not from disfigurement. The walls of Salonica are among the most interesting constructions of Byzantine military architecture; they have been repaired at various epochs, and numerous sarcophagi and fragments of Greek and Roman temples are built up in the masonry. The Byzantine fortifications and aqueduct of Kavala are also remarkable. At Verria (*Berœa*) may be seen some Christian remains, at Melnik a palace of the age of the Comneni, at Serres a Servian fortress built by Dushan. The remains at Filibejik (*Philippi*) are principally of the Roman and Byzantine periods; the numerous *ex voto* rock-tablets of the acropolis are especially interesting. The Roman inscriptions found in Macedonia are mainly funerary, but include several ephebic lists. The funerary tablets afford convincing proof of the persistence of the Thracian element, notwithstanding Hellenization and Latinization; many of them, for instance, represent the well-known Thracian horseman hunting the wild boar.

Mount Athos.

The picturesque promontory of Mount Athos (Greek Ἅγιον Ὄρος, Turkish *Aineros*, Italian *Monte Santo*) possesses a peculiar interest, owing to its unique group of monastic communities with their mediæval customs and institutions, their treasures of Byzantine art and rich collections of manuscripts. The promontory is about 40 miles in length, with a breadth varying from 4 to 7 miles; its whole area belongs to the various monasteries. It was inhabited in the earliest times by a mixed Greek and Thracian population; of its five cities mentioned by Herodotus few traces remain; some inscriptions discovered on the sites have been published by Leake. The legends of the monks attribute the first religious settlements to the age of Constantine, but the hermitages are first mentioned in historical documents of the 9th century. It is conjectured that the mountain was at an earlier period the abode of anchorites, whose numbers were increased by fugitives from the iconoclastic persecutions (726–842). The "cenobian" rule to which many of the monasteries still adhere was established by St Athanasius, the founder of the great monastery of Laura, in 969. Under a constitution approved by the Emperor Constantine Monomachos in 1046, women and female animals were excluded from the Holy Mountain. In 1060 the community was withdrawn from the authority of the Patriarch of Constantinople, and a monastic republic was practically constituted. Owing to the timely submission of the monks to the Turks after the capture of Salonica (1430), their privileges were respected by successive sultans: a tribute is paid to the Turkish Government, which is represented by a resident *kaimakam*, and the community is allowed to maintain a small police force. Under the present constitution, which dates from 1783, the general affairs of the commonwealth are entrusted to an assembly (σύναξις) of twenty members, one from each monastery; a committee of four members, chosen in turn, styled *epistates* (ἐπιστάται), forms the executive. The president of the committee (ὁ πρῶτος) is also the president of the assembly, which holds its sittings in the village of Karyes. The twenty monasteries, which all belong to the order of St Basil, are: Laura (ἡ Λαῦρα), founded in 963; Vatopédi (Βατοπέδιον), said to have been founded by the Emperor Theodosius; Rossikón (Ῥωσσικόν), the Russian monastery; Chiliandári (Χιλιαντάριον: variously derived from χίλιοι ἄνδρες and χίλια λεοντάρια), founded by the Servian prince Stephen Nemanya; Iveron (ἡ μονὴ τῶν Ἰβήρων), founded by Iberians, or Georgians; Esphigmenu (τοῦ Ἐσφιγμένου: the name is derived from the confined situation of the monastery); Kutlumush (Κουτλουμούση); Pandocratoros (τοῦ Παντοκράτορος); Philotheu (Φιλοθέου); Caracallu (τοῦ Καρακάλλου); St Paul (τοῦ ἁγίου Παύλου); St Denis (τοῦ ἁγίου Διονυσίου); St Gregory (τοῦ ἁγίου Γρηγορίου); Simópetra (Σιμόπετρα); Xeropotámu (τοῦ Ξηροποτάμου); St Xenophon (τοῦ ἁγίου Ξενοφῶντος); Dochiaríu (Δοχειαρείου); Constamonítu (Κωνσταμονίτου); Zográphu (τοῦ Ζωγράφου); and Stavronikítu (τοῦ Σταυρονικίτου). The "cenobian" monasteries (κοινόβια), each under the rule of an abbot (ἡγούμενος), are subjected to severe discipline; the brethren are clothed alike, take their meals (usually limited to bread and vegetables) in the refectory, and possess no private property. In the "idiorrhythmic" monasteries (ἰδιόρρυθμικά), which are governed by two or three annually elected wardens (ἐπίτροποι), a less stringent rule prevails, and the monks are allowed to supplement the fare of the monastery from their private incomes. Dependent on the several monasteries are twelve *sketes* (σκήτια, ἀσκητήρια), or monastic settlements, some of considerable size, in which a still more ascetic mode of life prevails: there are, further, several *metochs* or farms (μετόχια), and many hundred hermitages (κελλία). The monasteries, with the exception of Rossikon (St Panteleïmon) and the Serbo-Bulgarian Chiliandari and Zographu, are occupied exclusively by Greek monks. The large skete of St Andrew and some others belong to the Russians; there are also Rumanian and Georgian sketes. The great monastery of Rossikon, which numbers nearly a thousand inmates, has been under a Russian abbot since 1875; it is regarded as one of the principal centres of the Russian politico-religious propaganda in the Levant. The tasteless style of its modern buildings is out of harmony with the quaint beauty of the other monasteries. Furnished with ample means, the Russian monks neglect no opportunity of adding to their possessions on the Holy Mountain; their encroachments are resisted by the Greek monks, whose wealth, however, has been much diminished by the secularization of their estates in Greece and Rumania. The population of the Holy Mountain numbers from 6000 to 7000; about 3000 are monks (καλόγεροι), the remainder being lay brothers (κοσμικοί). The monasteries, which are all fortified, generally consist of large quadrangles enclosing one or more churches; standing amid rich foliage, they present a wonderfully picturesque appearance, especially when viewed from the sea. Their inmates, when not engaged in religious services, occupy themselves with husbandry, fishing, and various handicrafts; the standard of intellectual culture is not high. A large academy, founded by the monks of Vatopedi in 1749, for a time attracted students from all parts of the East, but eventually proved a failure, and is now in ruins. The muniment rooms of the monasteries contain a marvellous series of documents, including chrysobulls of various emperors and princes, sigillia of the patriarchs, typica, irades, and other documents, the study of which will throw an important light on the political and ecclesiastical history and social life of the East from the middle of the 9th century. Up to comparatively recent times a priceless collection of classical manuscripts was preserved in the libraries; many of them were destroyed during the War of Greek Independence by the Turks, who employed the parchments for the manufacture of cartridges; others fell a prey to the neglect or vandalism of the monks, who, it is said, used the material as bait in fishing; others have been sold to visitors, and a considerable number have been removed to Moscow and Paris. The library of Simopetra was destroyed by fire in 1891. There is now little hope of any important discovery of classical manuscripts. The codices remaining in the libraries are for the most part theological and ecclesiastical works. Of the Greek manuscripts, numbering about 11,000, 6618 have been catalogued by Professor Spyridon Lambros of Athens; his work, however, does not include the MSS. in some of the sketes or those in the libraries of Lauri and Vatopedi, of which catalogues (hitherto unpublished) have been prepared by resident monks. The Slavonic and Georgian MSS. have not been catalogued. Apart from the illuminated MSS., the mural paintings, the mosaics, and the goldsmiths' work of Mount Athos are of infinite interest to the student of Byzantine art. The frescoes in general date from the 15th or 16th century: some are attributed by the monks to Panselinos, "the Raphael of Byzantine painting," who apparently flourished in the time of the Paleologi. Most of them have been indifferently restored by local artists, who follow mechanically a kind of hieratic tradition, the principles of which are embodied in a work on iconography by the monk Dionysius, a pupil of Panselinos. The same spirit of conservatism is manifest in the architecture of the churches, which are all of the mediæval Byzantine type.

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(J. D. B.)

Macerata, a town, bishop's see, and capital of the province of the same name, the Marches, Italy, between the Apennines and the Adriatic, 43 miles by rail south of Ancona. It has a fine prefecture (formerly palace of the Gonzaga), a town hall, a university (1290), with a law faculty and special classes in medicine (11 professors, 310 students, in 1898), an agricultural school, and an industrial institute. The industries comprise the making of bricks, matches, terra-cotta, and chemicals. Population (1881), 20,249; (1901), 22,806.

Macfarren, Sir George Alexander (1813–1887), English composer, was born in London, 2nd March 1813, and entered the Royal Academy of Music in 1829. A symphony by him was played at an Academy concert in 1830, and another in 1831; for the opening of the Queen's Theatre in Tottenham Street, under the management of his father, in the latter year, he wrote an overture, and various similar works were provided for theatrical and other occasions. His *Chevy Chase* overture, the orchestral work by which he is perhaps best known, was written as early as 1836, and in a single night. On leaving the Academy in 1836, Macfarren was for about a year a music teacher in the Isle of Man. Undeterred by the untoward fate of an opera projected two years before, he wrote another, ultimately called *El Malechor*, which was no more fortunate, three successive managers of theatres becoming bankrupt after they had promised to produce it. In 1837 he was appointed a professor at the Academy, and wrote his *Romeo and Juliet* overture. In the following year he brought out *The Devil's Opera*, one of his best works; for Queen Victoria's marriage in 1840 he joined his father in preparing an "Emblematical Tribute" for Drury Lane. Five years afterwards he became conductor at Covent Garden, producing .the *Antigone* with Mendelssohn's music; he finished an opera on *Don Quixote* in the same year, and it was produced under Bunn at Drury Lane in 1846; his subsequent operas include *Charles II.* (1849), *Robin Hood* (1860), *She Stoops to Conquer* (1864), and *Helvellyn* (1864); a number of other dramatic works were either of such smaller calibre as *Jessy Lea* (1863) (for the German Reeds); *Freya's Gift*, a masque in honour of the prince of Wales's marriage (1863); or works that for one reason or another never saw the light, such as *Allan of Aberfeldy* (1851) and *Kenilworth* (1880), his last opera. A gradual failure of his eyesight, which had been defective from boyhood, resulted in total blindness in 1865, but he overcame the difficulties by employing an amanuensis in composition, and made hardly a break in the course of his work. He was made principal of the Royal Academy of Music in succession to Sterndale Bennett in February 1875, and in March of the same year Professor of Music in Cambridge University. Shortly before this he had begun a series of oratorios, which were the most ambitious, if not the most important, works of his later years: *St John the Baptist* (Bristol, 1873); *Resurrection* (Birmingham, 1876); *Joseph* (Leeds, 1877); and *King David* (Leeds, 1883). In spite of their solid workmanship, and the skill with which the ideas are treated, it is difficult to hear or read them through without smiling at some of the touches of quite unconscious humour often resulting from the way in which the Biblical narratives have been, as it were, dramatized. The list of his other works includes many cantatas, eight symphonies, many overtures, concertos, chamber compositions, anthems, &c. He delivered many lectures of great and lasting value, and his theoretical works, such as the *Rudiments of Harmony*, and the treatise on counterpoint, will probably be remembered longer than many of his compositions. A most important work of his is the first (historical) part of the article MUSIC in the earlier volumes of this Encyclopædia, ninth edition. He was knighted in 1883, and died suddenly in London, 31st October 1887.

An excellent memoir by H. C. Banister appeared in 1891.

(J. A. F. M.)

MacGregor, John ["Rob Roy"] (1825–1892), Scottish canoeist, traveller, and philanthropist, son of General Sir Duncan MacGregor, K.C.B., was born at Gravesend, 24th January 1825, and educated at different schools, according to his father's changes of station. He combined a roving disposition with a natural taste for mechanics and for literature. In 1839 he went to Trinity College, Dublin, and in 1844 to Trinity, Cambridge, where he was a wrangler. He was called to the bar in 1851, but being financially independent, he did not pursue his profession. He travelled a great deal in Europe, Egypt, Palestine, Russia, Algeria, and America, and between 1853 and 1863 was largely occupied with researches into the history and methods of marine propulsion. He was the pioneer of British canoeing. In 1865 he started on a first long canoeing cruise in his "Rob Roy" canoe, and in this way made a prolonged water tour through Europe, a record of which he published in 1866 as *A Thousand Miles in the Rob Roy Canoe*. This book, which was succeeded by others of the same sort, made MacGregor and his canoe famous. He made similar voyages in later years in the North Sea and in Palestine, and was the author of the article on CANOEING in vol. iv. of this Encyclopædia (ninth edition). He did not, however, confine his energies to travelling. He was active in charity and philanthropic work, one of the founders of the Shoe-black Brigade, vice-president of the Ragged School Union, honorary secretary of the Protestant Alliance, and a supporter of the Open-air Mission, British and Foreign Bible Society, and Reformatory and Refuge Union. In 1870 and again in 1873 he was elected on the London School Board. He died at Boscombe, 16th July 1892.

Machine Guns.—In the article GUN-MAKING in vol. xi. of this work (ninth edition) will be found a description of the machine guns in use in the British service up to the year 1880. It will be noticed that all of them are worked by hand-power applied to a lever or winch-handle, the motion of this lever being translated by suitable mechanism into those by which the cartridges are loaded, fired, extracted, and ejected—the cycle continuing as long as the lever is worked and there are cartridges in the "hoppers" which feed the gun. In the modern "automatic" machine gun the loading, firing, extracting, and ejecting are all performed automatically by the gun itself, either by the recoil of its barrel, or by a small portion of the gases of explosion being allowed to escape through a minute hole in the barrel near the muzzle. It is obvious, therefore, that as the due performance of the cycle of operations above mentioned is dependent on the explosion of the cartridge, a "hang-fire" merely causes a delay and nothing more, whereas, with a hand-worked gun, a cartridge which has "hung fire" must be extracted, and may explode in and derange the mechanism. Again, since no hand-power is applied, no disturbance of aim, due to this cause, can arise. Guns of this class can be worked by one man, although two at least are generally employed.

The idea of using the recoil, or a portion of the gases of explosion, for the working of the breech mechanism is by no means new, the latter system having been proposed and patented (certainly in a very crude and probably unworkable form) by Mr, afterwards Sir Henry, Bessemer in 1854; but whatever might be discovered by a search in old patent and other records or in museums, there can be no doubt that Sir Hiram Maxim was the first to produce a finished automatic gun of practical value. His patents in connexion with this particular class of weapon date back to 1884, and his gun on the recoil system was, after extensive trials, adopted into the British army in 1889 and into the navy in 1892. It is very possible that Bessemer's idea did not bear fruit earlier because the fouling left by the old forms of "black" or smoky powders was apt to clog the moving parts and to choke any small port. With the modern smokeless powders this difficulty does not arise.

Maxim.

The Maxim gun, as will be seen from Figs. 1 and 2, consists of two parts, the barrel casing (*a*) and breech casing (*d*), secured firmly together. The former (*a*), which is cylindrical in form, contains the barrel (*b*), and the water surrounding it to keep down the very high temperature attained by rapid fire, and the steam tube (*c*), which by the action of a sliding valve allows of the escape of steam but not of water. The barrel has asbestos packings at its front and rear bearings in the casing, which allow of its sliding in recoil without the escape of water. The breech casing (*d*) is a rectangular oblong box, and contains the lock and firing mechanism. At its rear end it has handles (*e*) by which the gun is directed, and the thumb-piece (*m*) by which the trigger is actuated. Its top is closed by a lid, hinged at (*i*) in front, and provided with a spring catch. At its front is a recess holding the feed-block (*f*) through which the belt of cartridges (*g*) is fed to the gun.

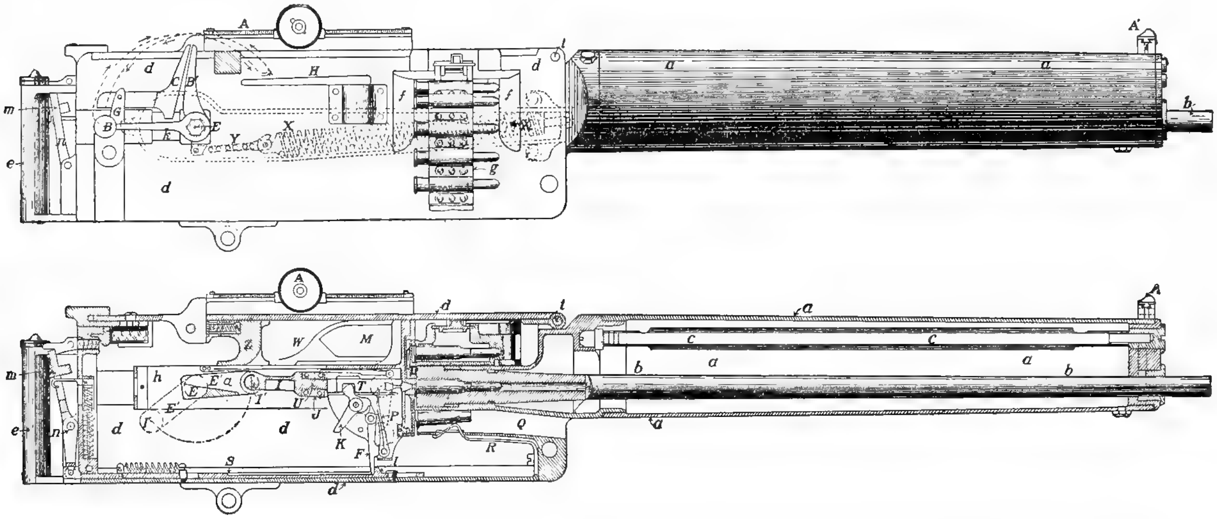
Attached to the rear of the barrel (*b*) on either side are two side plates (*h*), between which in guides O works the aggregation of parts D, F, J, K, L, P, T, and V, which constitute the lock, and (in bearings) the crank-axle E, crank E′, and connecting rod I. (See Figs. 2 to 6.)

The connecting rod I joins the lock and crank, being attached to the side levers J of the former by means of the "interrupted" screw U, which enables the lock to be readily detached as a whole, and removed from the mechanism.

The crank-axle E extends through both sides of the breech casing (*d*), slots (*k*, Fig. 1) allowing it a longitudinal movement of about an inch. To its left-hand end, outside the breech casing, is attached the fusee chain Y of the recoil spring X (see dotted lines in Fig. 1), and to its right-hand end a bell trunk lever, B B′; the arm B, which terminates in a knob, being turned by the crank handle, the arm B′ working against the buffer stop C.

In Figs. 2, 3, and 5 the breech is shown closed, and it will be noticed that the crank pin I′ is *above* the straight line joining the axis of the barrel, the striker T, and the crank axle E. As the crank is prevented from further movement *upwards* by the crank handle B taking against the check-lever G (Fig. 1), it is clear that the pressure on discharge of the cartridge cannot cause the crank axle to rotate, and so open the breech as shown in Figs. 4 and 6.

The withdrawal of the lock and opening of the breech are effected as follows :—The *total* travel in recoil of the barrel is about one inch, but on discharge, the barrel, the side plates, and lock all recoil *together* for about a quarter of an inch without any disturbance of the locking as explained above, and by the time this short travel is completed the *bullet has left the muzzle.* The arm B′ of the crank handle then engages the buffer stop C and causes the crank axle E to *rotate* and the crank E′ to *fall* and so draw back the lock from, and open, the breech. At the same time the fusee chain Y is wound up round the left-hand end of the crank axle E and the spring X extended. In the meantime the knob of the buffer handle B swings over, and just as the lock reaches its rearmost position (as in Figs. 4 and 6) strikes the flat buffer spring H, and, rebounding, assists the crank in revolving in the reverse direction ; the spring X also contracts, and, unwinding the fusee chain, draws back the lock again, and closes the breech, a fresh cartridge having been placed in the barrel as explained below.



Figs. 1 and 2.—Mechanism of Maxim Gun.

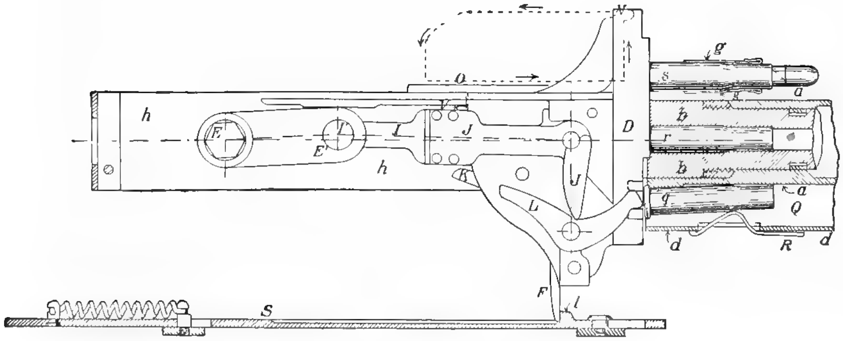


Fig. 3.—Maxim Gun Mechanism.

The gun is fired by means of the trigger F, which is actuated by the projection (*l*) on the trigger bar (S), the latter being drawn back when the button (*m*) on the push-lever (*n*) is pressed forwards. If, therefore, the button be kept permanently pressed, the projection (*l*) will always lie in the path of the trigger F just as the lock reaches its forward position and the breech is closed, and the gun will fire automatically, and continue to do so as long as there are cartridges in the belt.

The loading, extraction, and ejection of the cartridges are effected as follows :—The left-hand side-plate is extended forwards a little beyond the breech, and communicates the reciprocating motion of the barrel to a lever on the feed-block, which causes the cartridges in the belt to be fed forward one by one by a "step-by-step" pawl action, the cartridge which is next to be taken from the belt being arrested exactly above the breech, the ejector-tube Q being below in the same vertical plane.

The extractor D (see Figs. 3 to 6) which performs the operations of inserting, extracting, and ejecting the cartridges, travels vertically in guides on the face of the lock. Projecting outwards from each side of its top are horns N (Figs. 3 and 4). These travel round the edges of the cams M (Fig. 2) situated on each side of the breech casing, and in conjunction with the spring W (Fig. 2), compel the top of the extractor to take the path shown by the dotted lines and arrows in Figs. 3 to 6.

The extractor (Figs. 5 and 6) is recessed to take a movable plate (*u*) termed a "gib," behind which is a spring (*v*). In the face of the gib is a recess (*w*) into which the base of a cartridge can just enter. On either side of the gib the face of the extractor has under-cut flanges, open at the top and bottom, between which the base of a cartridge can fit the rim, being held in the undercuts (Figs. 3 and 4).

It is clear from this arrangement that the base of the cartridge having been introduced between the flanges at the top of the extractor, can be pushed down, the spring (*v*) yielding, till arrested at the recess (*w*) ; and, as the lower edges of this recess are slightly sloped, further pressure will make it leave the recess (*w*) and slide over the face of the gib, leave it, and take up a position in front of the hole for the point of the striker (*x*), being now only prevented from slipping out of the extractor by the extractor spring (*y*). If this last be clear of the extractor stop (*z*) it will yield to pressure and the cartridge will be free. This is the action in the gun except that the cartridge is held firm and the extractor pushed against it.

In Fig. 4, the extractor holds a cartridge (*r*) and a fired case (*q*) ready to be pushed into the empty breech and ejector-tube Q respectively. In the latter there is already a fired case (*p*), which will be driven by the fired case (*q*) beyond the ejector spring R. As soon as the lock reaches the face of the breech, the cartridge (*r*) and case (*q*) are deposited in the breech and ejector-tube respectively, and the extractor D *rises* under the action of the levers L and J, slides, as already explained, by the bases of the cartridges (*r*) and case (*q*), and then over the base of the cartridge (*s*) in the belt (*g*). Assuming the push-lever (*n*) to be pressed, the gun fires immediately this has occurred, and the bullet of the cartridge (*r*) is expelled. The position is now that shown in Fig. 3. The barrel now recoils and the lock is withdrawn, taking with it the fresh cartridge (*s*) from the belt and the now fired case (*r*). The extractor travels horizontally for a time and then drops (as shown by the dotted line and arrows), assuming the position shown in Fig. 6, which is exactly similar to that in Fig. 4 but with different cartridges; continuing the action, the position shown in Fig. 5 is arrived at. It will thus be seen that each cartridge makes two complete journeys with the extractor; the first as a live cartridge from the belt to the breech, the second from the breech to the ejector-tube, the forward journey being always on a lower level than that of the backward one. The sections in Figs. 5 and 6 clearly show the cocking and firing mechanism and the safety arrangement. The lock is cocked, after firing, by the arm of the "tumbler" K, being pressed down by the side lever J as it swings down when following the crank E′. Safety against firing before the breech is closed is provided by the projection on the safety lever V, which does not clear the striker T until lifted by the side lever J at the top of its travel, that is, when the crank E′ has passed the axial line as already explained.

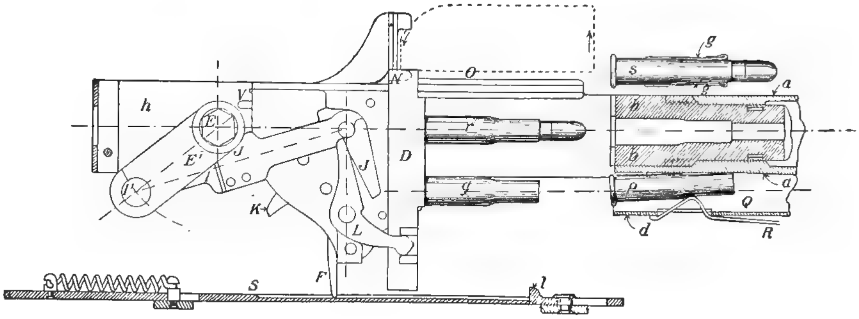


Fig. 4.—Maxim Gun Mechanism.

The lock in its rearmost position is kept in place by the block Z on the underside of the cover of the breech casing. When in this position it is clear of the guides O on the side plates, and if the cover be opened, it can be turned up, unscrewed by a turn through an eighth of a circle (the screw-thread U being interrupted in four places) and removed. To prepare the gun for firing, the crank handle is pushed over by hand to the buffer-spring, thus withdrawing the extractor, and held in this position; the tongue on the end of a filled belt is then pushed through the feed-block from the left and pulled as far as it will go from the opposite side. This places a cartridge above the breech ready to be seized by the extractor. The crank handle is now released and the lock flies forwards. The crank handle is now again pushed over and let go, and the first cartridge thus taken from the belt and placed in the breech. The gun is ready to fire.

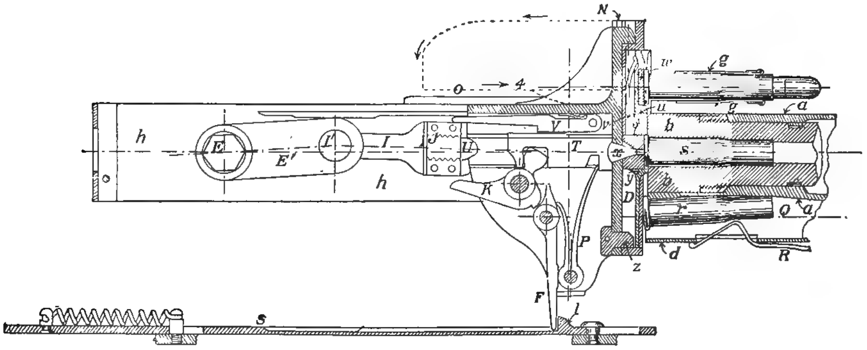


Fig. 5.—Maxim Gun Mechanism.

To remove a partially filled belt, the crank handle must be pushed over, thus freeing the extractor from the belt, and the latter withdrawn after pressing a spring catch under the feed block which releases the pawls. The gun now has *two* live cartridges in it—both in the extractor. Letting go the crank handle, one of them is deposited in the ejector-tube, and again pushing over and letting go the crank handle does the same with the second.

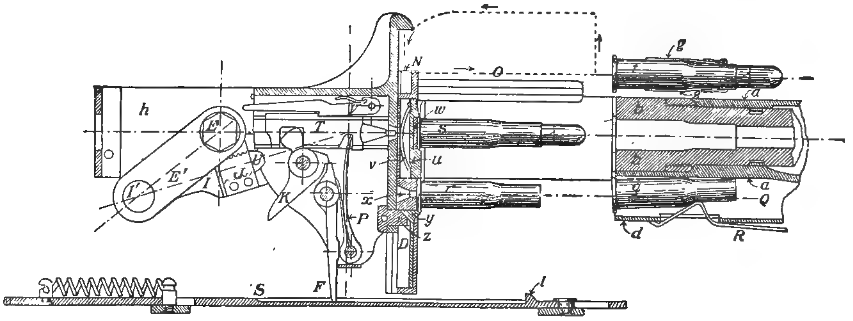


Fig. 6.—Maxim Gun Mechanism.

Figs. 7 and 8 show the feed-block and method of packing the cartridge belts. The greatest number usually carried in a belt is 250.

The gun is sighted to 2500 yards and has a folding tangent sight as shown. Its weight varies from 50 to 60 ℔, and it can fire about 450 rounds per minute.

The diagrams have been made from drawings, by permission of Messrs Vickers, Sons, and Maxim.

Hotchkiss.

The Hotchkiss gun, Figs. 9 to 12, which has been adopted by the French army and navy, depends for its action on the use of a small portion of the gases of the cartridge itself. The barrel A is firmly attached to the receiver or frame B, the latter containing the breech and firing mechanism. Under the barrel A, and communicating with it by a port (*c*) near the muzzle is a cylinder or tube C. When the gun is fired, and the bullet has passed the port (*c*), a portion of the gases of explosion pass into the cylinder C and drive back the piston F contained in it, a lug on the under part of the piston compressing the spring M, the latter, when the trigger N is pulled, driving back the piston again. The reciprocating motion of the piston performs all the processes of loading and firing the gun, and the action is continuous as long as the trigger is kept pressed back.

The piston F, enlarged and suitably shaped at the rear, actuates the breech-block H and firing pin or striker J; and, by suitable cam grooves (*f*) at about the centre of its length, works the larger feed-wheel U of the feed-box S; the smaller wheel U on the same axis in turn imparting a step-by-step motion to the metal feed-strips (see Fig. 12), each containing 30 cartridges, so that fresh cartridges are placed one by one before the face of the breech-block ready to be pushed into the breech when the fired cartridge has been extracted and ejected.

On the under surface of the piston F, in rear, is a recess or sear (*f*) in which the nose of the trigger N engages, holding back the piston when it has been driven back by the gases. As already stated, a lug on the under surface just in rear of the cam (*f*) engages with the front of the mainspring.

Taking first the position shown in Fig. 10 with the breech closed and locked, and the cartridge fired, it will be seen that the breech is locked by the *upper* cam (f^1), on the end of the piston F, having caused the movable locking-dog (h) to fall and bear against the recoil blocks Z (see Fig. 9 also) on the walls of the *receiver* or frame B. Consequently the breech is not unlocked until the piston has moved sufficiently to the rear for the *lower* cam (f^1) to lift the locking-dog (h) clear of the recoil blocks Z. As the piston F is not actuated by the gases until the bullet has passed the port (c), and then has to move a short distance before the locking-dog is raised, the bullet, travelling at some 2000 feet per second, is clear of the muzzle *before* the breech is unlocked.

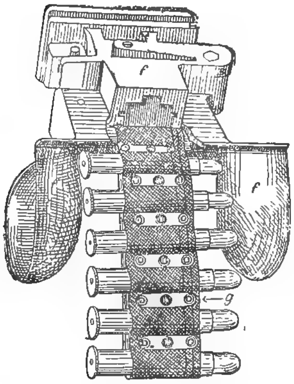


Fig. 7.—Maxim, Feed-block.

As the piston continues to recoil it draws back the striker J and then the breech-block H, and is then caught and retained by the engagement of the sear (f) with the trigger N, and the position assumed is that shown in Fig. 9.

From the head or nose-piece I of the breech-block projects the claw K of a spring extractor which, as the cartridge is pushed home by the breech-block, rides up over the rim of rimmed, or over the base into the grooves of rimless cartridges, and thus attaches itself to the cartridge, extracting the fired case when the breech-block is withdrawn. Ejection of the fired case is effected by means of the ejector L (Fig. 11) which catches against the base of the case, on the opposite side to the extractor claw, and so throws it sideways through the oblong-pointed opening in the receiver just in rear of the breech (see Fig. 9).

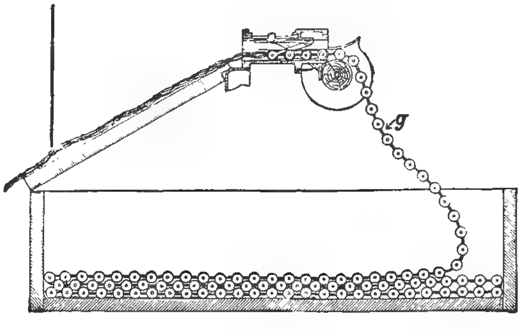
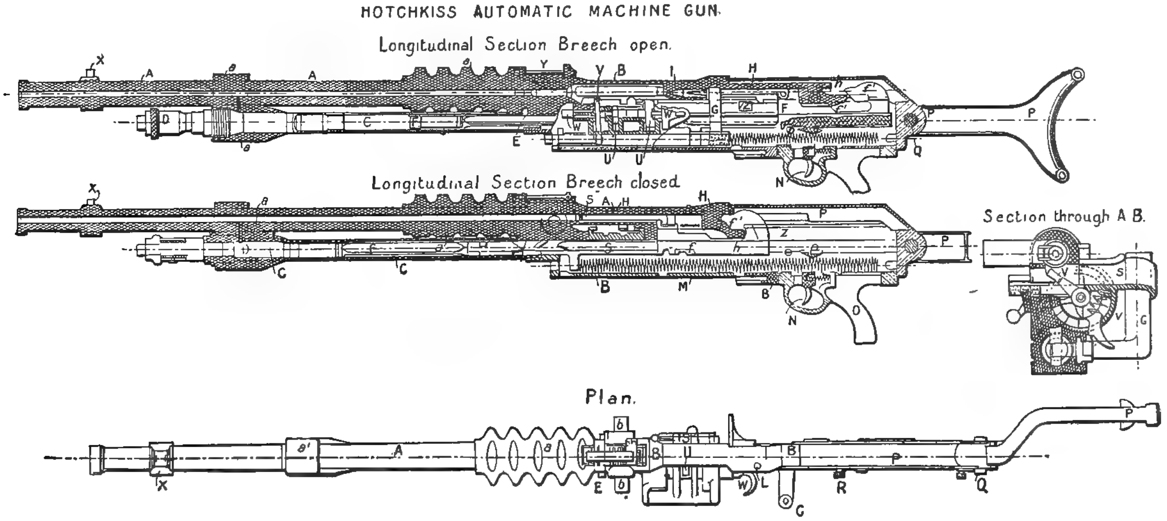


Fig. 8.—Maxim, Cartridge-packing.


HOTCHKISS AUTOMATIC MACHINE GUN.
Longitudinal Section Breech open.
X
A
a
A
a
Y
V
B
I
H
h
f
F
Z
G
W
W
D
C
E
U
U
P
Q
N
Longitudinal Section Breech closed.
X
a
S
A
H
H
f
P
Z
h
D
C
C
B
M
B
O
N
P
Section through A B.
V
S
V
G
Plan.
P
X
a'
A
a
b
b
E
B
B
W
L
G
R
Q
Figs. 9, 10, 11.—Hotchkiss Gun Mechanism.

The platform on the top of the feed-box through which the teeth of the smaller feed-wheel U project, and on which the feed-strips rest, lies *below* the axial line of the breech-block H, so that the face or nose-piece I of the latter only engages a *portion* of the base of the cartridge in the feed-strip as it pushes the cartridge into the breech, the bullet of the cartridge being guided into the breech by the incline at the opening of the latter. This point should be specially noted, the object of the arrangement being to enable the under surface of the breech-block to clear the clips which hold the cartridges in the feed-strips. The cartridge therefore, being extracted in the line of the axis of the block, is ejected through an opening *above* its plane of entry in the feed-strip.

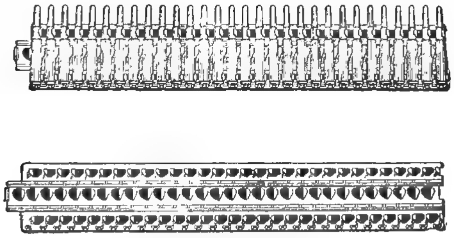


Fig. 12.—Hotchkiss Cartridge Feed-strips.

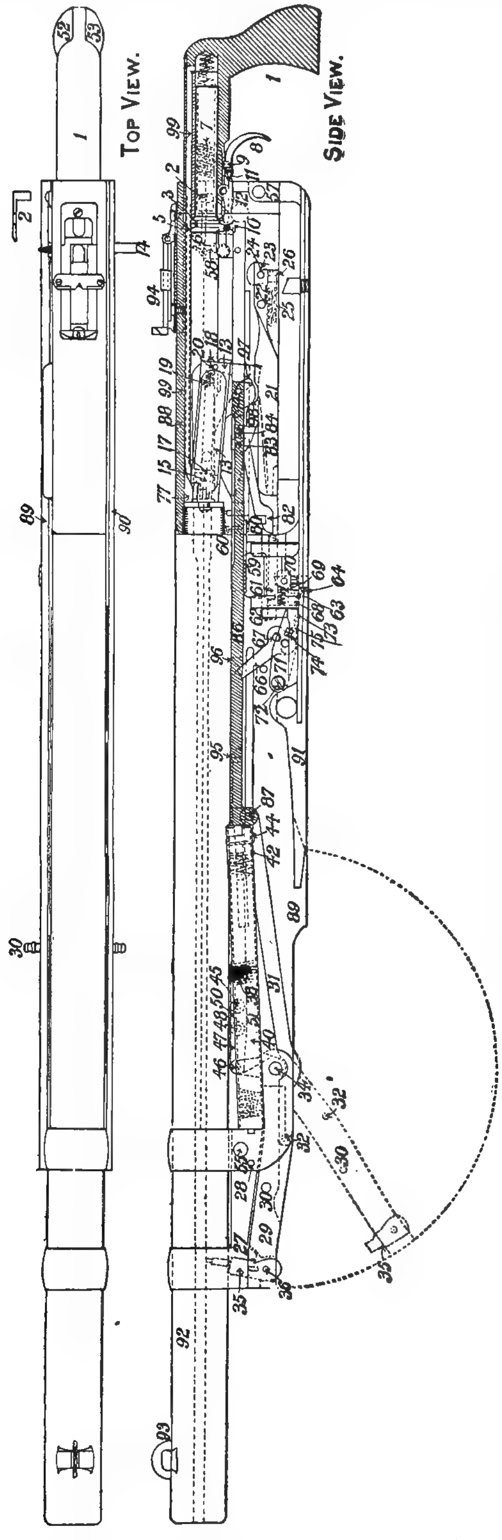
Returning to the position shown in Fig. 9, if the trigger be pulled, the compressed spring M reacts and drives the piston forwards, carrying the breech-block with it, the latter in turn driving a cartridge in front of it out of the feed-strip. When the block and cartridge are home, *and not till then*, the piston completes its travel, the upper cam (f^1) locking the dog (h), and the firing pin protrudes and fires the cartridge. Anything, therefore, which prevents the breech-block from being home against the breech, or the locking-dog from falling in front of the recoil blocks Z, renders firing of the cartridge impossible. Clearly if the trigger be kept depressed the action becomes automatic.

A special feature of this gun is the absence of a separate spring to actuate the firing-pin; the recoil spring M performing this function, in addition to that of driving the piston forwards.

The feed-strips have holes in them in which the teeth of the smaller feed-wheel U engage. The engagement of this feed with the piston F can be released by pulling out the feed arbor W, so that the strips can be removed at any time.

Under the feed-box is a spring stop V, which is depressed when there is a feed-strip in the block, but, when this is not the case, engages with and holds back the piston F when in its rear position. When, therefore, the last shot in a feed-strip has been fired, the stop V at once acts and holds the piston and block ready for a fresh feed-strip to be inserted. As the stop V acts quite independently of the trigger, this action takes place even if the trigger be still depressed after the last cartridge in a strip has been fired.

To cock the gun, when in the locked position, a cocking handle G is provided. This has a long arm projecting to the front with a catch which takes against the front of the lug on the under side of the piston. To prepare the gun for action the gun is cocked, and a feed-strip is pushed into the feed-block.



FIGS. 13 and 14.—Colt Automatic Gun Mechanism.

The pressure of the gas on the piston is regulated by the regulator screw D, by means of which the space in the cylinder C in front of the piston F can be reduced or increased.

A safety lock R is furnished, which is a "half round" pin which can be turned so as to enter the semicircular slot just in front of the sear (*f*), and so hold back the piston when in the cocked position.

Radiation of the heat, generated in the barrel by rapid fire, is facilitated by the radiator (*a*), which consists of rings on the barrel close to the breech, which offer an increased surface to the air.

The gun is sighted to 2000 yards, with the ordinary flap back-sight, weighs about 53 ℔, and can fire from 500 to 600 rounds per minute.

The diagrams have been made from drawings, by permission of the Hotchkiss Ordnance Company.

Colt.

The Colt automatic gun, which has been adopted by the American army and navy, depends for its action, similarly to the Hotchkiss, on the escape of a small portion of the gases of explosion through a port in the barrel a short distance from the muzzle. Figs. 13 and 14 give a plan, and side elevation with the left side plate removed, respectively. Into the recess in the barrel (92) just below the port fits the piston (35), capable of slight motion round the pivot (36), by which it is attached to the gas lever (29). The latter is a bell crank lever pivoted at (34), its short arm being attached at (46) by a pivot to a long link with a cross head, termed the retracting connexion (45). This link extends from a point close to the figures (44), where the arms of the cross head bear against the ends of two long spiral retracting springs, (37) and (38), contained in two tubes, (39) and (40), which are slotted for a few inches of their length to allow the cross head to follow up and compress the springs. (Only (38) and (40) are shown, (37) and (39) lying in the same plane of projection.)

When the gun fires, and the bullet has passed the port, the gases drive the piston (35) and gas lever (29) downwards, and the momentum imparted causes them to swing back round the pivot (36), as shown by the dotted circle. The gas lever is brought up now by the bottom plate (91); and the retracting springs, compressed by the cross head of the long link (45) owing to the *forward* motion of the short arm of the gas lever, react, and drive the gas lever into its forward position again.

The rotary movement of the gas lever is converted into a reciprocating movement of the slide (86) by means of the gas lever connexion rod (31) pivoted at (32) to the gas lever, and at (87) to the slide.

The slide (86) is a nearly flat bar, travelling in guides in the receiver, extending from (14) to (87). It is slotted completely through longitudinally for nearly the whole of its length, this slot affording an opening through which work the cartridge extractor (82) and carrier (21). At its rear end it engages by means of a pin (14) in a cam slot (97) in the bottom rib of the bolt (13), and at (83) it bears the pivot of the cartridge extractor (82). Its rear end is enlarged below to form a cam lug (98), and on its right side are two projections (95) and (96), which work the feed lever (66).

The feed wheel (61), over which passes the belt containing the cartridges, is actuated by a pawl "step-by-step" gear by means of the feed lever (66).

The carrier (21) is a long trip lever pivoted at (22), and provided with a spring dog (23) pivoted at (24).

The bolt (13) is a cylinder with a guide rib extending from its under surface. It is actuated by the slide by means of the pin (14) and cam slot (97) as already stated, and is bored through to take the striker or firing pin (18). The rear end of the latter projects slightly beyond the rear face of the bolt, being retained in this position by the spring (19). When this projecting end is pushed into the bolt, the point protrudes from the front of the bolt and fires the cartridge. The bolt, when the breech is locked, is held firm by two recoil blocks on the receiver (not shown) as is explained later. At the front of the bolt is an extractor (15) with a spring claw for extracting the fired case. (This is of course quite distinct from the cartridge extractor (82)). Ejection is effected by means of an ejector projecting into the path of the fired case in a manner similar to that employed in the Hotchkiss gun as already described.

The firing of the gun is performed by the cylindrical hammer (6) hollowed out in rear to contain the mainspring (7). When pushed back and cocked as shown in Fig. 14, it is held during a *portion* of the operations of the mechanism by *two* detents working independently of each other—the sear (10) and the nose of the trigger (8). The former is automatically released by a trip lever (not shown) as soon as the breech is locked, leaving the hammer held by the trigger only. This is the position shown in Fig. 14. The necessity for the two detents is explained later.

The hammer, when cocked, can also be permanently locked by the handle lock (2) actuated by a thumb piece on the outside of the receiver. The air compressed in rear of the hammer, as the latter is driven back, passes through the tube (99) to the breech; and a puff of air is therefore blown through the barrel after every shot, clearing out any loose fouling, or grains of unconsumed powder, from the cartridge chamber, and assisting to an appreciable extent to keep down the temperature of the barrel.

Taking the position shown in Fig. 14, the hammer is only held back by the trigger nose, the sear (10) having been released as stated above. A belt of cartridges (not shown) has been placed on the feed-wheel, and the cartridge next to be used after the one (not shown) now in the breech has its rim (or base with rimless cartridges) just above the hook on the extractor (82). If now the trigger be pulled, the hammer flies forwards, strikes the protruding end of the firing pin, and the cartridge fires; the gases cause the gas lever to swing round and drive back the slide. The pin (14) working in the cam groove (97) causes the rear of the bolt to *rise* and clear itself from the recoil blocks (not shown) on the receiver, and then to move rearwards horizontally, driving the hammer back until the latter is caught and held by the sear and trigger. In the meantime the extractor (82) has pulled a cartridge from the belt, and, assisted by two spring cartridge guides (80) and (81), of which only (80) is shown, deposits it on the carrier (21); the projection (95) strikes the feed-lever (66), and moves the feed mechanism so as to prepare to revolve the feed-wheel and place a fresh cartridge ready for the next round; and, as the slide completes its travel backwards, the cam (98) strikes the dog (23) and slightly depresses it (the spring (25) yielding), the carrier and cartridge on it consequently rising a little and falling again (this latter action is incidental only to the form of the parts, and is not a necessity).

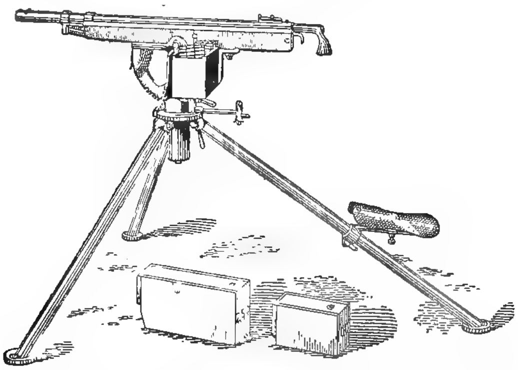


Fig. 15.—Colt Gun mounted.

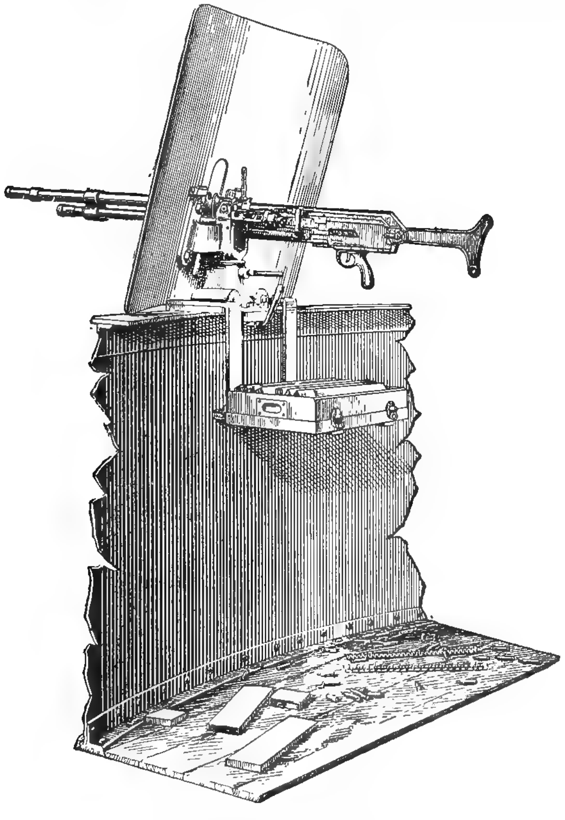


Fig. 16.—Hotchkiss Gun mounted.

The retracting springs now react and pull the slide forwards; the cam (98) strikes the dog (23), which, as the spring arrangement is of the "non-return" class, does not yield but is depressed, and the front of the carrier and the cartridge on it are therefore raised sharply, and the latter placed in the path of the bolt. The bolt being now pulled forwards, the cartridge is driven off the carrier into the breech, and the bolt locked by the pin (14), causing the bolt to drop in front of the recoil blocks; the carrier is pushed down flat by the advance of the cam lug (98), the trip releases the sear (10), and the projection (96) pushes back the feed lever, completing the action of feeding a fresh cartridge forward. The position shown in Fig. 13 is now resumed.

It is clear that were the trigger kept permanently pulled the gun would fire immediately the bolt was locked and the sear (10) depressed, and the action would become automatic.

The object of two detents, though now probably obvious, may here be explained. The whole action of the gun depends upon the hammer, after it is pushed back by the bolt, being *held* back until the bolt has gone completely forwards and locked the breech. If only the trigger detent existed, and that were kept pressed down, the hammer, after being pushed back by the bolt, would immediately *follow up* the latter, and might fire the cartridge prematurely, or fail to fire it at all; hence the use of the sear in addition to the trigger.

To cock the lock, or work the mechanism by hand, the gas lever is pulled round by the pin (30) provided for the purpose, and by this means the gun is prepared for firing. A brass tongue on the end of the belt is pushed through the opening above the feed-wheel and then pulled from the other side of the gun as far as it will go. This places a cartridge in front of the extractor, and if the gas lever be now pulled right back and let go, this cartridge is placed in the breech as already described, and the gun is ready for firing. If it be desired to remove a belt from the feed, a button (68) is pressed and the feed-wheel is then free to revolve backwards.

The gun is sighted with the ordinary rifle pattern sights, up to 2000 yards or more if required. It weighs about 40℔, and can fire about 400 rounds per minute as usually adjusted, though this rate can be increased. There is no means of altering the gas pressure in the field as with the Hotchkiss.

The diagrams have been made from drawings, by permission of the Colt Gun Company.

Comparing the principle of employing a recoiling barrel with that of using a portion of the gas, the advantages of the former are that the recoil is made to do useful work instead of straining the gun and mounting in its absorption; the latter system, however, has undoubtedly the advantage in simplicity of mechanism (the Hotchkiss is extraordinarily simple in construction for an automatic gun), and in the large margin of power for working the mechanism with certainty in all conditions of exposure to climate, dust, and dirt. While inferior in this respect, it is nevertheless the fact that the Maxim has proved itself in the field to be a very efficient and powerful weapon.

The great difficulty which has to be met in all single-barrel machine guns is the heating of the barrel. How great this heat is may be gathered from the fact that the 7½ pints of water in the water-jacket of the Maxim gun are raised to boiling point by 600 rounds of rapid fire,—*i.e.*, in about 1½ minutes,—and if firing be continued, about 1½ pints of water are evaporated for every 1000 rounds. Assuming that the operation is continuous, the rate of waste of energy due to heat expended on the water *alone* is equivalent to about 20 horse-power (294 foot tons per minute). The water-jacket acts well in keeping down the temperature of the barrel; but apart from the complications entailed by its use, the provision of water for this purpose is at times exceedingly troublesome on service. In the Hotchkiss and Colt guns, which have no water-jacket, an attempt is made to meet the heating, in the one by the radiator, and in the other by a very heavy barrel.

For military and naval purposes the automatic gun is, under certain conditions, of great value. For the sweeping of defiles, the warding off of the attacks of masses of men in close formation, or the pouring in of an immense number of bullets into a rapidly advancing torpedo boat, it is a most valuable weapon, and in addition its moral effect is great; but against men scattered over a wide front there is no doubt it is very wasteful for the effect obtained. It is by no means easy to proportion the fire to the target, as there are only two rates of fire, viz., rapid automatic and slow single shots. To fire a single shot requires some practice, since the gun will fire some 7 shots in one *second*, and to press the trigger and remove the finger or thumb instantly, and at the same time be ready to traverse to a fresh target, requires considerable skill. The result of these difficulties is that the target when struck is often riddled with bullets, when a few or even one would have sufficed. The aiming of the gun, when rapid fire is taking place, is also difficult even on firmly fixed mountings, as the vibration, due to the rapidly repeated similar impulses, is very great. Figures 15 to 17 show these guns on three classes of mounting which are in common use. (H. W. B.)

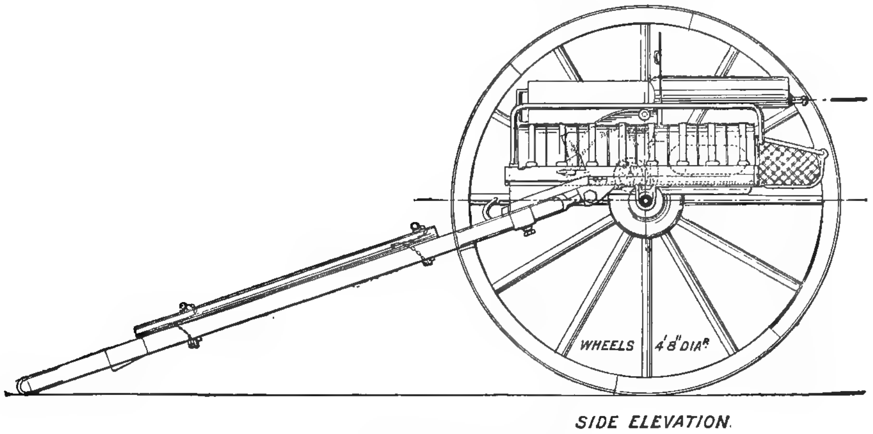


Fig. 17.—Maxim Gun mounted.

Mackay, Charles (1814–1889), Scottish writer, was born at Perth, 27th March 1814. He was educated at the Caledonian Asylum, London, and in Brussels; and in 1830, being engaged as private secretary to a Belgian ironmaster, he began writing articles and verses for local newspapers. Returning to London, he devoted himself to literary and journalistic work, and was attached to the *Morning Chronicle* (1835–44). He published a book called *Memoirs of Extraordinary Public Delusions* (1841), and gradually made himself known as an industrious and prolific journalist. In 1844 he was made editor of the Glasgow *Argus*, and two years later was given the degree of LL.D. by the university. His literary reputation was made by the publication in 1846 of a volume of verses, *Voices from the Crowd*, some of which (among them "The Good Time Coming") were set to music by Henry Russell and became very popular. In 1848 Mackay returned to London and worked for the *Illustrated London News*, of which he became editor in 1852. In it he published a number of songs, set to music by Bishop and Russell, and in 1855 they were collected in a volume; they included the popular "Cheer, Boys! Cheer!" It was as a song-writer that he was best known, but he was also a prolific author in prose, and after his severance from the *Illustrated London News* in 1858 he started two periodicals which turned out unsuccessfully, and also acted as special correspondent for *The Times* in America during the Civil War from 1862 to 1865. Among his publications must be mentioned the well-known *Thousand and One Gems of English Poetry* (1867). Mackay died in London, 24th December 1889. His son, Eric Mackay (1851–1899), is known as a writer of verse, particularly by his *Love Letters of a Violinist* (1886).

Mackay, a seaport town, Queensland, Australia, in the county of Carlisle, on the Pioneer river, 625 miles north-west of Brisbane. The harbour is not a good one. Sugar, tobacco, and coffee thrive in the district, which is dotted with hundreds of sugar-farms. There are several important sugar-mills, and one of these, the largest in Queensland, is capable of an annual output of 8000 tons. Rum is distilled. Workable coal is found in the district. This is the port of the Mount Orange and Mount Gotthart copper mines, and the Mount Britten and Eungella gold-fields. It is a calling station for the Queensland Royal Mail steamers. Population (1901), 5157.

M'Keesport, a city of Allegheny county, Pennsylvania, U.S.A., on the Monongahela river, at the mouth of the Youghiogheny river—both of which are navigable—14 miles south-east of Pittsburg, in the south-western part of the state, at an altitude of 753 feet. It is entered by the Pennsylvania, the Baltimore and Ohio, and the Pittsburg and Lake Erie railways. It has waterworks owned by the city, and its business streets are paved largely with bricks and granite blocks. It is in the midst of the coking coal region, and has an abundance of natural gas. Its industries consist mainly in iron and steel manufacture. In 1890 it contained a total of 118 manufacturing establishments, with a capital of $10,979,812, employing 6292 men, and with a product valued at $17,432,721. Not less than $\frac{15}{16}$ths of this consisted of iron and steel goods. The assessed valuation of real and personal property in 1900 (on a basis in the case of the former of about three-fourths of the full value) was $17,604,560, the net debt of the city was $705,148, and the rate of taxation $20.25 per $1000. Population (1880), 8212; (1890), 20,741; (1900), 34,227, showing a rapid rate of increase, due to the development of the city's manufactures of iron and steel.

M'Kees Rocks, a borough of Allegheny county, Pennsylvania, U.S.A., on the south bank of the Ohio river, opposite Allegheny city, in the south-western part of the state. It is entered by the Pittsburg and Lake Erie, and the Pittsburg, Charleston, and Youngstown railways. The leading industries of the town are iron and glass manufacturing. Population (1890), 1687; (1900), 6352, of whom 1264 were foreign-born and 20 were negroes.

Mackenzie, a river of the North-West Territories, Canada, discharging the waters of Great Slave Lake into the Arctic Ocean; discovered and first navigated by Alexander Mackenzie (1789). It has an average width of one mile; an average fall of six inches to the mile; an approximate discharge, at a medium stage, of 500,000 cubic feet per second; and a total length, including its great tributary the Peace, of 2350 miles. The latter rises, under the name of the Finlay, in the mountains of British Columbia, and flows north-eastwards and then south-eastwards, in the great intermontane valley that bounds the Rocky Mountains on the west, to its confluence with the Parsnip. From the confluence the waters of the combined rivers, now called the Peace, flow eastwards through the Rocky Mountains, and then north-eastwards to unite with the river which discharges the waters of Lake Athabasca; thence to Great Slave Lake it is known as Slave river. The principal tributaries of the Peace are: Omineca, Nation, Parsnip, Halfway, North Pine, South Pine, Smoky, Battle, and Loon rivers. The only considerable streams draining into Lake Athabasca are the Black, William, and Athabasca, and into Great Slave Lake the La Martre, Yellowknife, Lockhart—draining Aylmer, Clinton-Colden, and Artillery lakes—Du Rocher, Slave, and Hay. The principal tributaries of the Mackenzie are the Liard, 650 miles long, which rises near the sources of the Pelly—west of the Rocky Mountains—and breaks through that range on its way to join the parent stream, Great Bear river, which discharges Great Bear Lake, Nahanni, Dahadinni, Arctic Red and Peel rivers. The Mackenzie and its continuation, Slave river, are navigable from the Arctic Ocean to Fort Smith, a distance of over 1200 miles, and between the latter and the head of Lesser Slave Lake, a further distance of 625 miles, there is only one obstruction to navigation, the Grand Rapids near Fort McMurray. The Mackenzie is navigable from about 10th June to 20th October, and Great Slave Lake from about 1st July to the end of October.

Mackenzie, Alexander (1822–1892), Canadian statesman, was born in Perthshire, Scotland, 28th January 1822. His father was a builder, and young Mackenzie emigrated to Canada in 1842 and worked in Ontario as a stone-mason, setting up for himself later as a builder and contractor at Sarnia with his brother. In 1852 his keen interest in questions of reform and Liberal politics led to a connexion with a local paper, which brought him to the front, and in 1861 he became a member of the provincial parliament, where he at once made his mark and was closely connected with the Liberal premier, George Brown. He was elected for Lambton to the first Dominion House of Commons in 1867, and soon became the recognized leader of the Liberal Opposition; from 1871 to 1872 he also sat in the Ontario provincial assembly. In 1873 his attack on Sir John Macdonald's ministry with regard to the Pacific railway charter resulted in their defeat, and Mackenzie formed a new Government, taking the portfolio of public works and becoming the first Liberal premier of Canada. He remained in power till 1878, when industrial depression led to a reaction against the Liberal free-trade policy and enabled Sir John Macdonald to return to office on a protectionist programme. In 1875 Mackenzie paid a visit to Great Britain, and was received at Windsor by Queen Victoria; he was offered a knighthood, but declined it. After his defeat he suffered from failing health, but though he resigned the leadership of the Opposition, he retained a seat in parliament till his death at Toronto on 17th April 1892. (See also CANADA.)

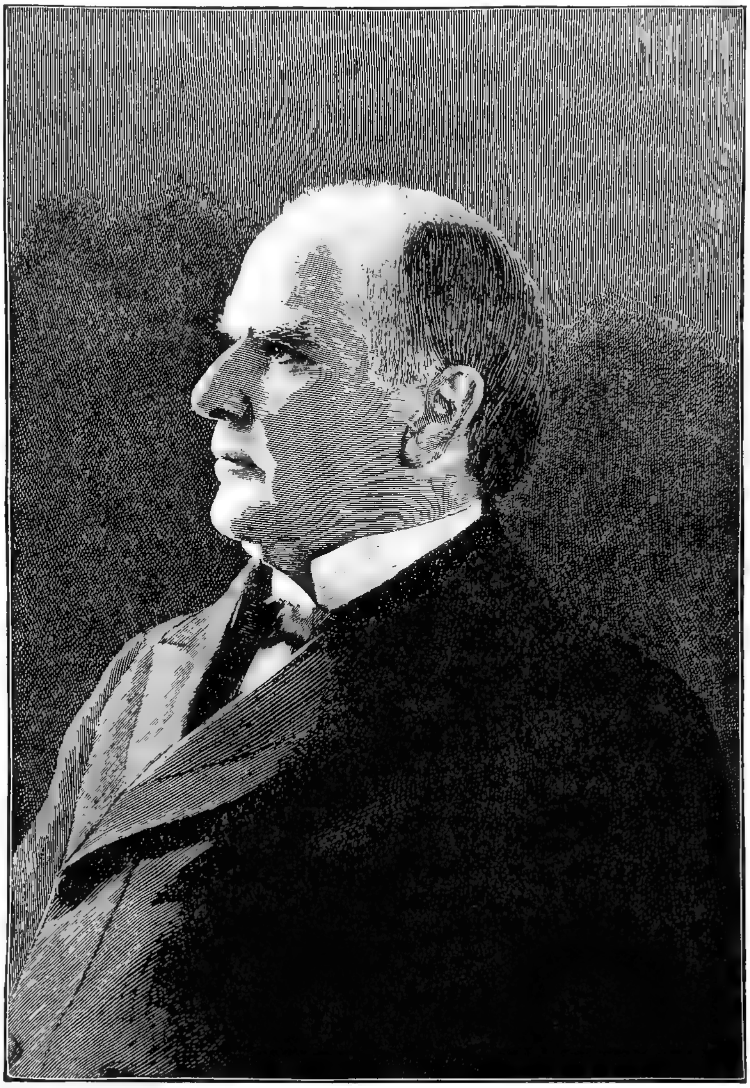
Mackenzie, Sir Alexander Campbell (1847-——), British composer, son of an eminent Edinburgh violinist and conductor, was born 22nd August 1847. On the advice of a member of Gung'l's band who had taken up his residence in Edinburgh, one Bartel, the young Mackenzie was sent for his musical education to Bartel's native place, Sondershausen, where he entered the Conservatorium under Ulrich and Stein, remaining there from 1857 to 1861, when he entered the ducal orchestra as a violinist. It was at this time that he made Liszt's acquaintance. On his return home he won the King's Scholarship at the Royal Academy of Music, and remained the usual three years in the institution, after which he established himself as a teacher of the piano, &c., in Edinburgh. He appeared in public as a violinist, taking part in Chappell's quartette concerts, and starting a set of classical concerts. He was appointed precentor of St George's Church in 1870, and conductor of the Scottish Vocal Music Association in 1873, at the same time getting through a prodigious amount of teaching. He kept in touch with his old friends by playing in the orchestra of the Birmingham Festivals from 1864 to 1873. The most important compositions of this period of Mackenzie's life were the Quartette in E flat for piano and strings, Op. 11, and an overture *Cervantes*, which owed its first performance to the encouragement and help of von Bülow. On the advice of this great pianist, he gave up his Edinburgh appointments, which had quite worn him out, and settled in Florence in order to compose. The cantatas *The Bride* (Worcester, 1881) and *Jason* (Bristol, 1882) belong to this time, as well as his first opera. This was commissioned for the Carl Rosa Company, and was written to a version of Merimée's *Colomba* prepared by Dr Franz Hueffer. It was produced with great success in 1883, and was the first of a too short series of modern English operas; Mackenzie's second opera, *The Troubadour*, was produced by the same company in 1886; and his third dramatic work was *His Majesty*, an excellent comic opera, given at the Savoy Theatre in 1897. In 1884 his *Rose of Sharon* was given with very great success at the Norwich Festival; in 1885 he was appointed conductor of Novello's oratorio concerts; *The Story of Sayid* came out at the Leeds Festival of 1886; and in 1888 he succeeded Macfarren as principal of the Royal Academy of Music. *The Dream of Jubal* was produced at Liverpool in 1889, and in London very soon afterwards. A fine setting of the hymn "Veni, Creator Spiritus" was given at Birmingham in 1891, and the oratorio *Bethlehem* in 1894. From 1892 to 1899 he conducted the Philharmonic Concerts, and was knighted in 1894. Besides the works mentioned he has written incidental music to plays, as, for instance, to *Ravenswood*, *The Little Minister*, and *Coriolanus;* concertos and other works for violin and orchestra, much orchestral music, and many songs and violin pieces. The romantic side of music appeals to Mackenzie far more strongly than any other, and the cases in which he has conformed to the classical conventions are of the rarest. In the orchestral ballad, *La Belle Dame sans Merci*, he touches the note of weird pathos, and in the nautical overture *Britannia* his gift of a strong sense of humour stands revealed. If his single comic opera was one of the least successful of the productions at the Savoy Theatre, it was certainly not the least humorous, and it had many passages of real and lasting beauty. In the two "Scottish Rhapsodies" for orchestra, in the music to *The Little Minister*, and in a beautiful fantasia for pianoforte and orchestra on Scottish themes, he has seized the essential, not the accidental, features of his native music.

Mackenzie, Sir Morell (1837–1892), British physician, son of Stephen Mackenzie, surgeon (d. 1851), was born at Leytonstone, Essex, 7th July 1837. After going through the course at the London Hospital, and becoming F.R.C.S. in 1858, he studied abroad at Paris, Vienna, and Pesth; and at Pesth he learnt the use of the newly-invented laryngoscope under Professor Czermak. Returning to London in 1862, he worked at the London Hospital, and took his degree in medicine. In 1863 he won the Jacksonian prize at the Royal College of Surgeons on "Pathology of the Larynx," and he then devoted himself to becoming a specialist in diseases of the throat. In 1863 the Throat Hospital in King Street, Golden Square, was founded, largely owing to his initiative, and by his work there and at the London Hospital (where he was one of the physicians from 1866 to 1873) Morell Mackenzie rapidly became recognized throughout Europe as a leading authority, and acquired an extensive practice. So great was his reputation that in May 1887, when the Crown Prince of Germany (afterwards the Emperor Frederick III.) was attacked by the affection of the throat of which he ultimately died, Morell Mackenzie was specially summoned to attend him. The German physicians who had attended the Prince since the beginning of March (Gerhardt, and subsequently Tobold, von Bergmann, and others) had diagnosed his ailment on 18th May as cancer of the throat; but Morell Mackenzie insisted (basing his opinion on a microscopical examination by Virchow of a portion of the tissue) that the disease was not demonstrably cancerous, that an operation for the extirpation of the larynx (planned for 21st May) was unjustifiable, and that the growth might well be a benign one and therefore curable by other treatment. The question was one not only of personal but of political importance, since it was doubted whether any one suffering from an incapacitating disease like cancer could, according to the family law of the Hohenzollerns, occupy the German throne; and there was talk of a renunciation of the succession by the Crown Prince. It was freely hinted, moreover, that some of the doctors themselves were influenced by political considerations. At any rate, Morell Mackenzie's opinion was followed: the Crown Prince went to England, under his treatment, and was present at the Jubilee celebrations in June. Morell Mackenzie was knighted in September 1887 for his services, and decorated with the Grand Cross of the Hohenzollern Order. In November, however, the German doctors were again called into consultation, and it was ultimately admitted that the disease really was cancer; though Mackenzie with very questionable judgment, more than hinted that it had become malignant since his first examination, in consequence of the irritating effect of the treatment by the German doctors. The Crown Prince (see FREDERICK III.) became Emperor on 9th March 1888, and died on 15th June. During all this period a violent quarrel raged between Sir Morell Mackenzie and the German surgeons and medical world, both as to the diagnosis and also as to the treatment both before and after the existence of a malignant growth was determined; and the discussion as to the part played by Mackenzie was carried on in a wider circle with much display of feeling after the Emperor's death. The German doctors published an account of the illness, to which Mackenzie replied by a work entitled *The Fatal Illness of Frederick the Noble* (1888), the publication of which caused him to be censured by the Royal College of Surgeons. After this sensational episode in his career, the remainder of Sir Morell Mackenzie's life was uneventful, and he died somewhat suddenly in London, 3rd February 1892. He published several books on laryngoscopy and diseases of the throat. A full discussion of the much-controverted details about Mackenzie's treatment of the Emperor Frederick will be found in *The Times* of 16th October 1888. (H. CH.)

McKinley, William (1843–1901), twenty-fifth President of the United States, was born in Niles, Trumbull county, Ohio, on 29th January 1843. His ancestors on the paternal side were of Scottish-Irish origin. His great-great-grandfather settled in York county, Pennsylvania, about 1743, whence his great-grandfather, David McKinley, moved to Ohio in 1814. David's son James had preceded him, having gone to Columbiana county, Ohio, in 1809. William McKinley, father of the President, was the son of this James McKinley, and was born in 1807. He was married in 1829 to Nancy Campbell Allison, of Columbiana county, Ohio, and to them were born nine children, of whom William, the President, was the seventh. In 1852 William McKinley, senior, took his family from Niles, Trumbull county, to Poland, Mahoning county, where the younger William was placed at school in the Union Seminary. At seventeen he was sent to Meadville, Pa., to enter the junior class of Allegheny College. He studied beyond his strength, however, and did not remain to finish his course, but returned to Poland, where for a time he taught in a neighbouring country school. When the Civil War broke out in 1861 he was eighteen years old, and promptly enlisted as a private soldier. He served until the end of the war, and was mustered out with his regiment 26th July 1865, with the brevet rank of major. Army life had changed the rather pale and sickly lad of eighteen into a man of superb figure and health at twenty-two. His regiment was the 23rd Ohio Volunteer Infantry, of which Rutherford B. Hayes was the first colonel. Mr Hayes became a general, and McKinley was for some time a member of his staff. Throughout General Hayes's subsequent career as member of Congress, Governor of Ohio, and President of the United States, he was deeply devoted to the younger man, who was destined to follow a like career as Congressman, Governor, and President.

After the war McKinley returned to Poland, and bent all his energy upon the study of law. He completed his preparatory reading at the Albany (N.Y.) Law School, and was admitted to the bar at Warren, Ohio, in March 1867. He was now twenty-four years old, and ripened and disciplined by experience. On the advice of an elder sister, who had been for several years a teacher in Canton, Ohio, he began his law practice in that place, which was to be his permanent home. He identified himself immediately with the Republican party, and took part in the campaign work on behalf of Grant's Presidential candidature in 1868. In the following year, in spite of the fact that his county (Stark) had almost invariably given Democratic majorities, he was elected prosecuting attorney—a position with which the public careers of many American statesmen have begun. He served in this position for two years, when, failing to obtain re-election by a narrow margin, he devoted himself to his profession, while not relaxing his interest in politics. He was married in 1871 to Miss Ida Saxton, daughter of a banker of Canton.

In 1876 Mr McKinley was elected to Congress. Conditions both in Ohio and in Congress had placed him, and were to keep him so for twenty years, in an attitude of aggressive and uncompromising partisanship. His congressional district was naturally Democratic, and its boundaries were changed two or three times by Democratic legislatures—"gerrymandered," to use an established American expression—for the purpose of so grouping Democratic strongholds as to cause his defeat. But he overcame what had threatened to be adverse majorities on all occasions from 1876 to 1890. Mr McKinley's was a manufacturing district, and his home town of Canton was growing by reason of its industrial enterprises. As a strong believer in the essential relation of the protective tariff policy to the growth of American industries, Mr McKinley soon became known in Congress as one of the most diligent students of industrial policy and questions affecting national taxation. In his first term he took part in the debates over the Wood Tariff Bill, proposing lower import duties. In his second term he was appointed to a position on the Ways and Means Committee. He was prominent in the debate which resulted in the defeat of the Democratic Morrison Tariff Bill in 1884, and he took an even more notable part in the defeat of the tariff revision project known as the Mills Bill. Soon after the opening of the fifty-first Congress in 1889, Mr McKinley became the chairman of the Ways and Means Committee, and Republican leader in the House. Party feeling was exceptionally intense at that time, and Mr McKinley's name as chairman of the Ways and Means Committee made him the most conspicuous among the framers of the new Republican tariff measure. His name was popularly attached to it, and he could not evade the storm of controversy which raged in Congress and throughout the country. The Democrats made a concentrated effort to prevent his return to Congress (1890), and they were successful. But Mr McKinley, in the darkest hours of the unpopularity of the McKinley tariff, continued to express his belief in its value. His defeat for Congress was accomplished chiefly by an extraordinary gerrymandering of his district, and he won a moral victory in view of the fact that more Republican votes were cast for him than had ever been cast for any Republican candidate before in the history of the counties which were now aggregated to form the district. The Republicans of the state at once proceeded to champion him and his tariff views by according him the unanimous nomination for the Governorship. His four years as chief of the executive of Ohio must be regarded as important, largely by reason of the valuable training they afforded in executive as distinguished from legislative work.



President McKinley.
(*From a Photograph by Parker, Washington, D.C.*)

Mr McKinley had now become a public man of the first rank. He had been for some time a prominent figure at the quadrennial conventions which bring together the leading Republicans of the entire nation to adopt a platform and nominate a President, and he had also been looked upon in the light of a possible Presidential candidate. In 1888 he was chairman of the platform committee, and leader of the delegation from Ohio, and found a condition prevailing in the convention which would unquestionably have given him the Presidential nomination, but for his absolute refusal to permit his name to be used, on account of the fact that the Ohio delegation had been instructed to urge the nomination of John Sherman. In 1892 Governor McKinley was the presiding officer of the National Convention; but he had concurred in the opinion that President Harrison ought to be renominated, and this view prevailed, although in spite of all his efforts a large number of delegates cast their votes for him.

It had been supposed that the tariff question would again play a leading part in the campaign of 1896, and such would probably have been the case but for the vast proportions assumed in the West and South by the propaganda for the free coinage of silver. In 1873, preparatory to a resumption of specie payments, the currency and coinage system of the United States had been revised, the silver dollar, which had formerly been the unlimited legal standard jointly with the gold dollar, being demonetized, and the gold dollar becoming the sole monetary standard. Subsequently the great development of silver-mining and the decline in the price of silver bullion gave rise—first among the silver miners, and afterwards among the Western farmers—to a movement for the remonetization of silver. At first this movement was irrespective of party lines. It was generally hoped that a large use of silver in the coinage and currency system with ultimate gold redemption would help the silver bullion market, and that meanwhile European nations might be persuaded to join the United States in some plan of international bimetallism. Mr McKinley had been heartily in favour of a restoration of free silver, provided it could be brought about safely and honourably; and this view had been very general among leading public men of all parties. At length, however, the Democratic party of the West and South assumed the position that the mints ought to be opened to the free coinage of silver, irrespective of European action, and the Republican party found itself resisting this movement. In the convention at St Louis, 1896, which nominated Mr McKinley for President, the Republicans declared themselves firmly for the existing gold standard until such time as silver might be rehabilitated with the co-operation of leading commercial nations.

The Democratic Convention met a few days later at Chicago, and nominated Mr William J. Bryan for the Presidency, on a platform of the immediate opening of the mints to the free and unlimited coinage of silver at the old ratio with gold of 16 to 1. The Republicans were thus diverted from their expected advocacy of high protection as the principal issue to the defence of the gold standard. The popular vote for McKinley electors in the ensuing election was 7,104,779, and that for Bryan electors about 600,000 less. Mr McKinley received 271 votes in the Electoral College, and Mr Bryan 176.

Immediately after his inauguration on 4th March 1897, President McKinley issued a proclamation calling Congress to assemble in an extra session on 15th March. The Democratic tariff in 1893 had been enacted as part of the general revenue measure which included an income-tax. The income-tax having been declared unconstitutional by the Supreme Court, the measure had failed to produce a sufficient revenue, in consequence of which Mr McKinley's predecessor had been obliged to increase the public debt. Mr McKinley's message to the new Congress dwelt upon the necessity of an immediate revision of the tariff and revenue system of the country, and the so-called Dingley Tariff Bill was accordingly passed through both houses, and was approved by the President on 24th July.

The regular session of Congress which opened in December was occupied with the situation in Cuba. A formidable rebellion of the Cuban patriots against the Spanish Government had begun in 1895, and the unavailing attempts of Spain to subdue it had been upon a large military scale, accompanied by measures of harshness towards the entire population, women and children included, that were resulting in wholesale starvation. A popular demand had arisen throughout the United States for intervention. The already strained situation was rendered worse by an explosion on 15th February 1898, in the harbour of Havana, which resulted in the destruction with great loss of life of the United States battleship *Maine*. The increasing difficulties of the situation led early in March to the unanimous vote in both Houses of Congress of $50,000,000, to be placed at the disposal of the President, and to be used at his discretion for the national defence. On 23rd March an ultimatum was presented to the Spanish Government by direction of President McKinley, setting forth the intolerable condition that existed in Cuba, and calling upon Spain to relinquish its sovereignty and withdraw from the island. A period of negotiation followed which culminated in Mr McKinley's message to Congress of 25th April recommending a declaration of war against Spain. Such a declaration was immediately passed by both Houses of Congress and approved by the President.

As commander-in-chief of the army and navy of the United States, Mr McKinley prosecuted a brief but vigorous war in which a volunteer army of nearly a quarter of a million men was called into existence, and two Spanish fleets were destroyed—one by the Asiatic squadron under Admiral Dewey in Manila Harbour, the other by the North Atlantic squadron under Admiral Sampson near the harbour of Santiago de Cuba. These victories at sea, together with the surrender to an American expeditionary force of the city of Santiago, in eastern Cuba, led to the signing of a peace protocol on 12th August, which was followed by the signature at Paris on 10th December of articles of peace. After a long discussion the peace treaty was ratified by the United States Senate, 6th February 1899; and in accordance with its terms Porto Rico, the Philippine Archipelago, and a portion of the Ladrone Islands were transferred by Spain to the sovereignty of the United States, while Cuba came under American jurisdiction pending the establishment there of an independent government. Two days before the ratification of the peace treaty, a conflict took place between armed Filipinos under the leadership of Emilio Aguinaldo and the American forces that were in possession of Manila. The six months that had elapsed between the signing of the peace protocol and the ratification of the treaty had constituted a period of virtual interregnum, Spain's authority having been practically destroyed in the Philippines and that of the United States not having begun. In this period a formidable native Filipino army had been organized and a provisional government created. The warfare waged by these Filipinos against the United States, while having for the most part a desultory and guerilla character, was of a very protracted and difficult nature. Sovereignty over the Filipinos having been accepted by virtue of the ratification of the Paris treaty, President McKinley was not at liberty to do otherwise than assert the authority of the United States and use every endeavour to suppress the insurrection. There was, however, a wide difference of opinion in the United States whether or not it had been wise to accept responsibility for so distant a territorial possession. In the foreign relations of the United States, as directed by President McKinley, the most significant change was the cordial understanding established with the British Government. Under no previous American administration since the establishment of Independence had the relations between the two Governments been so free from difficulty or embarrassment.

The elements which had supported Mr Bryan in 1896 had not been disheartened by their defeat, but had immediately organized for a new campaign in 1900 under the same candidate and with the same platform. The Democratic Convention, held on 4th July at Kansas City, again nominated Mr Bryan and again declared for the free coinage of silver. But the Republican policy of "imperialism" was declared to be "the paramount issue," and Mr Bryan, during a campaign of incessant travel and public speech, constantly denounced the course that had been pursued under Mr McKinley's leadership. The latter was unanimously renominated by the National Republican Convention which met in Philadelphia on 19th June. In 1896 Garret A. Hobart, of New Jersey, had been elected Vice-President, but had died in 1899. At the Philadelphia Convention of 1900, Governor Theodore Roosevelt, of the State of New York, was nominated for the Vice-Presidency. The Republican Convention demanded the maintenance of the gold standard, and pointed to the fulfilment of some of the most important of the pledges given by the Republican party four years earlier. The intervening period had been one of very exceptional prosperity in the United States, foreign commerce having reached an unprecedented volume, and agriculture and manufactures having made greater advancement than in any previous period of the country's history. The tendency towards the concentration of capital in great industrial corporations had been active to an extent undreamt of, with incidental consequences that had aroused much apprehension; and the Democrats accused President McKinley and the Republican party of having fostered the "trusts." As the result of the polling in November, 292 Republican Presidential electors were chosen, while 155 Democratic electors, chiefly in the Southern States, represented the final strength of the Bryan and Stevenson ticket. The Republican popular vote was about 7,208,000, and the Democratic about 6,358,000. Since the re-election of Mr Lincoln in 1864, and of General Grant in 1872, no American President had succeeded in securing a second consecutive term until Mr McKinley's re-election for the first quadrennial period of the 20th century.

In the term of Congress immediately following the Presidential election it was found possible to reduce materially the war taxes which had been levied on the outbreak of the Spanish-American war. Arrangements were perfected for the termination of the American military occupation of Cuba and the inauguration of a Cuban Republic as a virtual protectorate of the United States, the American Government having arranged with the Cuban Constitutional Convention for the retention of a series of naval stations on the Cuban coast. In the Philippines advanced steps had been taken in the substitution of civil government for military occupation, and a governor-general had been appointed and sent to Manila. Progress had been made towards the final solution of the preliminary problems affecting the construction of a ship canal across the isthmus connecting North and South America, a very important commission of engineers appointed by Mr McKinley having completed its investigations, while negotiations with Great Britain had resulted in a new convention setting aside the Clayton-Bulwer treaty and providing for a canal under American control. Prosperity at home was great, and foreign relations were free from complications. The problems which had devolved upon Mr McKinley's Administration had been far advanced towards final settlement. He retained without change the cabinet of his first Administration. After an arduous and anxious term, which had included the war with Spain, the war against the Philippine insurgents, and participation in the joint expedition to Peking, Mr McKinley had reached a period that promised to give him comparative repose and freedom from care. He had secured, through the co-operation of Congress, the permanent reorganization of the army and a very considerable development of the navy. The public revenues were superabundant, and the nation's outlook had never been so full of promise for peace and general progress. In these circumstances, in accordance with a long-anticipated plan, President McKinley, accompanied by the greater part of his cabinet, set forth in the early summer on a tour to visit the Pacific coast, where he was to witness the launching of the battleship *Ohio* at San Francisco. The route chosen was through the Southern States, where many stops were made, and where Mr McKinley delivered brief addresses. The heartiness of the welcome accorded him seemed to mark the disappearance of the last vestige of sectional feeling that had survived the Civil War, in which Mr McKinley had participated as a young man. After his return he spent the happiest and most restful month of his long period of official life in a visit at his old home in Canton, Ohio. At the end of this visit, by previous arrangement, he visited the city of Buffalo, New York, in order to attend the Pan-American Exposition and make a public address. This address, which was delivered on 5th September 1901, was a public utterance designed by Mr McKinley to affect American opinion and public policy. It declared that henceforth the progress of the nations must be through harmony and co-operation, in view of the fast-changing conditions of communication and trade, and it maintained that the time had come for wide-reaching modifications in the tariff policy of the United States, the method preferred by Mr McKinley being that of commercial reciprocity arrangements with various nations. On the following day, 6th September 1901, a public reception was held for President McKinley in one of the buildings of the Exposition, all sorts and conditions of men being welcome. Advantage of this opportunity was taken by a young man of Polish parentage, by name Leon Czolgosz, to shoot at the President with a revolver at close range. One of the two bullets fired penetrated the abdomen. After the world had been assured that the patient was doing well and would recover, he collapsed and died on the 14th. The assassin, who professed to hold the views of that branch of Anarchists who believe in the assassination of rulers and persons exercising political authority, was promptly seized, and was subsequently convicted and executed. Mr McKinley's conduct and utterances in his last days revealed a loftiness of personal character that everywhere elicited admiration and praise. Immediately after his death Vice-President Roosevelt took the oath of office, announcing that it would be his purpose to continue Mr McKinley's policy, while also retaining the cabinet and the principal officers of the Government. Mr McKinley's funeral took place at Canton, Ohio, on 19th September, the occasion being remarkable for the public manifestations of mourning, not only in the United States, but in Great Britain and other countries.

(A. SW.)

M'Kinney, a city in the north-east of Texas, U.S.A., capital of Collin county, at the intersection of the Houston and Texas Central, and the Sherman, Shreveport, and Southern railways. It is in a cotton-growing region, and is a compressing and shipping point for that staple. Population (1880), 1479; (1890), 2489; (1900), 4342—50 foreign-born and 917 negroes.

Macleod, Henry Dunning (1821–1902), Scottish political economist, was born in Edinburgh in 1821, and educated at Eton, Edinburgh University, and Trinity College, Cambridge, where he graduated in 1843. He travelled in Europe, and in 1849 was called to the English bar. He was employed in Scotland on the work of poor-law reform, and devoted himself to the study of economics. In 1856 he published his *Theory and Practice of Banking*, in 1858 *Elements of Political Economy*, and in 1859 a *Dictionary of Political Economy*. In 1873 appeared his *Principles of Economist Philosophy*, and other books on economics and banking were published later. Between 1868 and 1870 he was employed by the Government in digesting and codifying the law of bills of exchange. Macleod's principal contribution to the study of economics consists in his work on the theory of credit, to which he was the first to give due prominence. For a judicious discussion of the value of Macleod's writings, see an article on "The Revolt against Orthodox Economics" in the *Quarterly Review* for October 1901 (No. 388). He died on 16th July 1902.

MacMahon, Marie Edmé Patrice Maurice de, Duc de Magenta (1808–1893), French Marshal and President of the Republic, was born on 13th July 1808 at the château of Sully, near Autun. He was a descendant of an Irish family who went into exile with James II. Educated at the military school of St Cyr, in 1827 he entered the army, and soon saw active service in the French campaign in Algeria, where his ability and bravery became conspicuous. He was in the engagement at the Col de Terchia, and was subsequently sent on a difficult and dangerous mission to the general in command at Blida. This he successfully accomplished. Being recalled to France, he gained renewed distinction in the expedition to Antwerp in 1832. He became captain in 1833, and in that year returned to Algeria. He led daring cavalry charges across plains infested with Bedouin, and especially distinguished himself at the siege of Constantine in 1837. From then until 1855 he was almost constantly in Algeria, and rose to the rank of general of division. During the Crimean war MacMahon was given the command of a division, and in September 1855 he successfully conducted the assault upon the Malakoff redoubt which led to the fall of Sebastopol. After his return to France honours were showered upon him, and he was made a senator. Desiring a more active life, however, and declining the highest command in France, he was once more sent out, at his own request, to Algeria, where he completely defeated the Kabyles. After his return to France he voted as a senator against the unconstitutional law for general safety, which was brought forward in consequence of Orsini's abortive attempt on the emperor's life. MacMahon greatly distinguished himself in the Italian campaign of 1859. Partly by good luck and partly by his boldness and sagacity in pushing forward without orders at a critical moment at the battle of Magenta, he enabled the French to secure the victory. For his brilliant services MacMahon received his marshal's baton and was created duc de Magenta. In 1861 he represented France at the coronation of William I. of Prussia, and in 1864 he was nominated governor-general of Algeria. MacMahon's action in this capacity formed the least successful episode of his career. Although he did institute some reforms in the colonies, complaints were so numerous that twice in the early part of 1870 he sent in his resignation to the emperor. When the ill-fated Ollivier Cabinet was formed the emperor abandoned his Algerian schemes, and MacMahon was recalled.

War being declared between France and Prussia in July 1870, MacMahon was appointed to the command of the First Army Corps, his mission being to defend Alsace. On 6th August MacMahon was in chief command at Woerth, having under him a total of 50,000 men, and he occupied a strong position on the slopes of the Vosges. The Germans numbered about 120,000 men. The Marshal fought valiantly, and his courage in braving death again and again extracted the admiration even of his foes. But all was in vain, and the superior strength and strategy of the Germans triumphed. MacMahon was compelled to retreat upon Nancy, leaving in the enemy's hands 4000 prisoners, 36 cannon, and 2 standards. He fell back upon Saverne, and from thence proceeded in succession to Toul, Rheims, and Rethel. Though he suffered further losses in the course of his retreat, his movements were so ably conducted that the emperor confided to him the supreme command of the new levies which he was mustering at Châlons, and he was directed to effect a junction with Bazaine. This operation he undertook against his will. He had an army of 120,000 men with 324 guns; but large numbers of the troops were disorganized and almost entirely without discipline. On 25th August the Germans ascertained that MacMahon was endeavouring to effect a union with Bazaine at Metz, and altered their plans in order to circumvent him. When the Marshal reached Sedan with his dispirited troops, it was only to find that he was surrounded by the enemy, who by vigorous forward movements had captured the bridges over the Meuse and the commanding positions round the town. Early on 1st September the fierce and decisive battle of Sedan began. After some hours of sanguinary fighting MacMahon was dangerously wounded in the thigh, and resigned his command to General Wimpffen, who soon found he had no choice but to surrender. MacMahon shared the captivity of his comrades in Germany, and resided at Wiesbaden until the conclusion of peace.

In March 1871 the Marshal was appointed by Thiers commander-in-chief of the army of Versailles; and in that capacity he suppressed the Communist insurrection, and successfully conducted the second siege of Paris. In the following December the Marshal was invited to become a candidate for Paris in the elections to the National Assembly, but declined nomination. On the resignation of M. Thiers as President of the Republic, on 24th May 1873, MacMahon was elected to the vacant office by an almost unanimous vote, being supported by 390 members out of 392. The Marshal accepted the Presidency in a manly and dignified letter. The duc de Broglie was empowered to form a Conservative administration, but the President also took an early opportunity of showing that he intended to uphold the sovereignty of the National Assembly. On 5th November 1873 General Changarnier presented a motion in the Assembly to confirm MacMahon's powers for a period of ten years, and to provide for a commission of thirty to draw up a form of constitutional law. The Marshal consented, but in a message to the Assembly he declared in favour of a confirmation of his own powers for seven years, and expressed his determination to use all his influence in the maintenance of Conservative principles. After prolonged debates the Septennate was adopted on 19th November by 378 votes to 310. There was no *coup d'état* in favour of "Henri V.," as had been expected, and the President resolved to abide by "existing institutions." One of his earliest acts was to receive the finding of the court-martial upon his old comrade in arms, Marshal Bazaine, whose death sentence he commuted to one of twenty years' imprisonment in a fortress. Though MacMahon's life as President of the Republic was of the simplest possible character, his term of office was marked by many brilliant displays, while his wife was a leader in all works of charity and benevolence.

The President was very popular in the rural districts of France, through which he made a successful tour shortly after the declaration of the Septennate. But in Paris and other large cities his policy soon caused great dissatisfaction, the Republican party especially being alienated by press prosecutions and the attempted suppression of Republican ideas. Matters were at a comparative deadlock in the National Assembly, until the accession of some Orleanists to the Moderate Republican party in 1875 made it possible to pass various constitutional laws. In May 1877, however, the constitutional crisis became once more acute. A peremptory letter of censure from MacMahon to Jules Simon caused the latter to resign with his colleagues. The duc de Broglie formed a ministry, but Gambetta carried a resolution in the Chamber of Deputies in favour of parliamentary government. The President declined to yield, and being supported by the Senate, he dissolved the chamber, by decree, on 25th June. The prosecution of Gambetta followed for a speech at Lille, in which he had said "the Marshal must, if the elections be against him, *se soumettre ou se démettre*." In a manifesto respecting the elections, the President referred to his successful government, and observed, "I cannot obey the injunctions of the demagogy; I can neither become the instrument of Radicalism nor abandon the post in which the constitution has placed me." The confidence of the Marshal in the result of the elections was misplaced. Notwithstanding the great pressure put upon the constituencies by the Government the elections in October resulted in the return of 335 Republicans and only 198 anti-Republicans, the latter including 30 MacMahonists, 89 Bonapartists, 41 Legitimists, and 38 Orleanists. The President endeavoured to ignore the significance of the elections, and continued his reactionary policy. As a last resort he called to power an extra-parliamentary cabinet under General Rochebouet, but the Republican majority refused to vote Supplies, and after a brief interval the President was compelled to yield, and to accept a new Republican ministry under M. Dufaure. The prolonged crisis terminated on 14th December 1877, and no further constitutional difficulties arose in 1878. But as the senatorial elections, held early in 1879, gave the Republicans an effective working majority in the Upper

Chamber, they now called for the removal of the most conspicuous anti-Republicans among the generals and officials. The Marshal refused to supersede them, and declined to sanction the law brought in with this object. Perceiving further resistance to be useless, however, the Marshal resigned the Presidency on 30th January 1879, and M. Jules Grévy was elected as his successor.

Marshal MacMahon now retired into private life, having already passed his seventieth year. Relieved from the cares of state, his simple and unostentatious mode of existence enabled him to pass many years of dignified repose. He died at Paris on 17th October 1893, in his eighty-sixth year. A fine, tall, soldierly man, of a thoroughly Irish type, in private life the Marshal was universally esteemed as generous and honourable; as a soldier he was brave and able, without decided military genius; as a politician he was patriotic and well-intentioned, but devoid of any real capacity for statecraft.

(G. B. S.)

Macomb, a city of Illinois, U.S.A., capital of McDonough county, on the Chicago, Burlington, and Quincy railway, in the western part of the state. Population (1890), 4053; (1900), 5375.

Macon, a city of Georgia, U.S.A., capital of Bibb county, on the Ocmulgee river, at the head of navigation, in the central part of the state, at an altitude of 334 feet. It is the intersecting point of six railways, which make it, after Atlanta, the most important railway junction of the state. It is situated in the cotton belt, and has a large cotton trade. In 1900 its manufacturing establishments numbered 182, with a capital of $5,076,005, and products valued at $6,495,767. They employed an average number of 3700 wage-earners, who received $1,047,437 total wages. The principal article of manufacture (rapidly growing) was cotton goods, the product of which was valued at $1,237,125. Other products of importance are railway cars, lumber, and foundry and machine-shop products. Macon is the seat of a number of educational institutions, among which are Mercer University, which in 1899 had 15 instructors and 252 students, and Wesleyan Female College, with 20 instructors and 185 students. The assessed valuation of real and personal property in 1899 was $14,023,942, the net debt of the city was $752,193, and the rate of taxation was $26.50 per $1000. Population (1890), 22,746; (1900), 23,272, of whom 478 were foreign-born and 11,550—almost one-half of the total—were negroes.

Macquarie, a British island in the South Pacific, about 500 miles south-west of New Zealand, in 54° 30′ S. and 158° 50′ E. It is about 20 miles long, and covered with a grassy vegetation, with some trees or shrubs in the sheltered places which afford food to a parrot of the genus *Cyanorhamphus*, allied to those of the Auckland Islands. Although it has no settled population, Macquarie is constantly visited by sailors in quest of the seals which abound in its waters.

Madách, Imre (1829–1864), Hungarian dramatist, was born at Alsó-Sztregova in 1829. He took part in the great revolution of 1848–49, was imprisoned, and on his return to his small estate in the county of Nógrád, he found that his family life had meanwhile been completely wrecked. This only increased his natural tendency to melancholy, and he withdrew from public life till 1861, devoting his time mainly to the composition of his great work, *Az ember tragoediája* (*The Tragedy of Man*). John Arany, then at the height of his fame as a poet, at once recognized the great merits of that peculiar drama, and Madách enjoyed a short spell of fame before his untimely death of heart disease in 1864. In *The Tragedy of Man* Madách takes us from the hour when Adam and Eve were innocently walking in the Garden of Eden, to the times of the Pharaohs; then to the Athens of Miltiades; to sinking Rome; to the period of the Crusaders; into the study of the astronomer Kepler; thence into the horrors of the French Revolution; into greed-eaten and commerce-ridden modern London; nay, into the ultra-Socialist state of the future, when all the former ideals of man will by scientific formulæ be shown up in their hollowness; still further, the poet shows the future of ice-clad earth, when man will be reduced to a degraded brute dragging on the misery of his existence in a cave. In all these scenes, or rather anticipatory dreams, Adam, Eve, and the arch-fiend Lucifer are the chief and constantly recurring *personæ dramatis*. So, in the end, Adam, despairing of his race, wants to commit suicide, when in the critical moment Eve tells him that she is going to be a mother by him. Adam then prostrates himself before God, who encourages him to hope and trust. The diction of the drama is elevated and pure, and although not meant for the stage, it has proved very effective at several public performances. Concerning Madách there is an ample literature, consisting mostly of elaborate articles by Charles Szász (1862), Augustus Greguss (1872), B. Alexander (1871), M. Palágyi (1890), and others.

(E. RE*.)

Madagascar, an important island in the Indian Ocean, and the third largest island in the world, about 300 miles from the south-east coast of Africa. It is 985 miles in length from north to south, and about 250 miles in average breadth, although near the centre it is nearly 350 miles across; its area is about 230,000 square miles. In 1902 the governor, General Gallieni, proposed to remove the capital from Antanànarìvo in the interior to Tamatave on the east coast. Since the French conquest of Madagascar in 1895 great advances have been made in the triangulation, surveying, and mapping of the interior; and although detailed surveys have still to be made of the greater portion, the country has been traversed in many directions by French military officers and other travellers; and the provinces of Imèrina and Bétsiléo, as well as several of the chief river valleys, have been mapped very minutely. The south-western corner of the island is now the only large portion still unexplored.

Geology.

The geology is far from being completely known, but much has been done towards the examination of the rocks of the interior northern provinces, as well as of those of the coast plains of the northern half. A considerable collection of fossils has been made, and a large number of rock sections prepared for polariscopic investigation. From the information thus obtained it may be affirmed that "by far the greater part of the north-eastern half of Madagascar consists of gneiss and other crystalline rocks, although gneiss very largely predominates. Granite occurs frequently in the form of bosses, and in some places apparently intercalated with the crystalline schists. Diorite is also frequently met with, but gneiss is certainly the prevailing rock." "The region occupied by these crystalline (chiefly metamorphic) rocks has a length of about 730 miles, and an average breadth of probably not less than 150," with a total area of 100,000 or possibly 130,000 square miles. "Among the accessory minerals existing in the gneiss are magnetite, iron-pyrites, clay slate, hornblende, actinolite, mica-, chlorite-, and cyanite-schists, crystalline limestone, quartzite, graphite, and many varieties of quartz. Granite forms some of the most remarkable of the mountains and hill ranges of the interior."[1] Vast portions of the country are covered by red soil, which resembles and is often described as clay, but is really decomposed rock, chiefly gneiss, reddened with oxidized magnetite. The lower portions of Madagascar, chiefly situated in the west and south, which do not apparently much exceed 600 feet in height above the sea-level, consist of sedimentary rocks, the fossils of which show that they belong to the Jurassic, Cretaceous, and Eocene systems. In the north-west of the island sandstone covers a vast extent of country, beds of clay and shale are common, and there are extensive deposits of limestone. Lignite has been discovered in the same part of the island, but hitherto no true coal has been found. As regards metals, gold has been worked in many parts of the central and north-western regions, but not in large quantities in any one place. Lead is obtained from galena, and nickel and copper are also found in certain localities. Iron is found in abundance as magnetite, also as hæmatite and ironstone. Sulphur, saltpetre, bitumen, and lime are also procured, the last-named from the travertine springs of Antsirabè; while corundum, sapphires, spinel, rutile, and tourmaline are among the more precious products. In addition to the Secondary and Tertiary strata already mentioned, there are also beds of a much more modern date (Quaternary), containing fossils of recently extinct birds, mammals, and reptiles (see section on Palæontology).

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[1] The above extracts are from a paper by the Rev. R. Baron, F.G.S., in *Quart. Jour. Geol. Soc.*, May 1889; to him we owe most of our knowledge of the geology as well as of the botany of Madagascar.

Observations have shown that the yearly rainfall of the interior averages about 53 inches, while that of the east coast is about 95 inches. On the north-west coast the rainfall is slightly in excess of that of the interior.

Flora.

About 4100 flowering plants, of which a large proportion (about three-fourths) is endemic, are now known to botanists. The forest belt which extends round the island is densest on the eastern side, where it averages 30 miles in width, but on the north-east it attains a breadth of 50 to 60 miles; it is from 1500 to 1600 miles long. On the western side the woods are thinner and more scattered. It is estimated that there are probably 35,000 square miles of forest-covered country in Madagascar, or about one-seventh of its whole surface. The hard-wooded and valuable timber trees contained in these forests include various species of *Weinmannia* (*Lalòna*),[1] *Elæocarpus* (*Voànana*), *Dalbergia* (*Vòambòana*), *Nuxia* (*Vàlanìrana*), *Podocarpus*, a pine, the sole species in the island (*Hètatra*), *Tambourissa* (*Ambòra*), *Neobaronia* (*Hàrahàra*), *Ocotéa* (*Varòngy*), and probably ebony, species of *Diospyros*, &c. Then, besides those species described in the ninth edition of this work on account of their peculiar characteristics, the tall fir-like *Casuarina equisetifolia*, or beef-wood tree, is very prominent on the eastern coast, as well as several species of screw-pine (*Pandanus*). On the western coast dense thickets of mangrove line the shores of all creeks and rivers, and on all the coast lagoons and lower reaches of the rivers the *Viha* (*Typhonodorum lindleyanum*), a gigantic arum endemic to Madagascar, grows in great profusion to a height of 14 or 15 feet, and has a large white spathe of more than a foot in length. About 70 additional species of ferns have been discovered, making the total number as yet collected some 320. Two of the several beautiful orchids found strike the attention of every traveller on the east coast during the months of June and July by their abundance. One of these, *Angræcum superbum*, has a number of spikes of pure white flowers; the other, *A sesquipedale*, has larger but fewer flowers and has a remarkably long spur. The Rev. R. Baron, F.L.S., divides the flora into three distinctly-marked "regions." These run in a longitudinal direction, following approximately the longer axis of the island, and are termed respectively eastern, central, and western. Of these, the central includes the elevated plateaux of the interior, while the eastern and western occupy the two sides of the island, including the forest belts and most of the wooded country. The divisions between the eastern and western regions in the extreme north and south are almost arbitrary, and cannot be defined with much accuracy. The flora of the extreme south-west is least known, but appears to be marked by numerous spiny plants adapted to its very dry climate. Of the 4100 known plants composing the Madagascar flora, there are Dicotyledons, 3492; Monocotyledons, 248; Acotyledons, 360. Of these, the orders most largely represented (together with their species) are Leguminosæ, 346; Filices, 318; Compositæ, 281; Euphorbiaceæ, 228; Orchideæ, 170; Cyperaceæ, 160; Rubiaceæ, 147; Acanthaceæ, 131; Gramineæ, 130. The number of endemic genera now known is 148. Of the 3178 species of plants whose localities have been determined, 35 per cent. are peculiar to the eastern region, 27·5 per cent. to the central, and 22 per cent. to the western. One natural order, *Chlænaceæ*, is strictly confined to Madagascar.

Fauna.—Thirty-nine species of *Lemuroida* are now known to exist in the island, while more than 260 species of birds have been classified. Madagascar may also be considered one of the head-quarters of the *Chamelionidæ*, for of the 50 known species no fewer than 25, or half of them, have already been described from the island. Many of these are of curious form, with remarkable developments of the plates of the head and projecting horns and spines.

Palæontology.

Closely connected in interest with the animal life at present found in Madagascar is that of the extinct fauna. Researches in various parts of the island have revealed the existence in quite recent deposits, in a sub-fossil state, of the bones of numerous birds of the family *Struthidæ*. These have been arranged in twelve species, belonging to two genera, *Æpyornis* and *Mullerornis*, and vary in size from that of a bustard to that of birds much exceeding an ostrich, and rivalling the recently extinct Moa of New Zealand, one or two species being about 10 feet high. One species of these great wingless birds laid an egg which is the largest known, being 12½ inches by 9½ inches. Associated with these remains are found those of a large rail and a wild-goose, but much larger than any now inhabiting Madagascar. In the same beds the remains of probably three extinct species of hippopotamus have been found, about two-thirds the size of the living African species; also the bones and carapace, &c., of gigantic tortoises, the bones of a species of swine, as well as of a river-hog, and also of a slender-legged form of zebu-ox. Near the south-west coast the skull of a large extinct lemuroid animal has been discovered by Mr J. T. Last, much longer in shape than that of any living lemur, the animal being probably three times the size of any known lemuroid. Most, if not all, of the above-mentioned birds and animals were probably contemporaneous with the earliest human inhabitants of Madagascar. The remains of an animal which appears to form a link between the apes and the lemurs have been discovered; and in 1899 the bones of another gigantic lemuroid, much larger than that just mentioned, were found by M. A. Grandidier.[2] In the deposits of a much more remote era than those already spoken of—the Jurassic—the bones of some enormous terrestrial lizards have been found by Mr Last, belonging to two if not three species; these are described as belonging to a Sauropodous Dinosaur of the genus *Bothriospondylus*. And in the beds of the Lower Oolite the Rev. R. Baron had previously discovered fragments of the skull of a reptile resembling the gavial of the Ganges; from these a new genus has been founded by Mr R. B. Newton, which he calls *Steneosaurus*. The mammals, birds, and reptiles here described—twenty-six or twenty-seven in number—comprise all that is at present known of the ancient vertebrate fauna of Madagascar. A complete list of all the fossils of the island then known is given by Mr Newton in *Quar. Jour. Geol. Soc.*, February 1895. These, omitting the vertebrates already described, number 140, and belong to the Mollusca, Foraminifera, Echinodermata, Actinozoa, and Plantæ.

Franco-Malagasy war of 1883-85.

History.—The year 1882 was important as marking the beginning of a great change in the history of the island. Towards the middle of the year the relations between the native government and that of France became much strained, and many complaints were made by the latter against the Malagasy, together with demands for compensation. In order to settle, if possible, these causes of dispute, two Hova officers of high rank were sent to France as ambassadors, but as they were not authorized to concede any territory, their visit accomplished very little. They subsequently concluded treaties with Great Britain, Germany, and America, giving improved facilities for trade with Madagascar, but before their return matters had come to a crisis in the island. In May 1883 an ultimatum was sent to the Malagasy queen, requiring immediate compliance with the demands of France; and as these were refused by the Hova Government, the town and defences of Tamatave were bombarded by a French squadron and were then occupied by the marines, the Malagasy soldiers retiring. Several of the other ports were bombarded from time to time, and the war continued in a desultory fashion for many months; but no serious attempt was made to invade the interior; and at length, in 1885, terms of peace were agreed to. By a treaty signed on 12th December it was agreed that the foreign relations of Madagascar should be directed by France; that a Resident should live at the capital, with a small guard of French soldiers; and that the Bay of Diego Suarez, together with surrounding territory, should be ceded to France. These were the most important provisions, but the word "protectorate" was carefully excluded from the wording of the treaty, although doubtless the French envoys intended that this should be its practical issue. It was at the same time agreed that there should be no foreign interference with the internal government of the country, and that the queen should retain her former position, with all its honours and dignity.

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[1] The words in parentheses are the native Malagasy names.

[2] "Nombreux ossements de lémuriens disparus, dont la taille était énorme, plus grande que celle d'un homme."—*La Géographie*, January 1900, p. 80.

French protectorate, 1885-94.

French invasion and conquest, 1895.

For about nine years this treaty continued in force: several French Residents successively represented France at Antanànarìvo; but these found themselves quite unable to obtain that influence in the country which the home authorities thought they had a right to demand. The Malagasy prime minister was not disposed to give any advantage to France beyond what he could help, and at the same time he continued to arm and train, by the help of British officers, a large body of native soldiers. It was inevitable that this state of tension and irritation could not last, and at length, towards the close of 1894, the French Government sent an ultimatum to the Malagasy sovereign, with the following demands: (1) The Malagasy Government to have no dealings with other Powers except through the Resident-General. (2) All concessions to be void unless approved and registered by the Resident-General. (3) The French Government to have power to place soldiers in Madagascar as it may consider necessary. (4) The French Government to have power to carry out works of public utility. (5) French text of treaties alone to be authoritative. These demands were refused by the native Government, and other conditions were offered; but the French envoy, together with the Resident's escort, left the capital, as also did the French traders and others, including the large Jesuit mission. As soon as all these had left the island, the chief ports were occupied by French troops, and an expeditionary force under General Duchesne was afterwards landed on the north-west coast at Mojangà, with the object of advancing into the interior and breaking the Hova authority. Owing to the necessity of making a road for the passage of artillery and military stores, many months were spent on the way in the early part of 1895, and there was considerable loss of life by fever and other disease among the invading troops. But no effectual resistance was made by the Malagasy, and at length, on the 30th September, the French forces appeared on the heights to the north and east of Antanànarìvo, bombarded the city, which surrendered in the afternoon, and on the evening of the same day the French entered the capital.

Rebellion of 1896, and gradual subjection of the Malagasy.

The result of this event was that the protectorate of France was re-established in the central provinces, but the queen was still allowed to retain her position. In the early part of the following year (1896), however, a serious rebellion broke out in several parts of Imèrina, and soon gained ground. This movement was not only anti-French and anti-foreign, but also distinctly anti-Christian. The French troops gradually broke up the power of the rebellion in the central provinces, but as there appeared to be considerable unrest in many other parts of the island, General Gallieni, an officer with a reputation for vigour and ability in the Sudan and Tongking campaigns, was sent out to relieve the then Resident-General.

Administration of General Gallieni.

General Gallieni had a difficult task before him in establishing the authority of France throughout the island among numbers of tribes who had never submitted to any control from others. Among the first steps he took were to put the country under martial law, to abolish royalty and all semblance of Hova government, and to declare Madagascar to be henceforth a colony of France. Queen Ranavàlona III. was exiled to Réunion, and subsequently to Algeria. Meanwhile carriage roads were commenced to connect all the chief centres, and the military posts were gradually extended farther and farther from the central provinces, so as effectually to put down all opposition and to consolidate French rule over all the outlying tribes. French Residents and numerous other officials were placed at every important town, and various projects were started for the civilization of the Malagasy in accordance with French ideas. The area of the disturbed and unsettled parts of the country was lessened month by month, until, at the close of 1899, General Gallieni was able to report that only portions of the west and south-west remained to be brought into submission. In January 1899 three-fourths of the island was still under military administration. According to the French budget of 1900, the troops in Madagascar amounted to 11,305, of whom 7500 were natives. Diego Suarez, at the northern extremity of Madagascar, held as a French colony from 1885, was in 1896 placed under the authority of the Governor-General.

General condition of the country; statistics.

In the absence of any census, or registration of births, deaths, and marriages, it is impossible to give accurate statistics as to the movement of population; and trustworthy figures of commerce, &c., are likewise very difficult to obtain. It is believed that the population of the whole of Madagascar does not exceed 3,000,000, of whom probably nearly one-third inhabit Imèrina. Antanànarìvo contains 60,000 people, but the number is very variable. Notwithstanding repeated proclamations assuring the people that perfect religious liberty was guaranteed by France, the Jesuit missions have made strenuous efforts to break up the numerous Protestant village churches. The French Protestant churches, too, began to take part in 1896 in the missionary work carried on in the new colony, and nearly half the area for long occupied by the London Missionary Society has been transferred to the Paris Society. The bulk of the Malagasy converts are still Protestants, *i.e.*, some three-fourths, probably, of the 150,000 people confessing Christianity. Since 1897 high schools, medical and technical schools, and a few primary schools have been formed by the Government, but the bulk of the educational work is still carried on by the various missionary societies. The Jesuit mission is making strenuous efforts to control education, but the Protestant missions are not less strenuous in maintaining and adding to their primary and high schools and colleges. No statistics can be given as to education, but it is probable that 100,000 children are now being instructed. Information about the people, their language, and their civilization has become fuller, but nothing has been discovered materially to modify the conclusions formerly arrived at. With regard to "ranks of society," slavery was abolished by the French in 1896, and by this act the third great class of the *andèvo* or slaves has become merged in the second, that of the Hova or commoners. The division between the Andriana or nobles and the Hova remains unaltered, notwithstanding that royalty has been abolished. In the other tribes chieftainship is still retained in the administration of the country under the surveillance of French officials. The local budget for 1897 was 4,269,000 francs (about £178,000), which practically covered the expenditure apart from the cost of civil and military administration, for which a sum of 15,170,000 fr. (about £632,000) was voted by the French Chambers; in 1898 these sums were respectively 9,437,000 fr. (£393,000) and 20,185,000 fr. (£841,000). In 1899 the estimated revenue was 11,136,000 fr. (£445,440), including 1,800,000 fr. (£72,000) subvention from France. The cost of Madagascar to France for 1900 was estimated at over 25,000,000 fr. (£1,000,000). The converted debt of Madagascar stood at 20,000,000 fr. (£800,000) at 2½ per cent. in 1900. 1898 many parts of Imèrina suffered severely from famine, which was largely due to the depopulation of large portions of the country by the rebellion of 1896, and the destruction by the rebels of the stores of rice. Agriculture is being encouraged by the formation of *jardins d'essai* near every village; but, on the whole, the agriculture of the Malagasy has been only slightly influenced by political changes, the chief difference being the more extended cultivation of European vegetables and fruits. Their handicrafts have, however, been less exercised, partly through the demands made on the people for Government service (*corvée*), and partly through the greater employment of foreign textile fabrics. The use of sun-dried and of burnt bricks and tiles for all kinds of building has greatly extended, and has much altered the appearance of every town and village in the central provinces. As in all French colonies, very heavy duties are levied upon all imports and exports coming from and going to other countries than France, and this has naturally greatly diminished British as well as American trade with the island, while increasing French imports and exports. The total imports in 1888 were valued at £162,000; in 1898 at £865,640. The United Kingdom's share in the total for 1888 was estimated at £101,000; in that for 1897 at £179,000; for 1898 at £42,000—a great drop. Further, the sum for 1897 included £146,000 for cotton piece goods, an amount which, in consequence of the heavy duties imposed, dwindled to £35,000 in 1898. On the other hand, the figures for the import of cotton piece goods from France were £19,000 in 1897, but £220,000 in 1898. Imports from the United States were valued at £99,000 in 1896, when those from the United Kingdom totalled £270,000. The total exports in 1888 were valued at £174,000; in 1898 the total was £198,400. Exports to the United Kingdom rose from £43,000 in 1888 to £139,000 in 1895, only to fall again to £62,000 in 1896 and £32,920 in 1898. Exports to France rose from £17,000 in 1895 to £74,680 in 1898. The chief exports are cattle, caoutchouc, and hides. In 1898, 6061 vessels of 879,362 tons entered and cleared the ports, the bulk being French. The carriage roads from the east and north-west to connect the interior with the chief ports are making steady progress, and arrangements are also being made for the construction of railways and canals. There is interior telegraphic communication between Antanànarìvo and Tamatave and Mojangà, which is now being extended to the Bétsiléo province. French coin is now the only legal currency, and French weights and measures alone are legal.

Authorities.—A very large number of books, pamphlets, and magazine articles have been published upon Madagascar since 1882. **General**: A. Grandidier. *Histoire naturelle, physique, et politique de Madagascar.* Paris, 1882–99 (many volumes and portions, both of text and plates; still in progress).—Sibree and Baron (eds.). *Antanànarìvo Annual.* Antanànarìvo, 1882–1900. —*Notes, Reconnaissances, et Explorations*, revue mensuelle. Tananarive, 1897 *et seq.*—Sibree. *A Madagascar Bibliography.* Antanànarìvo, 1885.—Vaissière. *Histoire de Madagascar.* Paris, 1884; *Vingt ans à Madagascar.* Paris, 1885.—Oliver. *Madagascar: an Historical and Descriptive Account.* London, 1886; *Drury's Madagascar* (new ed.). London, 1890.—Cousins. *Madagascar of To-day.* London, 1895.—*Bulletin de la Comité de Madagascar* (monthly). Paris, 1895 *et seq.*—Sibree. *Madagascar before the Conquest.* London, 1896.—Catat. *Voyage à Madagascar.* Paris, 1895; *Annuaire de Madagascar.* Tananarive, 1898 *et seq.*—Baron. *Ten Years' Review of Mission Work in Madagascar.* Antanànarìvo, 1891.—Gallieni. *Rapport d'ensemble sur la situation générale de Madagascar.* 2 vols. Paris, 1899.—*Revue de Madagascar*, mensuelle, illustré, 1895 *et seq.* **Political**: Oliver. *True Story of the French Dispute in Madagascar.* London, 1885.—Shaw. *Madagascar and France.* London, 1885.—Saillens. *Nos Droits sur Madagascar.* Paris, 1885.—Corlay. *Notre Campagne à Madagascar.* Paris, 1896.—Knight. *Madagascar in War-time.* London, 1886.—Burleigh. *Two Campaigns: Ashantee and Madagascar.* London, 1896.—Carol. *Chez les Hovas.* Paris, 1898. **Ethnology**: Ferrand. *Les Mussulmans à Madagascar et aux Iles Comores.* Paris, 1891.—Berthier. "Rapport ethnographique sur les Races de Madagascar," *Notes, Reconnaissances, et Explorations*, Sept. 1898.—Jully. "L'Habitation à Madagascar," *op. cit.* Juil. 1898. **Philology**: Richardson. *Malagasy for Beginners.* Antanànarìvo, 1883; *A New Malagasy—English Dictionary.* Antanànarìvo, 1885.—Cousins and Parrett. *Malagasy Proverbs.* Antanànarìvo, 1885.—Causseque. *Grammaire Malgache.* Antanànarìvo, 1886.—Abinal et Malzac. *Dictionnaire Malgache-Français.* Tananarive, 1889.—Brandstetter. "Die Beziehungen des Malagasy zum Malaiischen"; *Malaio-polynesische Forschungen*, pt. 2. Lucerne, 1893.—Dahle. "Studies in the Malagasy Language," *Antan. Annual*, 1884, 1887. **Botany, Geology,** and **Zoology**: Baron. "The Flora of Madagascar," *Linn. Soc. Journ. Bot.* vol. xxv. 1889; "Notes on the Geology of Madagascar," *Quar. Journ. Geol. Soc.* May 1889.—Cortese. "Osservazioni geognostiche sul Madagascar," *Bol. R. Comit. Geol. Italia*, vol. xviii. 1887; "Appunti geologici sull' Isola di Madagascar," *op. cit.* vol. xix. 1888.—Gautier. "Mission Émile Gautier à Madagascar," *Ann. de Géog.* No. 7, 1893; "Madagascar occidentale," *op. cit.* Nov. 1895.—Baron. "Geological Notes of a Journey in Madagascar," *Quar. Journn. Geol. Soc.* Feb. 1895.—Buller Newton. "On a Collection of Fossils from Madagascar," *op. cit.* Feb. 1895.—Sibree. "Madagascar Ornithology," *Antan. Annual*, 1889, 1890, 1891, 1892; and *Ibis*, April, July, Oct. 1891, Jan. April 1892; "The Mammals of Madagascar," *op. cit.* (*A.A.*) 1893, 1895, 1896, 1897. (J. Si*.)

French Wars in Madagascar.—In 1882 the French claimed a protectorate over the north-west coast of Madagascar, based on alleged treaties with chiefs of the Sakalava tribes which inhabit that part of the island. Queen Ranavàlona II. denied the validity of the claim, and, after fruitless endeavours by the British Government to effect a peaceable settlement, hostilities commenced in 1883. Rear-Admiral Pierre bombarded several coast towns and occupied Mojangà, in the north-west, a port which is the key to the province of Imèrina, and Tamatave, the chief town on the east coast. Ranavàlona II. died on 13th July 1883, and was succeeded by her niece, Ranavàlona III. Reinforcements having arrived from France and Réunion, Rear-Admiral Galiber, who had succeeded to the command, after unsuccessful negotiations with the Hova Government, destroyed a number of towns on the eastern seaboard and blockaded others, but was too weak to attempt any inland expedition. An Englishman named Willoughby, who had raised and commanded some irregular horse in the Zulu war, was made first adjutant-general and, later, commander-in-chief of the Malagasy army, which he reorganized. With 10,000 men he occupied a very strong entrenched position at Manjakandrianombana, about five miles from Tamatave. In the meantime, in April 1884, Rear-Admiral Galiber was succeeded by Rear-Admiral Miot, who blockaded the ports, but was defeated in June in an attack in force on Manjakandrianombana. Towards the end of the year Admiral Miot occupied Diego Suarez and adjacent ports after some fighting, and a sharp and successful action at Andraparany on the 5th December placed the whole of the north-east of the island in his hands. His troops, however, suffered so severely from malarial fever that the reinforcements which he received from France, Réunion, and Tongking were only sufficient to make good the "waste." In 1885 Willoughby formed a camp of exercise covering Antanànarìvo, the capital, and an unsuccessful attempt was made to recapture Mojangà from the French. On 26th August a sharp action was fought at Ambodimadiron, near Passandava Bay, which was claimed as a victory by both sides; Marovoay was bombarded, and on the 10th September an unsuccessful attack was made by the French on the Hova position at Farafette, Admiral Miot personally leading a column. In November negotiations were commenced, which resulted in a treaty of peace, by which Madagascar became politically a French protectorate. The treaty was ratified by the Senate in March 1886, but was not recognized by the British Government until August 1890. In 1893 conflicts between the Hovas and the French led to a partial blockade of the ports by the French in 1894 and, at the end of that year, to an open rupture, followed by the occupation of Tamatave and, in January 1895, by the bombardment and occupation of Mojangà. The French Government then organized an expedition under General of Division Duchesne, consisting of two brigades commanded by Generals of Brigade Metzinger and Voyron, in all some 8400 men. Duchesne arrived at Mojangà in May, and found that Metzinger had already captured Marovoay and Midiani by storm, and that Ambohimarinà had been occupied after severe fighting. Early in June Duchesne crossed the Betsiboka and captured Mevatanana, but experienced such great difficulties from insufficient transport and heavy mortality from sickness amongst his troops that it was not until the 12th August that he arrived near Andriba, which he captured on the 22nd. Here he formed an advanced base and organized a flying column to march on Antanànarìvo. In command of this column he defeated the Hovas with great loss at Tsinainondry, and after a sharp action captured Antanànarìvo, the capital, on the 30th September, when he dictated terms of peace. The campaign, although successful in attaining its object, was a problem in transport and hygiene which cannot be said to have been satisfactorily solved. The so-called "pacification" of Madagascar was very thoroughly carried out after September 1896 by General Gallieni. (R. H. V.)

Madava Rao, Sir Raja T. (1828–1891), native Indian statesman, was born at Combaconum in Madras in 1828. Madava Rao created a new type of minister adapted to the modern requirements of a progressive native state, and he grafted it upon the old stock. He linked the past with the present, using the advantages of heredity, tradition, and conservatism to effect reforms in the public administration and in Indian society. He attained the position of Diwan of Travancore in 1857, and died on the 4th April 1891. Sprung from a Maratha Brahman stock, the son of a Diwan of Travancore, he was educated in the strictest tenets of his sacred caste. But he readily imbibed the new spirit of the age. To mathematics, science, and astronomy he added a study of English philosophy and international law, and a taste for art and pictures. Although a devout student of the Shastras, he advocated female education and social reform. Refusing to cross the sea and so break caste by appearing before a Parliamentary commission, he yet preached religious toleration. A patron of the Indian Congress, he borrowed from the armoury of British administration every reform which he introduced into the native states. He was respected alike by Europeans and natives, and received titles and honours from the British Government. As tutor of the Maharaja of Travancore, and then as revenue officer in that state, he showed firmness and ability, and became prime minister in 1857. He found the finances disorganized, and trade cramped by monopolies and oppressive duties. He co-operated with the Madras Government in carrying out reforms, and, when his measures led to misunderstandings with the Maharaja, he preferred honourable resignation to retention of a lucrative office in which he was powerless for good. In 1872 he was engaged at Indore in laying down a plan of reform and of public works which he bequeathed to his successor, when a grave crisis at Baroda demanded his talents there. The Gaekwar had been deposed for scandalous misrule, and an entire reorganization was needed. Aided by Sir Philip Melvill, Madava Rao swept away the corrupt officials, privileged sardars, and grasping contractors who had long ruined Baroda. He wrote able minutes defending the rights and privileges of the Gaekwar from fancied encroachment, and justifying the internal reforms which he introduced. He resigned office in 1882, and in his retirement devoted his leisure to reading and writing upon political and social questions. (W. L.-W.)

Madeira, a group of islands in the Atlantic, belonging to Portugal, situated about 500 miles south-west from Lisbon, 3½ days' steaming from Southampton, and 5 days from Liverpool. The capital is Funchal, the seat of a bishop (a suffragan of Lisbon), with 37,011 inhabitants (1900). The district of FUNCHAL, which embraces the entire archipelago, *i.e.*, the islands of Madeira, Porto Santo, the Desertas (Chão, Deserta, Grande, and Bugio), and the two Selvagens, has an area of 315 square miles, and population (1890), 134,040 and (1900) 150,528. There is a medical school at Funchal; also a lyceum. The principal products are wine, sugar, corn, vegetables, potatoes, chestnuts, yams, oranges, honey, walnuts, lemons, wax, olive oil, spirits, bananas, apples, and mangoes. The area planted with vines in 1892 was 24,620 acres, which yielded 867,250 gallons of wine (a fairly average year), valued at £34,000; but since then more land has been replanted with vines. In 1899 the wine exported was valued at £173,333. Sugar, spirits, soap, straw hats, ale, leather, embroidery, baskets, wooden wares, butter, linen, and woollens are manufactured. In 1898 there were 1336 persons engaged in fishing; they used 496 boats, and caught fish to the value of £8100. The total trade increased in value from £428,000 in 1893 to £628,000 in 1900, wine being the principal export, with embroidery, vegetables, fruits, and wicker goods. Between 1860 and 1900 the export of wine increased from 104,880 gallons to 587,880 gallons, the value in the latter year being £137,800. In the year 1899 a total of 1635 vessels of 4,692,264 tons entered and cleared the island ports. There are some 580 miles of roads in Madeira. The chief island is coming more into repute as a winter station.

Madeira River. See AMAZON.

Madhu Sudan Datta (or MICHAEL MADHU SUDAN DATTA, as he was called after he had embraced the Christian religion) (1824–1873), the greatest poet of India in the 19th century, was born at Sagandari, in the district of Jessor in Bengal, in 1824. His father was a pleader in Calcutta, and young Madhu Sudan received his education in the Hindu College of Calcutta, and was the foremost among the distinguished young students of his day, many of whom lived to make their mark in the literature and social progress of their country. Madhu Sudan left the college in 1842, and in the following year ran away from his father to avoid a marriage to which his father wished to force him, and embraced the Christian religion. Continuing his study now in the Bishop's College, Madhu Sudan learnt Greek and Latin and some modern European languages, and in 1848 went to Madras. There he wrote English verses, and married the daughter of a European indigo-planter, but was soon separated from her. He then united himself with an English lady, the daughter of an educational officer; and she remained true to him through life amidst all his misfortunes, and was the mother of the children he left. Madhu Sudan returned to Calcutta with his English wife in 1856, and soon discovered that the true way for winning literary fame and distinction was by writing in his own language, not by composing verses in English. His three classical dramas—*Sarmishtha*, *Padmavati*, and *Krishna Kumari*—appeared between 1858 and 1861, and were recognized as works of merit. But his great ambition was to introduce blank verse into Bengali. His knowledge of Sanskrit poetry, his appreciation of the Greek and Latin epics, and his admiration of Dante and of Milton, impelled him to break through the fetters of the Bengali rhyme, and to attempt a spirited and elevated style in blank verse. His first poem in blank verse, the *Tilottama*, was only a partial success; but his great epic which followed in 1861, the *Meghanad-Badha*, took the Indian world by surprise, and at once established his reputation as the greatest poet of his age and country. He took his story from the old Sanskrit epic, the *Ramayana*, but the beauty of the poem is all his own, and he imparted to it the pathos and sweetness of Eastern ideas and the vigour and loftiness of Western thought. In 1862 Madhu Sudan left for Europe. He lived in England for some years, and was called to the bar; and in 1867 returned to his country to practise as a barrister in Calcutta. But the poet was unfitted for a lawyer's vocation; his liabilities increased, his health failed, his powers declined. He still wrote much, but he wrote nothing that will be remembered. His brilliant but erratic life ended in a Calcutta hospital on 29th June 1873. Among Madhu Sudan's most intimate friends may be mentioned the great reformer Iswar Chandra Vidyasagar, who often helped him in his difficulties, and the poet Hem Chandra Banerjea, who wrote an appreciative critique on his great epic. Among the young Indians who were studying in England in the 'sixties with Madhu Sudan, a few rose to distinction subsequently. One of them, Satyendra Nath Tagore, was the first Indian who entered the Civil Service of India; and two others, Mano Mohan Ghosh and Umesh Chandra Bonnerjee, were called to the bar, rose to a considerable practice in Calcutta, and were honoured leaders among their countrymen. (R. C. D.)

Madison, a city of Indiana, U.S.A., capital of Jefferson county, on the Ohio river and the Pittsburg, Cincinnati, Chicago, and St Louis railway, in the south-eastern part of the state, at an altitude of 450 feet. It has much commerce by rail and river, and varied manufactures. Population (1890), 8936; (1900), 7835.

Madison, a city of Wisconsin, U.S.A., capital of the state and of Dane county, on the peninsula between Lakes Monona and Mendota, in the southern part of the state, at an altitude of 870 feet. It is regularly laid out on an undulating site, and is divided into eight wards. It is on three railways—the Chicago and North-Western, the Chicago, Milwaukee, and St Paul, and the Illinois Central. It is the seat of Wisconsin state university, which in 1900 had 137 instructors and 1841 students. Population (1890), 13,426; (1900), 19,164, of whom 3362 were foreign-born and 69 were negroes.

Madras Presidency, a province of British India, under the administration of a governor. It occupies the entire south of the peninsula. Politically, it includes the Laccadive Islands, off the Malabar coast, in the Indian Ocean. Total area (including native states), 150,798 square miles; population (1891), 39,331,062; (1901), 42,398,931, showing an increase of 7·7 per cent. The capital is Madras city, from which the province takes its name. The "agency" tracts in the hilly interior of the northern Circars are administered on a special system, and for revenue purposes a considerable difference still prevails between the *zamindari* estates scattered throughout the presidency and the ordinary *rayatwari* lands.

The following table gives the area and population of the several districts and native states of Madras in 1891 and 1901:—

Area and Population of Madras Presidency, 1891 and 1901.

	Area in Square Miles.	Population, 1891.	Population, 1901.			Density of Population to Square Mile, 1901.
			Males.	Females.	Total.	
BRITISH DISTRICTS—						
Ganjam	8,370	1,896,803	964,282	1,047,206	2,011,488	240
Vizagapatam	17,242	2,802,992	1,451,660	1,481,877	2,933,537	170
Godavari	7,857	2,078,782	1,134,107	1,169,388	2,303,495	293
Kistna	8,397	1,855,582	1,091,218	1,063,981	2,155,199	257
Nellore	8,765	1,463,736	753,612	744,184	1,497,796	170
Karnul	7,514	817,811	441,186	431,237	872,423	116
Bellary	5,975	900,126	481,422	465,907	947,329	159
Cuddapah	8,722	1,272,072	656,799	635,104	1,291,903	148
North Arcot	7,616	2,180,487	1,101,722	1,106,669	2,208,391	289
South Arcot	5,217	2,162,851	1,168,654	1,181,711	2,350,365	450
Salem	7,529	1,962,591	1,086,147	1,119,751	2,205,898	293
South Canara	3,902	1,056,081	549,274	585,350	1,134,624	290
Malabar	5,585	2,652,565	1,377,566	1,410,477	2,788,043	499
Nilgiris	957	99,797	60,567	50,882	111,449	116
Coimbatore	7,860	2,004,839	1,083,698	1,118,614	2,202,312	280
Tinnevelly	5,387	1,916,095	1,002,487	1,058,272	2,060,759	382
Madura	8,808	2,608,404	1,358,293	1,473,811	2,832,104	321
Tanjore	3,709	2,228,114	1,066,752	1,178,609	2,245,361	605
Trichinopoly	3,631	1,372,717	700,303	744,815	1,445,118	398
Chingleput	2,842	1,136,928	661,940	650,782	1,312,722	462
Anantapur	5,275	708,549	404,037	384,859	788,896	149
Madras City	29	452,518	257,298	252,099	509,397	17,565
Total British Territory	141,189	35,630,440	18,853,024	19,355,585	38,208,609	270
NATIVE STATES—						
Travancore	6,730	2,557,736	1,490,509	1,460,529	2,951,038	438
Cochin	1,362	722,906	407,010	408,208	815,218	598
Pudukota	1,101	373,096	180,884	199,698	380,582	345
Banganapalli (Karnul)	255	35,496	16,252	16,027	32,279	125
Sandur (Bellary)	161	11,388	5,658	5,547	11,205	69
Total Native States	9,609	3,700,622	2,100,313	2,090,009	4,190,322	436
Grand Total	150,798	39,331,062	20,953,337	21,445,594	42,398,931	281

Between 1881 and 1891 the population increased by more than 15 per cent. in British territory, and by more than 10 per cent. in native states, and between 1891 and 1901 by 7·2 and 13·2 per cent. respectively. The high rate of increase in the earlier period is to be attributed mainly to recovery from the famine of 1876–78, and partly to more accurate enumeration in the "agency" tracts. The average density ranges from 605 persons per square mile in the fertile delta of Tanjore to only 116 in the barren uplands of Karnul and in the Nilgiris.

Classified according to religion, and excluding native states, Hindus numbered 31,998,309 in 1891, or 90 per cent. of the total population, being a higher proportion than in any other province. Mahommedans numbered 2,250,386, or only 6 per cent., though they have increased more rapidly than Hindus. Christians numbered 865,528, or 2·4 per cent., of whom 13,462 were Europeans and 26,642 Eurasians, leaving 825,424 for native converts, chiefly in the southern districts of Tinnevelly, Madura, Tanjore, Trichinopoly, and South Canara. In the native states the proportion of Christians rose as high as 19 per cent. Jains, with whom Buddhists are included, numbered 28,461; "others," 487,756, chiefly aboriginal tribes in the "agency" tracts. The languages spoken—all of the Dravidian family—are Telugu in the north-east, Tamil in the south, Malayalam in the west, and Canarese in the central plateau.

Agricultural statistics are not available for the *zamindari* estates, which occupy nearly 27 per cent. of the total area of the presidency, paying an average revenue of R.0.4.3 per acre. On *rayatwari* lands the average incidence of land revenue is R.1.14.4 per assessed acre and Rs.2.4.10 per cultivated acre. In 1897–98 the total cultivated area was 24,247,617 acres, of which 2,961,377 acres were cropped more than once. The irrigated area was 5,875,374 acres, of which nearly one-half was irrigated from Government canals. The principal crops are rice (grown chiefly along the coast); the two kinds of millet (here called *cholum* and *cumbu*); *ragi* (*Eleusine corocana*), chiefly in the uplands; pulse, oil-seeds, cotton, indigo, sugar-cane, and tobacco. In 1897–98 the area under coffee was 64,402 acres, chiefly in the districts of the Nilgiris, Malabar, Salem, and Madura; the area under tea was 7722 acres, almost entirely in the Nilgiris.

The Madras system of irrigation has been most successful in the case of the three great eastern rivers, the Godavari, Kistna, and Cauvery. Each of these is intercepted by an *anicut* or dam at the head of its delta, from which canals diverge on each side for navigation as well as irrigation. The scheme for diverting the waters of the Tungabhadra (a tributary of the Kistna) over the thirsty uplands of Karnul has proved a failure, and the full result of the bold project of leading the Periyar river through a tunnel across the watershed of the Travancore hills on to the plain of Madura remains to be seen. In 1897–98 the total receipts from nine "major" works amounted to Rs.73,37,055, and the working expenses to Rs.17,90,996, showing a profit of Rs.55,46,059, or an average of 8·4 per cent. on a capital outlay of Rs.6,18,72.013. In addition, 27 "minor" works yielded a profit of Rs.7,52,785, or 4 per cent. on a capital outlay of Rs.1,69,73,752.

Madras possesses no special industry, like the cotton of Bombay or the jute of Bengal. In 1897 the total number of factories under inspection was 71, employing 31,197 operatives, of whom 2892 were women and 2216 children. Cotton-mills numbered 11, with 1705 looms and 274,254 spindles, employing 12,099 hands. The out-turn of yarn was 32,515,445 ℔, chiefly of counts between Nos. 10 and 21; the out-turn of woven goods was 5,320,781 ℔, chiefly tea-cloths, &c. There is one hemp mill at Vizagapatam, employing 823 hands; three breweries on the Nilgiri Hills, with an out-turn of 341,000 gallons; a flourishing sugar factory in Ganjam; and several tile-works on the Malabar coast. The manufacture of cigars has become an important industry in the districts of Madura and Trichinopoly. One factory alone produces 15 million cigars a year, valued at Rs.4,50,000.

The presidency is well supplied with railways, which naturally have their centre in Madras city, the chief seaport. The Madras railway connects with Bombay and Bangalore, and also crosses the peninsula to Calicut on the western coast. The South Indian serves the extreme south, with its terminus at Tuticorin. The Southern Mahratta traverses the Deccan districts; and the East Coast line, through the Northern Circars, has brought Madras into direct communication with Calcutta.

As might be expected from its double line of coast, the sea-borne trade of the presidency is less concentrated at its capital than is the case with either Bengal or Bombay. Only about 43 per cent. of the total is conducted at the port of Madras, the Malabar coast having 26 per cent., the Northern Circars 12 per cent., and Tinnevelly district 12 per cent. The following table gives the value (in tens of rupees) of the foreign exports and imports of merchandise only for the years 1877–78 and 1897–98 :—

	Imports.	Exports.
1877–78 . .	Rx.3,694,712	Rx.5,565,549
1897–98 . .	7,003,974	11,432,396

Thus both imports and exports approximately doubled in twenty years, showing a more rapid increase than either Bengal or Bombay. But the rate of increase was highest during the first half of the period, exports in particular having been checked by the bad seasons of 1896–98.

The following is the value (in the tens of rupees) of each of the principal articles of import and export in 1897–98 :—

Imports :—Cotton piece-goods, Rx.1,813,411 ; cotton twist, Rx.1,027,642 ; railway materials, Rx.665,248 ; wrought metals, Rx.573,402 ; machinery, Rx.322,351 ; mineral oils, Rx.274,608 ; spices, Rx.232,291 ; liquors, Rx.202,271 ; apparel, Rx.194,964 ; hardware and cutlery, Rx.172,031 ; provisions, Rx.128,000. Exports :—Hides, Rx.3,106,102 ; coffee, Rx.1,494,261 ; rice, Rx.1,207,247 ; indigo, Rx.1,066,445 ; raw cotton, Rx.852,399 ; cotton goods, Rx.768,302 ; oil-seeds, Rx.360,706 ; spices, Rx.314,996; sugar, Rx.263,690 ; oils, Rx.248,984 ; coir manufactures, Rx.237,356.

As compared with previous years, the imports of cotton goods show little change. Piece-goods reached their maximum (Rx.2,546,196) in 1894–95, and twist (Rx.1,156,548) in 1888–89. Railway materials, wrought metals, machinery, mineral oils, hardware, and cutlery all increased steadily during the ten years ending 1898. The foreign imports of coal suddenly dropped by one-half, owing to competition from the Bengal mines, which now supply 80 per cent. of the amount consumed in the railways and factories of Madras. Among metals (wrought and unwrought) iron accounts for Rx.334,418, copper for Rx.178,328, and steel for Rx.60,088.

Under exports, the most noticeable feature is the large proportion of the total (more than one-fourth) contributed by hides, which doubled in the last ten years of the 19th century. The exports of rice, which are mainly to Ceylon, have also doubled. Coffee and indigo, though variable crops, are both fairly maintained. Raw cotton shows a heavy decline, which was continuous during the four years ending 1897–98. It reached its maximum (Rx.2,495,773) in 1889–90. Cotton goods, which consist chiefly of coloured cloth sent to Ceylon, the Straits Settlements, and Burma, are fairly well maintained. Sugar shows a heavy decrease, due to a bad season.

The United Kingdom has maintained its trade with Madras more successfully than with Bombay. The imports from the United Kingdom increased during the ten years 1887–88 to 1897–98, though the proportion to the total fell from 85 to 78 per cent. The exports to the United Kingdom actually decreased, and the proportion to the total fell from 60 to 43 per cent. The special feature of Madras trade is the large exportation to Ceylon, which more than doubled between 1888 and 1898, and now forms 20 per cent. of the total. It consists mainly of cotton piece-goods, rice, fish, and other provisions.

The value of the coasting trade of Madras in 1897–98 was as follows (in rupees) :—Ports within the presidency—imports Rs.1,77,54,948 ; exports, Rs.1,79,63,838. Ports outside the presidency—imports, Rs.4,24,29,976 ; exports, Rs.3,27,18,949. Total —imports, Rs.6,01,84,924 ; exports, Rs.5,06,82,787.

The administration of the Madras presidency is conducted by a governor and a council, consisting of two members of the civil service, who are appointed by the Crown for a term of five years. The secretariat includes a chief secretary, a secretary, two under-secretaries, and an assistant. There is a board of revenue of three members. The number of districts is 22, each under the charge of a collector, with sub-collectors and assistants. The districts are not grouped into divisions or commissionerships, as in other provinces. In 1898 the number of covenanted civilians on the Madras establishment was 162. The total number of civil and revenue judges was 310, and of magistrates of all sorts, 725. The total strength of the police was 22,747 officers and men, being 1 policeman to every 8 square miles of area and to every 2167 of the population.

Since the reorganization of the Indian army in 1894 the Madras command, under a lieutenant-general, comprises Burma, Mysore, Haidarabad, and Belgaum in Bombay, in addition to the Madras presidency, with headquarters at Ootacamund in the Nilgiri Hills. It consists of two first-class and six second-class military districts, of which Madras and the southern district alone lie entirely within the presidency. In 1898 the strength of the Madras command was 12,447 Europeans and 29,410 natives ; total, 41,857. In addition, there were 5710 enrolled volunteers.

For legislative purposes the council of the governor is augmented by additional members, not exceeding 20, who are nominated by the governor for a term of two years. Of these not more than 9 may be officials, and 7 are nominated on the recommendation of the Madras corporation, groups of municipalities and district boards, selected public associations, and the senate of the Madras University. Members of this legislative council enjoy the right of interpellation and of discussing the annual financial statement.

Excluding Madras city, the number of municipalities in the presidency is 58, with an aggregate population of 1,687,563 in 1891. In 1898 the total number of members was 868, of whom 367 were elected by the ratepayers, and 727 were natives. The aggregate municipal income (including loans) was Rs.29,21,107, of which Rs.7,09,610 was derived from rates, Rs.3,58,951 from tolls, and Rs.2,86,403 from Government contributions. The average incidence of taxation (including tolls) was 14 annas per head. The aggregate expenditure was Rs .35,02,705, of which Rs.10,41,099 was devoted to public works (including water-supply), Rs.10,16,941 to medical services and sanitation, Rs.3,42,801 to education, and Rs.2,57,579 to lighting and miscellaneous.

The principle of local devolution is carried somewhat farther in Madras than in other provinces. At the bottom are union *panchayats* or village committees, whose chief duty is to attend to sanitation. In 1898 these numbered 376, with 3551 members. Above them come 80 *taluk* or sub-divisional boards, with 1122 members. At the head of all are 21 district boards, with 647 members, of whom 296 were elected by the *taluk* boards. In 1897–98 the aggregate income of local funds (including loans) was Rs.88,27,640, of which Rs.63,66,768 was derived from rates and Rs.3,15,143 from a provincial grant. The aggregate expenditure was Rs.83,93,060, of which Rs.35,29,227 was devoted to public works, Rs.18,73,480 to medical and sanitary purposes, and Rs.10,95,782 to education.

The total net revenue of Madras for 1897–98 (in tens of rupees, distributed under the three heads of imperial, provincial, and local, was Rx.7,304,601, Rx.2,811,486, and Rx.1,049,068 respectively, or a total of Rx.11,165,155, the corresponding totals for the expenditure being Rx.3,371,870, Rx.2,811,684, Rx.1,048,870, and Rx.7,232,424.

The following table gives the gross revenue under five principal heads for the years 1887–88 and 1897–98 :—

	1887–88.	1897–98.
Land . .	Rx.4,527,937	Rx.4,937,748
Stamps . .	597,161	842,026
Excise . .	973,906	1,462,010
Forests . .	137,492	213,649
Assessed taxes	168,146	266,446

These figures show steady progress, especially under excise and assessed taxes. The increase of land revenue is the more noticeable as 1897–98 was a bad season.

The following table gives the chief statistics of education in Madras for the years 1886–87 and 1896–97:—

	1886–87.		1896–97.	
	Schools.	Pupils.	Schools.	Pupils.
Colleges	35	3,323	43	4,423
Secondary schools	747	66,856	748	90,610
Primary schools	14,065	384,888	20,792	617,886
Special schools	82	3,022	122	5,386
Private institutions	1,788	30,853	5,167	104,548
Total	16,717	488,942	26,872	822,853

It is noticeable that pupils have increased more rapidly than institutions, especially in the case of secondary schools, which tends to make the stronger institutions more efficient. If we compare the number of pupils with the estimated population of school-going age (15 per cent. of the total population), the increase during the ten years was from 10·6 to 15·4 per cent. Taking girls alone, the number at school increased from 65,137 to 116,747, while the proportion to the female population of school-going age rose from 2·8 to 4·3 per cent. A peculiarity of the Madras system is that English is taught even in primary classes, so that the total number of pupils learning English in 1896–97 was 141,625, being one in every 38 of the population of school-going age. Another feature is the extent to which Brahmans take advantage of the opportunities open to them. Out of every 16 Hindus in colleges, 15 are Brahmans; and out of 103 Hindus in high schools, 94 are Brahmans.

The following table gives the expenditure on education for the same years, according to sources:—

	1886–87.	1896–97.
Provincial revenues	Rs.13,48,923	Rs.18,75,783
Local funds	5,55,762	8,74,237
Municipal funds	1,63,560	2,33,373
Fees	14,98,366	20,22,226
Other sources	9,95,969	16,81,605
Total	45,62,580	66,87,224

Expenditure has not grown quite so fast as the number of pupils. But here, as in other provinces, the larger share of the increased expenditure has come from fees and "other sources," which mainly consist of mission contributions. Altogether, the proportion of the total borne by public funds has fallen from 45·3 to 44·6 per cent. In secondary schools alone public funds contribute less than one-fourth.

Madras has been fortunate in almost entirely escaping the plague, despite serious outbreaks in Mysore and the border district of Dharwar in Bombay. The total number of deaths from plague recorded throughout the presidency down to April 1899 was only 1804. Madras was little affected by the famine of 1899–1900. In April 1900 the total number of persons in receipt of relief was only 18,000, chiefly in the Deccan districts, which had suffered severely in the famine of 1896–97.

For 1897 the total number of deaths registered was 827,525, of which 292,292 were ascribed to fevers and 143,445 to cholera. The death-rate was 25·4 per thousand, compared with a mean of 20·4 during the previous five years. The registered birth-rate was 28·7 per thousand. The number of persons successfully vaccinated was 1,067,319. (J. S. CO.)

Madras City, the capital of Madras presidency and chief seaport on the eastern coast of India, situated in 13° 4′ N. and 80° 17′ E. The city, with its suburbs, extends nine miles along the sea and nearly four miles inland, intersected by the little river Cooum. Area, 29 square miles; population (1881) 405,848; (1891), 452,518; (1901), 509,397; showing an increase of 11 per cent. between 1881 and 1891 and of 12·57 per cent. between 1891 and 1901. Madras is thus the third city in India. Classified according to religion, Hindus in 1891 numbered 358,997, or 79 per cent.; Mahommedans, 53,184, or 12 per cent.; Christians, 39,742, or 9 per cent., of whom 4229 were Europeans and 11,943 Eurasians, leaving 23,570 for native converts; Jains (including Buddhists), 410; and "others," 185.

Madras possesses no special industries. There are four cotton-mills, with 1595 looms and 125,220 spindles, employing 6031 hands; a large cement work, several iron-foundries, and two cigar factories. Large sums of money have from time to time been spent upon the harbour works, but without any great success. The port still remains practically an open roadstead, and the P. and O. steamers ceased to call in 1898. Madras conducts about 56 per cent. of the foreign trade of the presidency, but a much smaller share of the coasting trade. In 1897–98 the total sea-borne trade, both merchandise and treasure, was valued at Rs.12,98,85,783, of which Rs.10,50,17,710 represents foreign trade. The number of vessels that entered and cleared with cargo in the foreign trade was 279, with an aggregate tonnage of 523,713. Including coasting trade, the number of vessels was 711, with a tonnage of 1,158,897, which paid dues to the amount of Rs.1,09,495. The total income of the harbour trust was Rs.7,20,000, and the total expenditure Rs.7,30,000, including Rs.2,24,000 for interest and Rs.1,00,000 for repayment of advances.

The municipal government of the city was framed by an Act of the Madras legislature, passed in 1884. The governing body consists of 32 commissioners, of whom 24 are elected by the ratepayers, together with a paid president. The number of registered voters in 1898 was 5720, being 12·5 per thousand of the total inhabitants. At contested elections in ten wards about half the registered voters exercised the franchise. In 1897–98 the total income (excluding loans, &c.) was Rs.13,60,000, of which Rs.10,30,000 was derived from rates and taxes, the incidence of taxation being Rs.2·27 per head. The principal tax is a rate of 10 per cent. on houses and lands. The total expenditure was Rs.17,03,000, of which Rs.7,97,000 was devoted to public works, including a new drainage scheme; Rs.3,83,000 to sanitation and medical purposes; Rs.11,890 to education; and Rs.2,06,000 to interest and repayment of debt. The total amount of debt outstanding was Rs.12,18,400, almost all raised for water-works and drainage. A new system of water-supply is projected. The old system supplied 480 million cubic feet of water during the year.

The Madras University was constituted in 1857, as an examining body, on the model of the University of London. During the five years ending 1897 the total number of candidates who matriculated was 5546, while 2401 graduated B.A., 538 passed examinations in law, 233 in medicine, and 38 in engineering. The chief educational institutions in Madras city are: the Presidency College (with 395 students in 1897), six missionary colleges and one native college; the medical college, the law college, the college of engineering, the teachers' college, and the college of agriculture (in the suburb of Saidapet), all maintained by Government; the Government school of arts (with 674 pupils learning drawing); 18 high schools for boys, one of which is maintained by Government for Mahommedans; 11 high schools for girls. In 1896–97 the total number of pupils under instruction was 40,315, the proportion to the population of school-going age being 89 per cent. for boys and 30 per cent. for girls. For 1897 the death-rate was 35·8 per thousand, compared with a mean of 40·2 during the previous five years; the birth-rate was 41·6 per thousand. (J. S. CO.)

Madrazo y Kunt, Don Federico de (1815–1894), Spanish painter, was born in Rome on 12th February 1815. He was the son of the painter Madrazo y Agudo (1781–1859), was baptized at St. Peter's, Rome, and received his first instruction from his father. While still attending the classes at the Academy of San Fernando, he painted his first picture, "The Resurrection of Christ"

(1829), which was purchased by Queen Christina. Not long afterwards he painted "Achilles in his Tent," and subsequently presented to the Academy "The Continence of Scipio," which secured him admission as a member "for merit." While decorating the palace of Vista Alegre, he took up portraiture. In 1852 he went to Paris, where he studied under Winterhalter, and painted portraits of "Baron Taylor" and of "Ingres." In 1837 he was commissioned to produce a picture for the gallery at Versailles, and painted "Godfrey de Bouillon proclaimed King of Jerusalem," which was finished in 1839. The artist then went to Rome, where he worked at various subjects, sacred and profane—among others, "The Three Holy Women at the Sepulchre." Then he painted "Maria Christina in the Dress of a Nun by the Bedside of Ferdinand III." (1843); "Queen Isabella," "The Duchess of Medina-Cœli," and "The Countess de Vilchès" (1845–47), besides a number of portraits of the Spanish aristocracy: "King Don Francisco," the Duchesses of Alba and of Seville, the Countess de Robertsart, and P. de Madrazo; some of these portraits were sent to the Exhibition of 1855. He had received a third-class medal in 1838, two first-class medals in 1845 and 1855, and the decoration of the Legion of Honour in 1846. He had been corresponding member of the Paris Academy of Fine Arts since 10th December 1853, and in 1873, on the death of Schnorr the painter, he was chosen foreign member. After his father's death he succeeded him as director of the Prado Gallery and president of the Academy of San Fernando. He assisted his brother, Don Pedro, in preparing the catalogue of the Gallery which was published in 1873. He originated in Spain the production of art reviews and journals, such as *El Artista*, *El Renacimiento*, and *El Semanario Pintoresco*. He was corresponding member of the Academies of Belgium and of St Luke at Rome, and was the writer of various historical and critical papers. He died at Madrid on the 11th of June 1894. His brother, Don Louis de Madrazo, is also known as a painter, chiefly by his "Burial of Saint Cecilia" (1855). Don Federico's best-known pupil is his son, Don Raimundo de Madrazo, born in 1841. (h. fr.)

Madrid, a province of central Spain; area, 2997 square miles. The population rose from 682,644 in 1887 to 737,444 in 1897. The average density of the population is thus about 246 per square mile, but the majority of the inhabitants are within the municipal boundaries of the capital, and the density outside is barely 62 per square mile. The birth-rate averages 38·3 per thousand, the death-rate, 38·4, and the proportion of illegitimate births only 2·63 per cent. About 1100 emigrate annually. The province is divided into 18 administrative districts and 195 parishes. It is included for military purposes within the first army corps commanded by the captain-general of Madrid; for judicial purposes in the Court of Appeal of Madrid, and for ecclesiastical in the diocese of Madrid Alcala. Besides the local lines, all the great railways in the kingdom converge in this province, and it contains in all 221 miles of line. No province in Spain contains a greater number of persons paying the industrial and commercial rates. Local industries, not only in the town and suburbs of Madrid, but in the rest of the province, have developed very much, especially manufactures of chocolate, alcohol, porcelain and pottery, soap, flour, glass, candles, paper, iron, tanning, and saw-milling. Agriculture and wine-growing have also progressed; vines have been extensively planted near the capital, and agricultural methods and machinery improved. Efforts have been made by the various authorities to cover the large stretches of waste ground and commons with pines and other trees.

Much timber is extracted from the forests of the northern and north-eastern part of the province for building purposes and for firewood and charcoal. The royal domains of Escurial, Aranjuez, and El Pardo and the preserves of the nobility are all well wooded, and contain much game. In 1898 the province had 14,094 horses, 23,473 mules, 8463 asses, 19,396 cattle, 260,462 sheep, 37,638 goats, and 11,695 pigs. The south-eastern districts are the best irrigated, and produce in abundance fruit, vegetables, wheat, olives, esparto grass, and excellent wine, red and white. There are more than 60,000 acres well irrigated, and over two millions and a quarter well cultivated, wheat being grown on 167,389 acres, other cereals on 203,252 acres, leguminous crops on 36,922 acres, vines on 158,502 acres, and olives on 18,415 acres.

Madrid, the capital of the above province, and of the kingdom of Spain, situated on the left bank of the river Manzanares. Its population increased to 472,228 in 1887, and to 512,150 in 1897. In the latter year the births were 15,413 (7833 males, 7580 females), being an average for the twelvemonth of 31·85 per thousand inhabitants. The deaths in 1897 were 14,594 (7579 males, 7015 females), 6111 being those of children under ten years of age, the average for the year per thousand inhabitants being 40·50. There is a very great difference between the death-rate in winter and in summer. In the former season it is often as high as 80 daily, dropping to between 20 and 30 in summer. The death-rate is lower than that of 22 provincial capitals. The average proportion of illegitimate births in 1897 was 6·86 per cent., but in the most populous district there were 1636 illegitimate births against only 1339 legitimate.

The public buildings were extensively restored and improved between 1885 and 1900. Foremost must be mentioned the Biblioteca National, standing near the Mint on the Paseo de Recoletos, of which the first stone was laid in 1866, and which was only completed in 1892. Not only the National Library, with its important collections of MSS. and documents, but the Archæological Museum, the Museums of Modern Painting and Sculpture, and the Fine Arts Academy of San Fernando, are within its walls. The total cost of the building was £640,000. The art exhibition in connexion with the celebration of the fourth centenary of the discovery of America by Columbus was held within it in 1892. The royal carpet and tapestry manufactory has been transferred to a site in the Pacifico suburb. A large and handsome building has been erected near the Retiro Park for the Ministers of Public Works, Agriculture, Industry, Commerce, and Fine Arts, and Education; and nearly opposite stands the new station of the Southern Railway Company. The Great Northern and the Spain to Portugal railway companies have also replaced their ugly old stations by very spacious handsome structures, much resembling those of Paris. In 1896 the Royal Exchange was installed in a large monumental building with a fine colonnade facing the Dos de Mayo monument, not far from the Museum of Paintings. In the same part of the city, the Medina-Cœli Palace has disappeared to make room for new streets. In the Salon del Prado the duke of Sexto's palace at the corner of Alcala Street, opposite the War Office, has made way for the new offices of the Bank of Spain, a heavy, imposing building 290 yards long. At each extremity of the Prado two large circular "squares" have been made out of the older and irregular ones, and the fountains of Cibeles and Neptune have been moved to the centre of the Plazas de Castelas and de Canovas. The north and north-east of the city—the new suburbs—have developed past the Retiro Park as far as the Bull-ring, built in 1874 to hold 16,000 spectators, and have covered all the vast space included between the Retiro, the Bull-ring, the long Castellana Drive to the race-course, and the Exhibition building. On the slopes of the other side of the Castellana, and away along what were the northern limits of Madrid in 1875, the modern suburbs have extended to the vicinity of the fine cellular prison that was built at the close of the reign of King Alphonso XII. to replace the gloomy building known as El Saladero. It can hold nearly 1000 male prisoners, and serves also as a house of correction for offenders undergoing short terms of imprisonment. The prison for females calls for considerable improvement. The new parts of the capital, with their broad streets and squares, and their villas sometimes surrounded with gardens, the noble mansions of the upper classes, the boulevards lined with rather stunted trees, and the modern public buildings, all resemble the similar features of other European capitals, and contrast with the old Madrid that has preserved so many of its traits in architecture, popular life, and habits. Some of the streets have been widened slightly, and in many thoroughfares new houses are gradually studding the background formed by the ugly irregular dwelling-places of the 18th and earlier centuries. This contrast is to be seen especially in and about the Calle Mayor, the Plaza Mayor, the Calle Toledo, the Rastro, and the heart of the city. There are, however, several buildings, dating from times long past, which are worthy of admiration—grand, old-world residences of the ancient nobility, massive convents, the episcopal palace, the Town Hall opposite the palace of the Lujanes, the Government House, the house of the seven chimneys that was the residence of Charles I. of England and Buckingham in 1623, and the many ministerial offices installed in old conventual buildings. The churches of Madrid underwent alteration in the last quarter of the 19th century. When the capital was separated from the archiepiscopal see of Toledo, and erected into a bishopric, styled of Madrid Alcala, the church of San Isidro was made the cathedral. The church of the old Franciscan convent, San Francisco el Grande, has been splendidly restored by the State at considerable expense. Its dome, chapels, and walls were covered with remarkable works, frescoes, and paintings by most of the leading Spanish artists of the last half of the 19th century. The modern chapels and churches of the capital are not worth noticing, except the church of the Almudena, founded by King Alphonso XII. close to his palace, which, however, has progressed so slowly that only its crypt and the base of its massive walls and columns of solid granite were complete in 1901. The Campo de Moro, as the slope below the palace down to the river road is styled, was greatly improved by the Queen Mother (Maria Christina). Some noble timber has been sacrificed, and a modern park and gardens substituted. Little progress has been made in the reconstruction of the historic church of the Virgin of Atocha, which it was at one time intended to make a pantheon for the worthies of modern Spain, several of whom, like Castanos and Palafox, the heroes of the War of Independence against Napoleon I., and Prim, the chief of the Revolution of 1868, had found there a last resting-place. The Courts of Justice are still held in the 17th-century convent of Las Salesas Reales. The Houses of Parliament are in separate buildings. The Congreso, or House of Deputies, which has met since 1843 in a large handsome structure in the Carrera San Geronimo, has a very important library; the Senate is in an old convent of the Augustine order (restored), and has fine modern paintings, and also a library of 20,000 volumes. The squares of the Spanish capital are adorned with many statues of kings, statesmen, soldiers of the War of Independence, and great writers like Calderon and Cervantes; and not a few of the residences or birthplaces of eminent men have been redeemed from oblivion and distinguished by slabs of marble with inscriptions. There are no less than fourteen theatres and two circuses, besides the Royal Opera House and the Retiro Gardens, also with a theatre that is the chief summer resort at night.

Few capitals have more extensively developed their electric and horse tramways, gas and electric light companies, and telephones. Much was done to improve the sanitary conditions of the city in the last twenty years of the 19th century. The streets are deluged three times a day with fire-hose, but even that has little effect upon the dust. Unfortunately the water-supply, which used to be famed for its abundance and purity, is now wholly insufficient owing to the growth of the city. The reservoirs of the Lozoya canal, 32 miles long, are quite inadequate for the requirements of modern Madrid, and they have been kept in such an unsatisfactory state that in 1898 and 1899 for several months the water not only was on the point of giving out, but at times was of such inferior quality that the people had recourse to the many wells and fountains still extant in the ten districts of the Spanish capital. A decided improvement has been made in the burial customs. No bodies are allowed to be interred in the churches and convents. Some of the older burial grounds in the northern suburbs have been closed altogether, and in those which remain open, few coffins are placed in the niche vaults in the depth of the thick walls, as was once the practice. A large modern necropolis has been established a few miles to the north-east, where most burials now take place, and the older cemeteries must all be closed at no distant date. Madrid had a British cemetery more than thirty years before the end of the 19th century. The city contains also a British Embassy chapel, a German chapel, and several Spanish Protestant chapels attended by over 1200 native Protestants, while the Protestant schools, chiefly supported by British, German, and American contributions, are attended by more than 2500 children.

The first Protestant bishop of Madrid was ordained in 1895 by Archbishop Plunkett of Dublin. The Spanish educational establishments have also been considerably improved. The university had in 1897 a staff of 102 professors and 21,500 students. Of these 11,500 belonged to the faculty of law, 8000 to that of medicine, 150 to that of science, 1650 to pharmacy, and 200 to philosophy and literature. Besides the special superior schools there are a self-supporting institute for preparing girls for the higher degrees and for certificates as primary teachers, and two institutes for secondary education, one attached to the university and the other conducted chiefly by ecclesiastics. There are now more than 120 primary, State, and municipal schools, educating 58,000 boys and 49,500 girls. The Jesuit schools of Chamartin and the Scolapian fathers are conspicuous among private institutions. The charitable institutions have been remarkably improved. The Princess Hospital has been completely restored on modern methods, and can accommodate several hundred patients. The old contagious diseases hospital of San Juan de Dios has been pulled down and a fine new hospital built in the suburbs beyond the Retiro Park, to hold 700 patients. The Military Hospital has also been demolished and a very good one built in the suburbs. The old Provincial Hospital, to hold 1200 patients, is, however, in anything but a satisfactory condition. There are now in all twenty hospitals in Madrid, and a lunatic asylum on the outskirts of the capital, founded by one of the most eminent of Spanish surgeons, and conducted by him on a scale which enables the institute worthily to compare with those in other European capitals. The rate of mortality in the three foundling hospitals is high, the services being seriously crippled by lack of funds. New buildings have been provided for the orphanages, and for the asylums for the blind, deaf and dumb, incurables, and aged paupers. There are hospitals supported by the French, Italian, and Belgian colonies; these are old and well-endowed foundations. Public charity generally is very active. In Madrid, as in the rest of Spain, there has been an unprecedented increase in convents, monasteries, and religious institutions, societies, and Catholic workmen's clubs and classes.

Apart from private institutions for such purposes, the State maintains in the capital a savings bank for the poorer classes, and on the other hand acts the *rôle* of pawnbroker for their benefit. The commerce of the capital is chiefly important in the retail trade, and the mercantile and industrial classes are organized in "guilds," which themselves collect the lump sum of taxation exacted by the exchequer and the municipality, from each *gremio* or class of taxpayers. The working classes also have commercial and industrial *circulos* or clubs that are obeyed by the guilds with great *esprit de corps*, a chamber of commerce and industries, and associations of "productions" to defend their economic interests. The industries of the capital have developed extraordinarily since 1890. In the town and within the municipal boundaries in the suburbs many manufactories have been established, giving employment to more than 30,000 hands, besides the 4000 women and girls of the Tobacco Monopoly Company's factory. Among the most important factories are those which make every article in leather, especially cigar and card cases, purses and pocket-books, all duly stamped Paris, London, and

Vienna, to be sold more profitably in the shops of Madrid. Next come the manufactures of fans, umbrellas, sun-shades, chemicals, varnishes, buttons, wax candles, beds, cardboard in all shapes, porcelain, coarse pottery, matches, baskets of all kinds, sweets and preserves, gloves, guitars, biscuits, furniture, carpets, corks, cards, carriages, jewellery, drinks of all kinds, plate, and plated goods. There are also tanneries, saw and flour mills, glass and porcelain works, soap works, brickfields, paper mills, zinc, bronze, copper, and iron foundries. The working classes are strongly imbued with Socialistic ideas, and are organized in large societies. The union of masons alone numbers 15,000 members. The strikes of these workmen and their May Day demonstrations have often been troublesome. Order is kept by a garrison of 12,500 men in the barracks of the city and cantonments around, and by a strong force of civil guards or gendarmes quartered in the town itself. The civil and municipal authorities can employ besides the gendarmes the police, about 1400 strong, and what is called the *guardias urbanos*, another police force whose special duty it is to regulate the street traffic and prevent breaches of the municipal regulations. There is not, on the average, more crime in Madrid than in the provinces. (A. E. H.)

Madridejos, a town of Spain, in the province of Toledo, on the borders of Ciudad Real, 65 miles south of Madrid. The surrounding country is fertile, producing wheat, wine, oil, and hemp. There are mines of copper and lead in the neighbourhood. The industries are leather and alcohol. Population (1887), 6579; (1897), 6387.

Madura, a city and district of British India, in the Madras presidency. The city is on the right bank of the river Vaigai, and is a station on the South Indian railway, 345 miles south-east of Madras. Population (1881), 73,807; (1891), 87,428; (1901), 105,501. The municipal income in 1897–98 was Rs.1,81,470. It has two aided colleges, with 120 students in 1896–97; three aided high schools, with 1410 pupils; Jesuit and American Protestant missions; eight printing-presses, issuing one English newspaper and two mission periodicals; five reading-rooms and literary institutes; and a cotton mill, with 36,344 spindles, employing 1750 hands.

The district of Madura has an area of 8808 square miles. Population (1881), 2,168,680; (1891), 2,608,404; (1901), 2,832,104, showing an increase of 20 per cent. after the famine of 1876–77, which was felt here but slightly, and of 8·58 per cent. between 1891 and 1901; average density, 321 persons per square mile. The land revenue and rates in 1897–98 were Rs.34,28,552, the incidence of assessment being R.1.12 per acre; cultivated area, 1,009,253 acres, of which 276,170 were irrigated from tanks, &c., including 34,835 from Government canals; number of police, 1225; boys at school (1896–97), 50,328, being 27 per cent. of the male population of school-going age; registered death-rate, 23·7 per thousand. The principal crops are millet, rice, other food-grains, oil-seeds, cotton. Coffee is grown on the Palni Hills, to the extent of 6161 acres; tobacco chiefly in the neighbourhood of Dindigul, whence it is exported to Trichinopoly to be made into cigars. There are five cigar factories in the district, one of which employs 1000 hands, with an annual out-turn valued at Rs.4,50,000, and 149 saltpetre refineries. The only other large industry is that of coffee-cleaning. Madura is traversed by the main line of the South Indian railway. It has four small seaports, whose total trade (chiefly with Ceylon) was valued in 1897–98 at Rs.20,12,204. The most important irrigation work is that known as the Periyar project, which consists of a tunnel through the Travancore Hills, to convey the rainfall across the watershed, at a capital cost of Rs.85,29,000. In 1897–98 the irrigated area was 28,051 acres; the receipts were Rs.1,30,822, compared with an expenditure (including interest) of Rs.4,35,969.

Madura, an island of the East Indian Archipelago, separated by the strait of that name from the east end of Java. Being a continuation of the limestone range of northern Java, the island is of the same geological structure as Rembang and Surabaya. The formation of the coast and plains is Tertiary and recent alluvium. There are hills and ranges 1300 to 1600 feet high. The soil being poor, fishing and cattle-rearing are the chief means of subsistence. The cattle exceed 550,000, outnumbering the stock of cattle in any other residency of Java, and yielding an excess for export to Surabaya and east Java. Besides rice, which is not grown in sufficient quantity for home consumption, and maize, Madura yields cocoa-nut oil and jati. There is no agriculture carried on for European proprietors or for the Government, but the manufacture of salt for the Government, abolished in other places, still continues in Madura. The Madurese often emigrate in thousands to other residencies of Java. The chief group of islands belonging to Madura are the Kangean and Sapudi Islands, yielding timber, trepang, turtle, pisang, and other products. Area, 1770 square miles. Population (1897), 1,652,580, of whom 1,646,071 were natives, 4252 Chinese, and 558 Europeans.

See Veth. *Java*, vol. iii.—Kielstra, "Het Eiland Madoera," in *De Gids*, 1890.—Van Lennep, "De Madoereezen," in *De Indische Gids*, 1895, with detailed bibliography.

Madvig, Johan Nicolai (1804–1886), Danish philologist, was born on the island of Bornholm, 7th August 1804. He was educated at the Classical School of Frederiksborg and the University of Copenhagen. In 1826 he graduated with a dissertation *Emendationes in Ciceronis libros de legibus et Academica*, and afterwards gained the doctor's degree with a thesis on some of the ancient commentators of Cicero. In 1828 he became reader, and in 1829 professor, of Latin language and literature at Copenhagen, and in 1832 was appointed university librarian. In 1848 Madvig began to take an active part in politics. He entered parliament as a member of what was called the "Eider-Danish" party, because they desired the Eider to be the boundary of the country. When this party came into power, Madvig became Minister of Education, and retained this post till 1851. In 1852 he became Director of Public Instruction. Some years later, from 1856 to 1863, Madvig was president of the Danish parliament and leader of the National Liberal party. With these brief interruptions the greater part of his life was devoted to the study and teaching of Latin and the improvement of the classical schools, of which he was chief inspector. As a critic he was distinguished for learning and acumen. He devoted much attention to Cicero, and revolutionized the study of his philosophical writings by an edition of *De Finibus*, published in 1839. He also edited *De Senectute* and *De Amicitia*, and several of the Orations. In 1860 he published his *Emendationes Livianæ*, followed by an edition of Livy, in which he and Ussing collaborated. He also worked at Lucretius and Juvenal, and published two volumes of emendations with the title *Adversaria critica ad scriptores Græcos et Latinos*. Perhaps his most widely known works are those on Latin grammar and Greek syntax, especially his Latin grammar for schools. In 1874 his sight began to fail, and he was forced to give up much of his work. He still, however, continued to lecture, and in 1879, when the University of Copenhagen celebrated its 400th anniversary, he was chosen rector for the sixth time. In 1880 he resigned his professorship, but went on with his work on the Roman Constitution, which was completed and published before his death. In this book Madvig takes a strongly conservative standpoint, and attacks Mommsen's views on Cæsar's programme of reforms. It is a clear exposition of its subject, though rather too dogmatic and without sufficient regard for the views of other scholars. Madvig died at Copenhagen on 13th December 1886. (A. Z.)

Maestricht (in Dutch *Maastricht*), capital of the Dutch province of Limburg, at the influx of the Geer into the Maas, 19 miles by rail north-north-east of Liège. The railway, Maastricht–Aken, was in 1898 taken over by the State. Maestricht has a small museum of antiquities, and geological and palæontological collections; also several technical schools. The industrial establishments embrace an earthenware and glass factory employing 3000 hands, factories for paper, firearms, and woollens, breweries, and distilleries. Population (1901), 34,182.

Maeterlinck, Maurice. See Belgium. (*Literature*).

Mafeking, a town of British South Africa, formerly the head kraal of the Barolong branch of the Bechuana nation, and still their largest station, but now chiefly important as the administrative centre of British Bechuanaland. It lies close to the Transvaal frontier, about the sources of the Molopo river, 96 miles north of Vryburg, on the Cape to Bulawayo trunk line, of which it is one of the busiest stations. It is situated nearly 200 miles due east of Johannesburg, and is memorable in South African warfare both as the point from which Dr Jameson started on his famous Raid on 28th December 1895, and still more for its heroic defence under Colonel (afterwards General) Baden-Powell against the Boers. The siege, which began soon after the outbreak of hostilities on 11th October 1899, lasted till 18th May 1900, when the place was relieved by Colonel Mahon.

Magdeburg, a town and first-class fortress of Prussia, capital of the province of Saxony, on the river Elbe, 88 miles by rail west-south-west of Berlin, an important railway junction, and one of the principal commercial and industrial towns in North Germany, as well as the headquarters of the 4th German Army Corps. It now includes also the fifth suburb of Wilhelmstadt on the west. Since the fortifications were pushed out in 1866 and 1888, new quarters have grown up on the north, south, and west, and the narrow crooked streets of the old town are being widened and straightened as occasion offers; but the principal thoroughfare, Der Breite Weg, still retains its 17th-century gable-ended houses. In the last years of the 19th century several new parks were laid out in the suburbs. Amongst the various modern buildings may be mentioned the post office, Imperial Bank, royal consistory hall (1891), and the municipal offices and library. A new building has been erected for the industrial art, natural science, and other collections, formerly housed in the Prince's Palace. The church of Our Lady was completely restored in 1890–91. The city is adorned with various monuments—an equestrian statue of the Emperor William I. (1897) by Siemering, one to Luther (1886), and another to Immermann (1899). It also possesses a couple of theatres, a branch (1889) of the Halle Agricultural College, an art school, a commercial school, an imperial orphanage, a teachers' seminary, a meteorological observatory, and a gaol. The first place amongst the industries is taken by the ironworks (one being a branch of the Krupp firm, the Grusonwerke, employing 3500 men), which produce naval armour, caissons, cannon, cranes, &c. Of almost equal importance are the sugar refineries and chicory factories. Then come factories for tobacco, chocolate, artificial manure, cement, varnish, chemicals, and pottery, rope-walks, distilleries, breweries, and various other branches. Magdeburg is the central market in Germany for sugar and chicory, but trades extensively also in cereals, fruit and vegetables (grown close to the city), groceries, cattle and horses, wool, cloth, yarn, leather, coals, iron wares, fats, and books. A new winter harbour, made at a cost of £400,000, is intended to promote the river traffic up and down the Elbe. Altogether an aggregate of 2¾ million tons of merchandise passes Magdeburg, going upstream, and over ¾ million tons, going downstream, annually. Population (1885), 159,520; (1890), 202,234; (1900), 229,663. In 1887 the suburbs of Buckau and Neustadt were incorporated.

Magee, William Connor (1821–1891), bishop of Peterborough and archbishop of York, was born at Cork in 1821. His father was curate of the parish attached to the Protestant cathedral in that city. Young Magee entered Trinity College, Dublin, at the early age of thirteen, but nevertheless succeeded in obtaining a scholarship. His reading at college was rather discursive than profound, but he passed a brilliant examination in gaining Archbishop King's prize. He was instrumental in resuscitating the Trinity College Historical Society, which has done so much good work since. He was ordained to the curacy of St Thomas's, Dublin, but after two years evinced symptoms of consumption, and was sent for a time to Malaga. On his return he took a curacy at Bath, where his reputation rapidly grew. He was nominated to the incumbency of Kensington Chapel, Bath, but the appointment was vetoed by his rector, who is reported to have said, "I brought Magee here to fill my church. If he goes to Kensington Chapel he will empty it." He was, however, speedily appointed to the Octagon Chapel, where his fame continued to spread, and his extraordinary powers as a platform orator were displayed on many occasions. Some years afterwards he was made prebendary of Wells Cathedral, and in 1860 he had the offer of the important post of Quebec Chapel in London, on the resignation of Dr Goulburn, afterwards dean of Norwich. The delicate state of his health caused him to accept the living of Enniskillen almost immediately afterwards. In 1864 he was made dean of Cork and chaplain to the lord-lieutenant. Here he manifested those great gifts which ultimately raised him to a more exalted station: a powerful grasp of mental, moral, and political problems, combined with eloquence of a high order, illuminated with the most brilliant flashes of wit. In 1868 the question of the Disestablishment of the Irish Church came to the front, and Magee threw himself into the task of its defence with his usual energy and vivacity. The success of his orations caused Mr Disraeli to offer him the bishopric of Peterborough in a characteristic letter. He justified his appointment by his magnificent speech when the Disestablishment Bill reached the House of Lords in 1869, and then plunged into diocesan and general work in England. Here he was everywhere in request, and preached and published sermons on a variety of subjects, the most celebrated, perhaps, of these being his three remarkable sermons on Christian Evidence, in Norwich Cathedral in 1871. He took up the temperance question, and electrified the country by a declaration in the House of Lords that he would rather see "England free than England compulsorily sober," an utterance which the extreme advocates of total abstinence commented on most severely, leaving out, in a manner not uncommon with men in whom the judicial faculty is weak, the qualifying word "compulsorily," and representing the bishop as having cast a slur on sobriety. He was also a supporter of the movement for abolishing the recitation of the Athanasian Creed in the public services of the Church of England, believing, as he said, that the "presence" of the damnatory clauses, "as they stand and where they stand, is a real peril to the Church and to Christianity itself," and that those clauses "are no essential part" of the creed. The project was laid aside in consequence of the hostility of a large body of the clergy, reinforced by the threat of Dr Pusey and Canon Liddon to abandon their offices if it were carried. The bishop, moreover, took a prominent part in the Ritual controversy, opposing what he conceived to be Romanizing excess in ritual, as well as the endeavour of the opposite party to "put down Ritualism," as Mr Disraeli expressed it, by the operation of the civil law. In short, there was no subject affecting the Church or the moral well-being of the people in which his influence was not felt, and in which his remarkable insight and acumen would not have done much service, could he have carried his colleagues with him. His incisive way of putting things earned for him the title of "the Militant Bishop," but, as he himself remarked in relation to this title, his efforts were ever for peace. Unfortunately for the Church, he was not elevated to the see of York until his energies were exhausted. He died on 5th May 1891, about four months after his appointment, leaving the Church the poorer for the loss of a statesman. His family were left impoverished by the heavy fees incident on his installation as archbishop. These were ultimately defrayed by a subscription—a tardy acknowledgment of a combination of gifts rare in the history of the English Church. His manifold activities, his capability as an administrator, his sound judgment, and his remarkable insight into the ecclesiastical problems of his time, may be best studied in the self-revelation of the man to his lifelong friend, Dr M'Donnell, formerly dean of Cashel, who published an account of the archbishop's life along with his correspondence. (J. J. L*.)

Magenta, a town of the province of Milan, Lombardy, Italy, situated in the midst of ricefields, 17 miles west of Milan by rail. It manufactures silks and matches, but is famous for the battle (1859) in which the allied French and Piedmontese defeated the Austrians. A monument was erected on the battlefield in 1862. Population, about 5500.

Maggiore, Lago, a lake of northern Italy and Switzerland, lying at the foot of the Lepontine Alps, due north from Novara. According to Marinelli, its area is 82 square miles, its altitude above sea-level 643 feet, and its maximum depth 1221 feet. Between midnight and morning it is usual for a northerly wind to blow, the Tramontana, whilst the Inverna, a southerly wind, prevails from noon until about four o'clock in the afternoon.

See O. MARINELLI, in *Geografia per Tutti* (1894); É. RITTER, in *Le Globe : Mémoires*, vol. vii. (1896); and, for a discussion of the hydrographic problems connected with the lake, G. FANTOLI, *Sul Régime Idraulico dei Laghi* (Milan, 1897).

Magic (including CONJURING and LEGERDEMAIN).—The article on White Magic in the earlier volumes of this work (ninth edition, vol. xv.) concludes with a description of Maskelyne's "box-trick"—a trick which others had only partially succeeded in imitating, and the secret of which has never been thoroughly elucidated. In dealing with the more recent history of magic and conjuring, we may conveniently take up the story at the point where the previous article leaves it.

Modern magic has given rise to many interesting developments, but none perhaps attracted a larger share of public attention than the legal battle in the last years of the century over the old box-trick, invented by Mr Maskelyne in 1860. The case had a special interest in England, from the fact that it was the only one in which a trick had ever occupied the attention of the House of Lords. The litigation arose in this way. Mr Maskelyne had been in the habit of offering a considerable reward to any one who could produce a correct imitation of his box-trick. The offer was a direct challenge to imitators, and was intended to show—as nothing else could have done—that the tricks sold and exhibited as "correct imitations" were not what they professed to be. Two amateur mechanicians, having made or procured a box externally resembling Mr Maskelyne's, gave a private performance before a few friends, and then claimed the reward. Mr Maskelyne refused to pay, his contention being that hundreds of people had already escaped from locked and corded boxes resembling his in appearance. Indeed, it was for that very reason that he had been compelled to make the offer. The claimants then brought an action to recover £500—the amount offered. Mr Maskelyne produced his box in court, and challenged the plaintiffs to expose the secret, contending that they could not possibly imitate correctly a trick of which they did not know the secret. Their point, however, was that they had nothing to do with the secret, and that a box-trick was not a trick-box. The jury, being unable to decide whether a mechanical trick is a piece of mechanism or the effect it produces, could not agree, and were discharged. In a second trial, the jury, after much deliberation, found for the plaintiffs. Mr Maskelyne appealed against the verdict. His appeal occupied the court for three days, and was dismissed. Finally he carried the case to the House of Lords, and lost it. The majority of the law lords, while fully admitting that the secret had never been discovered, were of opinion that the trick had been correctly "imitated." To people dealing with mechanical devices this decision is bound to appear not a little curious. A mechanical trick is a mechanical invention, and, when we have two absolutely different inventions, although they may produce more or less similar results, one is by no means an *imitation* of the other—to say nothing of a "correct imitation." Applied to inventions generally, such a ruling would produce disastrous results.

To those interested in magic, however, one effect of the litigation was to intensify the mystery surrounding the original box-trick. The whole matter has been publicly thrashed out. It has been learned that the trick, generally, consists of a movable panel fastened by a secret catch. Provided that the rope be not too severely knotted over the panel, the performer can escape; but otherwise failure is inevitable. Further, it is known that the original trick has never failed, even under the most severe tests, whereas the imitations have failed repeatedly. There can only be one reason for this—a great difference in the mechanical principles employed. What that difference may be can only be decided by future disclosures.

Like most forms of refined entertainment, magic appears to have kept well abreast of the times. Certainly, at no period of the world's history has it ever been so popular as at present. As a natural consequence, so many skilled exponents of the art have never before existed. Yet there is one respect in which at the present day magic shows no advance upon the records of earlier times. The one great peculiarity in connexion with magic, at every period, has been the limited number of those who prove themselves capable of originating magical effects. This peculiarity has never been more thoroughly emphasized than at present. Since the days of Robert Houdin, only two men have attained any remarkable degree of prominence—Mr Maskelyne and M. Buatier de Kolta. There are many who, as entertainers, are entitled to rank with the highest, but to those two only can prominence be justly given as originators. The only logical conclusion to be drawn is that to invent original illusions is a matter of no ordinary difficulty, and, indeed, all who have attempted work of that kind will admit that such is the case. When, however, an original principle has been invented, it may be utilized in producing many and apparently quite distinct effects. As an example of this, Maskelyne's "Cleopatra's Needle," invented in 1879, may be mentioned. The trick consisted of a piece of mechanism representing an exceedingly light model of the famous obelisk. So light was it, in fact, that it could easily be lifted with one hand. Upon an isolated stand, previously examined by the audience, a sheet of ordinary brown paper was laid, and on this the "needle" was placed. Thus during the performance communication with the obelisk was obviously impossible. Yet from within it human beings emerged in a most startling manner. The secret consisted in the fact that the "needle" was capable of being lifted by invisible means, and from the outset contained two or three persons concealed within it. Notwithstanding the fact that this illusion was one of Mr Maskelyne's simplest devices, it puzzled even experts for a considerable time. When at last the secret leaked out, the principle was seized upon with avidity and utilized in a variety of ways—for example, by M. Buatier de Kolta in his beautiful illusion, "The Cocoon," first produced at the Egyptian Hall, London, in 1887. In this case de Kolta had the advantage of Mr Maskelyne's assistance in perfecting the mechanical details. De Kolta's smaller tricks have for years supplied the whole army of ordinary conjurors with novelties. In 1886, at the Eden Theatre, Paris, he introduced his famous illusion known as "The Vanishing Lady." This mystery, performed as he alone could perform it, was one of the most effective tricks ever exhibited. Hundreds of "imitations" were, of course, produced; but, like the imitations of Mr Maskelyne's box, they sink into insignificance when compared with the original; and in this case, unfortunately for the originator, the reputation of the original was speedily ruined by clumsy exponents, who only succeeded in exposing the principle. The effect produced by de Kolta was as follows:—Taking from his pocket what appeared to be an ordinary newspaper, folded, he opened it out and laid it upon the stage. Then a chair was shown, front and back, to the audience, and placed upon the paper. Madame de Kolta, in ordinary evening dress, then took her seat upon the chair, and a large piece of black silk was thrown over her, enveloping her from head to foot. Then de Kolta would shout, "I'll throw you in the air!"—or words to that effect—and to all appearance he grasped her round the waist, lifted her above his head, and she vanished, covering and all, at his finger-tips. The trick, as performed by imitators, is well known, and is described in many works upon conjuring, *e.g.*, in Hoffman's *Magic*.

Among the illusions depending for their effect upon sudden disappearance, perhaps the most inexplicable was that produced by Mr Maskelyne in 1891 under the appropriate title of "Oh!"—that being an expression frequently used by spectators upon witnessing the startling effect. In the illusion the performer whose disappearance was to be effected seated himself upon a raised couch, above which a kind of canopy was supported upon brass rods. From the canopy depended curtains capable of being raised or lowered. The right hand of the performer was strapped to one end of this couch, and the left hand was secured by means of a strap attached to one end of a stout cord. The other end of the cord, having been passed through a hole in the framework of the canopy, was securely held by a member of the audience. The curtains were then lowered to within 18 inches of the ground, and through an aperture in the front curtain the performer's right hand was passed. This hand, again, was held by a second member of the audience. Finally, a sheet of iron was placed beneath the couch, to prevent any possibility of the performer's escape being effected through a trap in the stage. Thus, with the performer's right hand in full view, his left drawn upwards by the cord attached to it, and a clear space below the couch, escape seemed impossible; yet, upon the word "Go!" the right hand disappeared, the cord became slack in the hands of the holder, the curtains were instantly raised, and the performer had vanished. The secret of this mystery, like many others associated with the Egyptian Hall, has been well preserved. Having a theatre to himself, and being surrounded by trusty assistants, Mr Maskelyne possesses a great advantage. Those of his *confrères* who are obliged to perform at variety theatres and elsewhere must necessarily expose their secrets to stage hands. But, apart from this fact, some of Mr Maskelyne's effects are so elaborate in their mechanism that many weeks are occupied in making the stage arrangements. Such effects therefore would be quite impracticable for the purposes of the peripatetic illusionist.

In 1886 M. Buatier de Kolta, in conjunction with Mr Maskelyne, presented at the Egyptian Hall, London, a series of illusionary effects upon an entirely novel principle, to which they gave the name of "Black Magic." The main idea was based upon the fact—obvious when once it is pointed out—that visible form cannot exist in the absence of shadow or varying tint. In other words, we can only distinguish forms when they exhibit either variations in colour or shade. Absolute uniformity must, necessarily, mean invisibility. To bring about this uniformity, the entire stage was draped in black velvet, giving it the appearance of a dark and immensely deep cavern. There were no lights within it, though from the front it was brilliantly illuminated. Upon the stage, thus prepared, the most startling appearances and disappearances took place, within a few feet of the footlights. The illusions were produced by the simple method of covering anything to be concealed by screens of black velvet. These could be brought almost to the front of the stage, and yet would remain invisible; thus, in an instant, persons or articles would appear, apparently from space, or would disappear into it. The principle involved in the production of these illusions was adopted subsequently by many conjurors, and has served to produce an almost endless variety of effects.

The production of innumerable blossoms from a sheet of paper was undoubtedly the prettiest of M. Buatier de Kolta's smaller tricks. A small sheet of cartridge-paper is twisted into a cone, which is shown to be empty, but immediately artificial blossoms begin to pour out of it, until quite a bushel of them are piled up. Unfortunately for the inventor, the first time he introduced the trick at the Eden Theatre, Paris, one or two of the "blossoms" were carried by a draught of air into the auditorium. These were at once sold to a manufacturer of conjuring appliances, and within a few days de Kolta's "Spring Blossoms" were upon the market.

Another startling trick, by the same inventor, is "The Flying Cage." A live bird is imprisoned within a small cage, held between the performer's hands, when suddenly, by a quick movement of the arms, both bird and cage vanish. The cage simply collapses, and is drawn by a string up the coat-sleeve, the unfortunate bird being sometimes maimed, if not killed outright. The Society for the Prevention of Cruelty to Animals once took action in the matter, and sought to prevent the performance of the trick at one of the London music-halls; but the conjuror in this case invited the officials to witness a private demonstration, and was clever enough to convince them that there was no cruelty. Conjuring with animals has a great charm for young folk, and happily it is very seldom that a trick involves any cruelty whatever. The animals, as a rule, quickly become accustomed to the business, and appear thoroughly to understand what is required of them.

In recent years the mystery known as "Second Sight" has been vastly improved. The old system, invented by Pinetti in 1785, and brought to great perfection by Robert Houdin, has almost disappeared. It consisted of an elaborate code of signals, given by means of subtle variations in the questions put to the supposed clairvoyant;

the form in which the question was put conveying the appropriate answer. Now it is customary to avoid speech altogether. The information is conveyed by means of gesture or slight sounds at varying intervals. This business requires an enormous amount of practice, and an abnormal memory on the part of those who become expert.

But there are certain tricks of this class which require little or no skill and a very small amount of practice. These are generally introduced by impostors who claim or tacitly suggest the possession of supernatural powers. The following is a very familiar example of the kind of trick employed by such persons. The performers are usually a man and a woman. The man first appears, and informs the audience that he will shortly introduce a lady possessing extraordinary powers. Not only can she read the thoughts of any person whose mind is *en rapport* with hers, but also she can foretell the future, trace missing friends, discover lost property, &c. In order to display the lady's capabilities, he requests that any members of the audience who have questions they would like answered will write them secretly. For convenience in writing, slips of paper, pencils, and squares of thick millboard are passed round, the millboard squares being for use as writing-desks. The writers are particularly cautioned to allow no one to see what is written, but to fold up the papers and retain them in their own possession. Further, the writers are instructed that, when the clairvoyant appears, the thoughts of each must be kept intently fixed upon what he has written. The pencils and millboards are then collected, and the preparations being so far complete, other portions of the entertainment are proceeded with. Finally, as the last item in the programme, the clairvoyant is introduced. A handkerchief, upon which some liquid has been poured, is held over the lady's nose and mouth, and apparently she falls into a trance. Then she proceeds to describe the appearance of certain of the writers, the position they occupy in the room, and the nature of the questions they have written, giving to those questions more or less plausible answers. The trick never fails to produce the most profound astonishment, and by its means several persons have made rapid strides to fortune. But the whole business is an impudent imposture. Therefore it cannot be too often or too thoroughly exposed. It is accomplished as follows. Some of the millboards passed round for convenience in writing are built up of a number of thicknesses, fastened together at the edges only. Beneath the outer layer a sheet of carbon paper is concealed, so that the pressure of the pencil causes a reproduction in duplicate to be impressed upon an inner layer of cardboard. These prepared pads are handed round by attendants, who note the dress and appearance of the persons by whom the questions are written. That information, together with the prepared pads, is subsequently conveyed to the clairvoyant. She requires a certain amount of time in order to memorize the questions and the description of the writers; consequently she is not introduced to the audience until, say, an hour has elapsed. Of course, it would not be discreet to have all the millboards prepared. Many of them, perhaps the majority, are really what they appear to be; but, needless to say, the questions written upon these are never answered. It is carefully pointed out beforehand that the clairvoyant can only read the questions of those whose minds are in sympathy with hers. That statement, naturally, serves to account for her inability to read or answer questions written by those who have used the plain millboards.

In connexion with this trick a further imposture is carried out by inviting strangers to send, by post, any questions they wish to have answered. Such an invitation appears to be quite straightforward and genuine, but those who are sufficiently credulous or sufficiently curious to respond to it lend themselves to the perpetration of an ingenious fraud. In reply to any such communication, the writer is informed that it is necessary for him to attend one of the public performances, and endeavour to bring his mind into harmony with that of the clairvoyant. Enclosed is a complimentary ticket entitling him to attend *any* performance he pleases. The procedure, then, is simply this. Each ticket bears a private mark, and a corresponding mark is put upon the letter written by the person to whom it is sent. When any marked ticket is presented, the attendant notes the dress and appearance of the visitor and the seat he occupies. That information is given to the clairvoyant, together with the ticket. She refers to the letter bearing the mark corresponding to the ticket, and ascertains what that particular visitor wishes to know. Thus to the public she appears to read and answer a question which has not been written down, but merely thought of by a total stranger. There are numerous methods of obtaining information by means similar to those already described. Sufficient, however, has been said to show that such devices are of the simplest, and require nothing more than a callous effrontery to carry them into effect. Of course, all kinds of mischances are bound to occur. But, when one is supposed to be dealing with undiscovered laws of nature, it does not require much ingenuity to wriggle out of any situation, however difficult.

In reference to that branch of conjuring known as "Legerdemain" or "Sleight-of-hand," which relies mainly upon dexterity of the fingers, for many years little advance was made. But recently some new sleights were introduced from America. These consist in an amplification of the method of concealing coins and cards at the back of the fingers. The principle has received the incongruous title of "back-palming." By means of this method both back and front of the hand alternately can be shown empty, while, notwithstanding its apparent emptiness, the hand nevertheless conceals a coin or card. The first and fourth fingers are caused to act as pivots, upon which the concealed articles are turned from front to back, and *vice versâ*, the turning being performed by the second and third fingers. The movement is very rapid, and is accomplished in the act of turning over the hand to show the two sides alternately. The sleight requires an enormous amount of practice. It has been brought to the highest state of perfection by Herr Valadon.

In all ages a very popular magical effect has been the apparent floating of a person in empty space. An endless variety of ingenious apparatus has been invented for the purpose of producing such effects, and the present article would be incomplete without some reference to one or two of the more modern examples. A very pretty illusion of this kind is that originally produced under the title of "Astarte." A lady is brought forward, and after making her bow to the audience she retires to the back of the stage, the whole of which is draped with black velvet and kept in deep shadow. There she is caused to rise in the air, to move from side to side, to advance and retire, and to revolve in all directions. The secret consists in an iron lever, covered with velvet to match the background, and therefore invisible to the audience. This lever is passed through an opening in the back curtain and attached to a socket upon the metal girdle worn by the performer. The girdle consists of two rings, one inside the other, the inner one being capable of turning about its axis. By means of this main lever and a spindle passing through it and gearing into the inner ring of the girdle, the various movements are produced. A hoop is passed over the performer with a view to demonstrate her complete isolation, but the audience is not allowed to examine it. It has a spring joint which allows it to pass the supporting lever. Among illusions of this class there is probably none that will bear comparison with the "levitation" mystery produced by Mr Maskelyne. A performer, in a recumbent position, is caused to rise several feet from the stage, and to remain suspended in space while an intensely brilliant light is thrown upon him, illuminating the entire surroundings. Persons walk completely round him, and a solid steel hoop, examined by the audience, is passed over him, backwards and forwards, to prove the absence of any tangible connexion. The most skilled experts have failed to give any adequate explanation of this mystery, of which the secret has been well preserved. (G. FA.; J. N. M.)

Magliani, Agostino (1824–1891), Italian politician and financier, was born at Laurino, Salerno, in 1824. Entering the Neapolitan financial administration, he showed such aptitude as to be selected by Sella in 1862 for the post of secretary-general of the Italian Ministry of Finance. Shortly after the advent of the Left he was created senator, and appointed by Depretis Minister of Finance (1877), a position which he held, in spite of attacks, for eleven years. More than any other Italian politician, Magliani represented the "democratic finance" of the Left, arranging for the repeal of the grist tax, reducing the price of salt, and contracting a foreign loan for the abolition of the forced paper currency; but at the same time he seriously burdened the lower classes by increasing indirect taxation to the extent of £12,000,000 per annum, and inaugurating a policy of exaggerated protection. The abolition of the forced currency gained for him temporary popularity; but as the metallic currency gradually proved unequal to the strain of the financial situation, his prestige declined, and he was obliged to resign in December 1888. Unduly optimistic in temperament and lax in administration, he contributed to create the desperate financial position of 1888–1893, but died on 21st February 1891, before realizing the worst consequences of his policy. (H. W. S.)

MAGNETISM.

THE present article contains a short account of the general experimental work in magnetism which has been carried out since the publication of the important treatise in the ninth edition of the *Encyclopædia Britannica*, vol. xv. pp. 219–276. In an introductory section a few elementary formulæ relating to matters of fundamental importance are collected, and definitions are given of the principal terms in common use. Repetition has, as far as possible, been avoided, and this article must be regarded as merely supplementary to the former one. Some special branches of the subject are dealt with in separate articles under the headings MEASURING INSTRUMENTS, ELECTRIC; ELECTROMAGNETS; MAGNETO-OPTICS; and MAGNETISM, TERRESTRIAL. These should be consulted by the reader who desires to acquaint himself with recent advances in the directions indicated.

TERMINOLOGY AND ELEMENTARY PRINCIPLES.

In what follows, the C.G.S. electromagnetic system of units will be generally adopted, and, unless otherwise stated, magnetic substances will be assumed to be isotropic.

Magnetic Classification of Substances.—According to the discovery of Faraday, all substances are either attracted or repelled by the pole of a sufficiently powerful magnet. The metals iron, nickel, and cobalt, together with some of their alloys and compounds, exhibit the phenomenon of attraction in a particularly striking manner. These form a class by themselves, and are spoken of as *ferromagnetic*, or, when confusion is not likely to arise, simply as *magnetic* substances. Those bodies which are attracted, but in a very much less degree, are termed *paramagnetic;* while those which exhibit repulsion are known as *diamagnetic.*

Unit Magnetic Pole.—A pole of unit strength is that which acts on an equal pole at a distance of one centimetre with a force of one dyne. A pole which points north is reckoned positive, one which points south negative. If m_1 and m_2 are the strength of two poles, d the distance between them expressed in centimetres, and f the force in dynes, then $f=m_1m_2/d^2$. The poles at the ends of an infinitely thin magnet, or *magnetic filament,* would act as definite centres of force. An actual magnet may be regarded as a bundle of magnetic filaments, and those portions of the surface of the magnet where the magnetic filaments terminate, and so-called "free magnetism" appears, may be conveniently called poles or polar regions.

Magnetic Field.—The *strength* or *intensity* of a magnetic field at any point is measured by the force in dynes which a unit pole will experience when placed at that point, the *direction* of the field being the direction in which a positive pole is urged. The field strength at any point is also called the *magnetic force* at that point; it is denoted by H, or, when it is desired to draw attention to the fact that it is a vector or directed quantity, by the block letter H or the German character $\mathfrak{H}$.[1] A *line of force* is a line drawn through a magnetic field in the direction of the force at each point through which it passes. A *uniform magnetic field* is one in which H has everywhere the same value and the same direction, the lines of force being therefore straight and parallel. A magnetic field is produced either by a conductor carrying an electric current or by the pole of a magnet. The direction of the magnetic field due to a long straight wire in which a current is flowing is at every point at right angles to the plane passing through it and through the wire. Its strength at any point distant r centimetres from the wire is

$$H=2i/r,$$

i being the current in C.G.S. units.[2] The lines of force are evidently circles concentric with the wire and in planes at right angles to it. The field at the centre of a circular conductor of radius r through which a current is passing is

$$H=2\pi i/r,$$

the direction of the field being along the axis. The field strength in the interior of a long uniformly wound coil containing n turns of wire and having a length of l centimetres is (except near the ends)

$$H=4\pi in/l.$$

In the middle portion of the coil the strength of the field is very nearly uniform, but towards the ends it diminishes, and at the ends themselves is reduced to one-half. The direction of the field is parallel to the axis of the coil, and is related to the direction of the current circulating through the wire in the same manner as the thrust of a corkscrew is related to its rotation. If the coil has the form of an endless ring of mean radius r, the length will be $2\pi r$, and the field inside the coil may be expressed as

$$H=2ni/r.$$

The uniformity of the field is not in this case disturbed by the influence of ends, but its strength at any point varies inversely as the distance from the axis of the ring. When, therefore, sensible uniformity is desired, the radius of the ring should be large in relation to that of the convolutions, or the ring should have the form of a short cylinder with thin walls. The strongest magnetic fields employed for experimental purposes are obtained by the use of electromagnets. For many experiments the field due to the earth's magnetism is sufficient; this is practically quite uniform throughout considerable spaces, but its total intensity is less than half a unit. Magnetic force is sometimes, and perhaps more suitably, termed *magnetic intensity;* it corresponds to the intensity of gravity *g* in the theory of heavy bodies (see Maxwell, *Electricity and Magnetism,* § 12 and § 68, footnote).

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[1] Maxwell employed German characters to denote vector quantities. J. A. Fleming first recommended the use of block letters, as being more convenient both to printers and to readers. In the article MAGNETISM (*Ency. Brit.* 9th ed.) Old English characters are used.

[2] The C.G.S. unit of current = 10 amperes.

Magnetic Induction or Magnetic Flux.—When magnetic force acts on any medium, whether magnetic or diamagnetic or neutral, it produces within it a phenomenon of the nature of a flux called *magnetic induction* (Maxwell, *loc. cit.* § 428). Magnetic induction, like other fluxes, such as electric, thermal, or fluid currents, is defined with reference to an area; it satisfies the same conditions of continuity as the electric current does, and in isotropic media it depends on the magnetic force just as the electric current depends on the electromotive force. The magnitude of the flux produced by a given magnetic force differs in different media. In a uniform magnetic field of unit intensity, formed in empty space, the induction or magnetic flux across an area of 1 square centimetre normal to the direction of the field is arbitrarily taken as the unit of induction. Hence, if the induction per square centimetre at any point is denoted by B (or by **B** or 𝔅 when the vector quality is to be attended to), then in empty space B is numerically equal to H; moreover, in isotropic media both have the same direction, and for these reasons it is often said that in empty space (and practically in air) B and H are identical. Their numerical equality is, however, a mere accident, depending upon the capricious selection of a definition by the framers of the C.G.S. electromagnetic system of units (see ELECTRICITY, § iv., *Electric Units*). The magnetic flux per square centimetre at any point (B, **B**, or 𝔅) is briefly called the *induction,* or, especially by electrical engineers, the *flux-density.* The direction of magnetic induction may be indicated by *lines of induction;* a line of induction is always a closed curve. Lines of induction drawn through every point in the contour of a small surface form a re-entrant tube bounded by lines of induction; such a tube is called a *tube of induction.* The cross-section of a tube of induction may vary in different parts, but the total induction across any section is everywhere exactly the same. A special meaning has been assigned to the term "lines of induction." Suppose the whole space in which induction is taking place to be divided up into *unit tubes,* such that the surface integral of the induction over any cross-section of a tube is equal to unity, and along the axis of each tube let a line of induction be drawn. These axial lines constitute the system of lines of induction which are so often referred to in the specification of a field. Where the induction is high, the lines will be crowded together; where it is weak, they will be widely separated, the number per square centimetre crossing a normal surface at any point being always equal to the numerical value of B. The induction may therefore be specified as B lines per square centimetre. The direction of the induction is also of course indicated by the direction of the lines, which thus serve to map out space in a convenient manner. Lines of induction are frequently but inaccurately spoken of as lines of force.

Magnetic Moment and Magnetization.—The *moment* of a uniformly and longitudinally magnetized bar magnet is the product of its length into the strength of one of its poles. The *intensity of magnetization,* or, more shortly, the *magnetization* of a uniformly magnetized body, is defined as the magnetic moment per unit of volume (1 cubic centimetre), and is denoted by I, **I**, or 𝔍. When induction or magnetic flux takes place in a ferromagnetic metal, the metal becomes magnetized, but the magnetization at any point is proportional not to B, but to B − H. If the C.G.S. electromagnetic system of units is adopted, the factor of proportionality will be $1/4\pi$, so that

$$\mathrm{I}=(\mathrm{B}-\mathrm{H})/4\pi,$$

or

$$\mathrm{B}=\mathrm{H}+4\pi\mathrm{I}.$$

Unless the path of the induction is entirely inside the metal, free magnetic poles are developed at those parts of the metal where induction enters and leaves, the polarity being south at the entry and north at the exit of the flux. These free poles produce a magnetic field which is coexistent with that arising from other sources. The *resultant magnetic field,* therefore, is compounded of two fields, the one being due to the poles, and the other to the external causes which would be operative in the absence of the magnetized metal. The intensity (at any point) of the field due to the magnetization may be denoted by H_i, that of the external field by H_0, and that of the resultant field by H. In certain cases, as, for instance, in an iron ring wrapped uniformly round with a coil of wire through which a current is passing, the induction is entirely within the metal; there are, consequently, no free poles, and the ring, though magnetized, constitutes a poleless magnet. Magnetization is usually regarded as the direct effect of magnetic force, which is therefore often termed the *magnetizing force.*

Permeability and Susceptibility.—The ratio B/H is called the *permeability* of the medium in which the induction is taking place, and is denoted by μ. The ratio I/H is called the *susceptibility* of the magnetized substance, and is denoted by κ. Hence

$$\mathrm{B}=\mu\mathrm{H} \text{ and } \mathrm{I}=\kappa\mathrm{H}.$$

Also

$$\mu=\frac{\mathrm{B}}{\mathrm{H}}=\frac{\mathrm{H}+4\pi\mathrm{I}}{\mathrm{H}}=1+4\pi\kappa,$$

and

$$\kappa=\frac{\mu-1}{4\pi}.$$

Since in empty space B has been assumed to be numerically equal to H, it follows that the permeability of a vacuum is equal to 1. The permeability of most material substances differs very slightly from unity, being greater in paramagnetic and less in diamagnetic substances. In the case of the ferromagnetic metals and some of their alloys and compounds, the permeability has generally a much higher value. Moreover, it is not constant, being an apparently arbitrary function of H or of B; in the same specimen its value may, under different conditions, vary from less than 2 to upwards of 5000. The magnetic susceptibility κ expresses the numerical relation of the magnetization to the magnetizing force. From the equation $\kappa=(\mu-1)/4\pi$, it follows that the magnetic susceptibility of a vacuum (where $\mu=1$) is 0, that of a diamagnetic substance (where $\mu<1$) has a negative value, while the susceptibility of paramagnetic and ferromagnetic substances (for which $\mu>1$) is positive. No substance has yet been discovered having a negative susceptibility sufficiently great to render the permeability $(=1+4\pi\kappa)$ negative.

Hysteresis, Coercive Force, Retentiveness.—It is found that when a piece of ferromagnetic metal, such as iron, is subjected to a magnetic field of changing intensity, the changes which take place in the induced magnetization of the iron exhibit a tendency to lag behind those which occur in the intensity of the field—a phenomenon to which Ewing (*Phil. Trans.* vol. clxxvi. p. 524) has given the name of *hysteresis* (from ὑστερέω, to lag behind). Thus it happens that there is no definite relation between the magnetization of a piece of metal which has been previously magnetized and the strength of the field in which it is placed. Much depends upon its antecedent magnetic condition, and indeed upon its whole magnetic history. A well-known example of hysteresis is presented by the case of permanent magnets. If a bar of hard steel is placed in a strong magnetic field, a certain intensity of magnetization is induced in the bar; but when the strength of the field is afterwards reduced to zero, the magnetization does not entirely disappear. That portion which is permanently retained, and which may amount to considerably more than one-half, is called the *residual magnetization.* The ratio of the residual magnetization to its previous maximum value measures the *retentiveness* of the metal.[1] Steel which is well suited for the construction of permanent magnets is said to possess great "coercive force." To this term, which had long been used in a loose and indefinite manner, Hopkinson supplied a precise meaning (*Phil. Trans.* vol. clxxvi. p. 460). The *coercive force* of a material is that reversed magnetic force which, while it is acting, just suffices to reduce the residual induction to nothing after the material has been temporarily submitted to any great magnetizing force. A metal which has great retentiveness may at the same time have small coercive force, and it is the latter quality which is of chief importance in permanent magnets.

Demagnetizing Force.—It has already been mentioned that when a ferromagnetic body is placed in a magnetic field, the resultant magnetic force H, at a point within the body, is compounded of the force H_0, due to the external field, and of another force, H_i, arising from the induced magnetization of the body. Since H_i generally tends to oppose the external force, thus making H less than H_0, it may be called the *demagnetizing force.* Except in a few special cases, when a uniform external field produces uniform magnetization, the value of the demagnetizing force cannot be calculated, and an exact determination of the actual magnetic force within the body is therefore impossible. An important instance in which the calculation can be made is that of an elongated ellipsoid of revolution placed in a uniform field H_0, with its axis of revolution parallel to the lines of force. The magnetization at any point inside the ellipsoid will then be

$$\mathrm{I}=\frac{\kappa\mathrm{H}_0}{1+\kappa\mathrm{N}}$$

where

$$\mathrm{N}=4\pi\left(\frac{1}{e^2}-1\right)\left(\frac{1}{2e}\log\frac{1+e}{1-e}-1\right),$$

e being the eccentricity (see *Ency. Brit.* vol. xv. pp. 246, 232). Since $\mathrm{I}=\kappa\mathrm{H}$, we have

$$\kappa\mathrm{H}+\kappa\mathrm{NI}=\kappa\mathrm{H}_0,$$

or

$$\mathrm{H}=\mathrm{H}_0-\mathrm{NI},$$

NI being the demagnetizing force H_i. N may be called, after du Bois (*Magnetic Circuit,* p. 33), the *demagnetizing factor,* and the ratio of the length of the ellipsoid $2c$ to its equatorial diameter $2a$ $(=c/a)$, the *dimensional ratio*, denoted by the symbol $\mathfrak{m}$.

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[1] Hopkinson specified the retentiveness by the numerical value of the "residual induction" $(=4\pi\mathrm{I})$.

Since $$e=\sqrt{1-\frac{a^2}{c^2}}=\sqrt{1-\frac{1}{\mathfrak{m}^2}},$$

the above expression for N may be written

$$\begin{aligned}N&=\frac{4\pi}{\mathfrak{m}^2-1}\left(\frac{\mathfrak{m}}{2\sqrt{\mathfrak{m}^2-1}}\log\frac{\mathfrak{m}+\sqrt{\mathfrak{m}^2-1}}{\mathfrak{m}-\sqrt{\mathfrak{m}^2-1}}-1\right)\\&=\frac{4\pi}{\mathfrak{m}^2-1}\left\{\frac{\mathfrak{m}}{\sqrt{\mathfrak{m}^2-1}}\log\left(\mathfrak{m}+\sqrt{\mathfrak{m}^2-1}\right)-1\right\},\end{aligned}$$

from which the value of N for a given dimensional ratio can be calculated. When the ellipsoid is so much elongated that 1 is negligible in relation to $\mathfrak{m}^2$, the expression approximates to the simpler form

$$N=\frac{4\pi}{\mathfrak{m}^2}\left(\log 2\mathfrak{m}-1\right).$$

The demagnetizing force inside a cylindrical rod placed longitudinally in a uniform field H_0 is not uniform, being greatest at the ends and least in the middle part. Denoting its mean value by $\overline{H}_i$, and that of the demagnetizing factor by $\overline{N}$, we have

$$H=H_0-\overline{H}_i=H_0-\overline{N}I.$$

Du Bois has shown that when the dimensional ratio $\mathfrak{m}$ (=length/diameter) exceeds 100, $\overline{N}\mathfrak{m}^2=\text{constant}=45$, and hence for long thin rods

$$\overline{N}=45/\mathfrak{m}^2.$$

From an analysis of a number of experiments made with rods of different dimensions, du Bois has deduced the corresponding mean demagnetizing factors. These, together with values of $\mathfrak{m}^2\overline{N}$ for cylindrical rods, and of N and $\mathfrak{m}^2$N for ellipsoids of revolution, are given in the following very useful table (*loc. cit.* p. 41):—

Demagnetizing Factors.

$\mathfrak{m}$.	Cylinder.		Ellipsoid.	
	$\overline{N}$.	$\mathfrak{m}^2\overline{N}$.	N.	$\mathfrak{m}^2$N.
0	12·566	0	12·5664	0
0·5	—	—	6·5864	—
1	—	—	4·1888	—
5	—	—	0·7015	—
10	0·2160	21·6	0·2549	25·5
15	0·1206	27·1	0·1350	30·5
20	0·0775	31·0	0·0848	34·0
25	0·0533	33·4	0·0579	36·2
30	0·0393	35·4	0·0432	38·8
40	0·0238	38·7	0·0266	42·5
50	0·0162	40·5	0·0181	45·3
60	0·0118	42·4	0·0132	47·5
70	0·0089	43·7	0·0101	49·5
80	0·0069	44·4	0·0080	51·2
90	0·0055	44·8	0·0065	52·5
100	0·0045	45·0	0·0054	54·0
150	0·0020	45·0	0·0026	58·3
200	0·0011	45·0	0·0016	64·0
300	0·00050	45·0	0·00075	67·5
400	0·00028	45·0	0·00045	72·0
500	0·00018	45·0	0·00030	75·0
1000	0·00005	45·0	0·00008	80·0

In the middle part of a rod which has a length of 400 or 500 diameters the effect of the ends is insensible; but for many experiments the condition of endlessness may be best secured by giving the metal the shape of a ring of uniform section, the magnetic field being produced by an electric current through a coil of wire evenly wound round the ring. In such cases $H_i=0$ and $H=H_0$.

The residual magnetization I_r retained by a bar of ferromagnetic metal after it has been removed from the influence of an external field produces a demagnetizing force $\overline{N}I_r$, which is greater the smaller the dimensional ratio. Hence the difficulty of imparting any considerable permanent magnetization to a short thick bar not possessed of great coercive force. The magnetization retained by a long thin rod, even when its coercive force is small, is sometimes little less than that which was produced by the direct action of the field.

Demagnetization by Reversals.—In the course of an experiment it is often desired to eliminate the effects of previous magnetization, and, as far as possible, wipe out the magnetic history of a specimen. In order to attain this result it was formerly the practice to raise the metal to a bright red heat, and allow it to cool while carefully guarded from magnetic influence. This operation, besides being very troublesome, was open to the objection that it was almost sure to produce a material but uncertain change in the physical constitution of the metal, so that, in fact, the results of experiments made before and after the treatment were not comparable. Ewing introduced the method (*Phil. Trans.* vol. clxxvi. p. 539) of demagnetizing a specimen by subjecting it to a succession of magnetic forces which alternated in direction and gradually diminished in strength from a high value to zero. By means of a simple arrangement, which will be described farther on, this process can be carried out in a few seconds, and the metal can be brought as often as desired to a definite condition, which, if not quite identical with the virgin state, at least closely approximates to it.

The laws of the *magnetic circuit* are discussed under the heading ELECTROMAGNET.

MAGNETIC MEASUREMENTS.

Measurement of Magnetization and Induction.—The magnetic condition assumed by a piece of ferromagnetic metal in different circumstances is determinable by various modes of experiment which may be classed as magnetometric, ballistic, and traction methods. When either the magnetization I or the induction B corresponding to a given magnetizing force H is known, the other mav be found by means of the formula $B=4\pi I+H$.

Magnetometric Methods.—Intensity of magnetization is most directly measured by observing the action which a magnetized body, generally a long straight rod, exerts upon a small magnetic needle placed near it. The magnetic needle may be cemented horizontally across the back of a little plane or concave mirror, about $\frac{1}{4}$ or $\frac{3}{8}$ inch in diameter, which is suspended by a single fibre of unspun silk; this arrangement, when enclosed in a case with a glazed front to protect it from currents of air, constitutes a simple but efficient magnetometer. Deflections of the suspended needle are indicated by the movement of a narrow beam of light which the mirror reflects from a lamp and focusses upon a graduated cardboard scale placed at a distance of a few feet; the angular deflection of the beam of light is, of course, twice that of the needle. The suspended needle is, in the absence of disturbing causes, directed solely by the horizontal component of the earth's field of magnetic force H_E, and therefore sets itself approximately north and south. The magnetized body which is to be tested should be placed in such a position that the force H_P due to its poles may, at the spot occupied by the suspended needle, act in a direction at right angles to that due to the earth—that is, east and west. The direction of the resultant field of force will then make, with that of H_E, an angle θ, such that $H_P/H_E=\tan\theta$, and the suspended needle will be deflected through the same angle. We have therefore

$$H_P=H_E\tan\theta.$$

The angle θ is indicated by the position of the spot of light upon the scale, and the horizontal intensity of the earth's field H_E is known; thus we can at once determine the value of H_P, from which the magnetization I of the body under test may be calculated.

In order to fulfil the requirement that the field which a magnetized rod produces at the magnetometer shall be at right angles to that of the earth, the rod may be conveniently placed in any one of three different positions with regard to the suspended needle.

(1) The rod is set in a horizontal position level with the suspended needle, its axis being in a line which is perpendicular to the magnetic meridian, and which passes through the centre of suspension of the needle. This is called the "end-on" position, and is indicated in Fig. 1. AB is the rod and C the middle point of its axis; NS is the magnetometer needle; AM bisects the

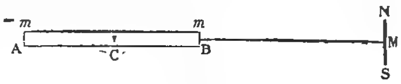

Fig. 1.

undeflected needle NS at right angles. Let $2l$ = the length of the rod (or, more accurately, the distance between its poles), v = its volume, m and $-m$ the strength of its poles, and let d = the distance CM. For most ordinary purposes the length of the needle may be assumed to be negligible in comparison with the distance between the needle and the rod. We then have approximately for the field at M due to the rod

$$\mathrm{H}_{\mathrm{P}}=\frac{m}{(d-l)^2}-\frac{m}{(d+l)^2}=m\frac{4dl}{(d^2-l^2)^2}.$$

Therefore $$2\,ml=\frac{(d^2-l^2)^2\mathrm{H}}{2d}=\frac{(d^2-l^2)^2\mathrm{H}_{\mathrm{E}}\tan\theta.}{2d}$$

And $$\mathrm{I}=\frac{2ml}{v}=\frac{(d^2-l^2)^2\mathrm{H}_{\mathrm{E}}}{2dv}\tan\theta,$$

whence we can find the values of I which correspond to different angles of deflection.

(2) The rod may be placed horizontally east and west in such a position that the direction of the undeflected suspended needle bisects it at right angles. This is known as the "broadside-on" position, and is represented in Fig. 2. Let the distance of each pole of the rod AB from the centre of the magnetometer needle $=d$. Then, since H_{P}, the force at M due to m and $-m$, is the resultant of $\frac{m}{d^2}$ and $-\frac{m}{d^2}$, we have

$$\frac{\mathrm{H}_{\mathrm{P}}}{\frac{m}{d^2}}=\frac{2l}{d}$$

or $$\mathrm{H}=\frac{2ml}{d^3},$$

the direction being parallel to AB.

And $$\mathrm{I}=\frac{d^3\mathrm{H}_{\mathrm{P}}}{v}=\frac{d^3\mathrm{H}_{\mathrm{E}}}{v}\tan\theta.$$

(3) In the third position the test rod is placed vertically with one of its poles at the level of the magnetometer needle, and in the line drawn perpendicularly to the undeflected needle from its centre of suspension. The arrangement is shown in Fig. 3, where AB is the vertical rod and M indicates the position of the magnetometer needle, which is supposed to be perpendicular to the plane of the paper. Denoting the distance AM by d_1, BM by d_2, and AB by l, we have for the force at M due to the magnetism of the rod

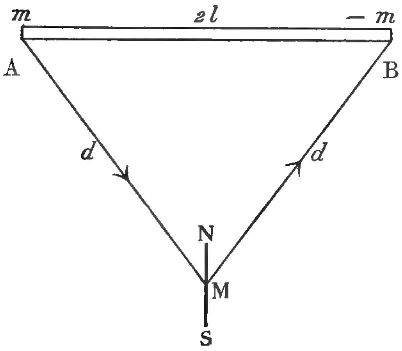

Fig. 2.

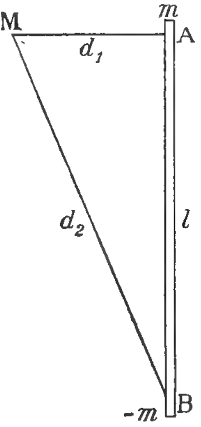

Fig. 3.

$$\mathrm{H}_{\mathrm{P}}=\frac{m}{{d_1}^2}-\text{horizontal component of }\frac{m}{{d_2}^2}$$

$$=m\left(\frac{1}{{d_1}^2}-\frac{d_1}{{d_2}^3}\right).$$

Therefore $$m=\frac{\mathrm{H}_{\mathrm{P}}}{\frac{1}{{d_1}^2}-\frac{d_1}{{d_2}^3}}=\frac{{d_1}^2\mathrm{H}_{\mathrm{E}}}{1-\left(\frac{d_1}{d_2}\right)^3}\tan\theta,$$

and $$\mathrm{I}=\frac{l{d_1}^2\,\mathrm{H}_{\mathrm{E}}}{v\left\{1-\left(\frac{d_1}{d_2}\right)^3\right\}}\tan\theta.$$

This last method of arrangement is called by Ewing the "one-pole" method, because the magnetometer deflection is mainly caused by the upper pole of the rod (*Magnetic Induction*, p. 40). For experiments with long thin rods or wires it has an advantage over the other arrangements in that the position of the poles need not be known with great accuracy, a small upward or downward displacement having little effect upon the magnetometer deflection. On the other hand, a vertically-placed rod is subject to the inconvenience that it is influenced by the earth's magnetic field, which is not the case when the rod is horizontal and at right angles to the magnetic meridian. This extraneous influence may, however, be allowed for, or it may preferably be eliminated by surrounding the rod with a coil of wire carrying a current such as will produce in the interior a magnetic field equal and opposite to the vertical component of the earth's field.

If the cardboard scale upon which the beam of light is reflected by the magnetometer mirror is a flat one, the deflections as indicated by the movement of the spot of light are related to the actual deflections of the needle in the ratio of tan 2θ to θ. Since θ is always small, sufficiently accurate results may generally be obtained, and much trouble saved, if we assume that $\tan 2\theta = 2\tan\theta$. If the distance of the mirror from the scale is equal to n scale divisions, and if a deflection θ of the needle causes the reflected spot of light to move over s scale divisions, we shall have

$$s/n=\tan 2\theta \text{ exactly},$$
$$s/2n=\tan\theta \text{ approximately}.$$

We may therefore generally substitute $s/2n$ for $\tan\theta$ in the various expressions which have been given for I.

Of the three methods which have been described, the first two are generally the most suitable for determining the moment or the magnetization of a permanent magnet, and the last for studying the changes which occur in the magnetization of a long rod or wire when subjected to various external magnetic forces, or, in other words, for determining the relation of I to H. A plan of the apparatus as arranged by Ewing for the latter purpose is shown diagrammatically in Fig. 4. The cardboard scale SS is placed above a wooden screen, having in it a narrow vertical slit which permits a beam of light from the lamp L to reach the mirror of the magnetometer M, whence it is reflected upon the scale. A is the upper end of a glass tube, half a metre or so in length, which is clamped in a vertical position behind the magnetometer. The tube is wound over its whole length with two separate coils of insulated wire, the one being outside the other. The inner coil is supplied, through the intervening apparatus, with current from the battery of secondary cells B_1; this produces the desired magnetic field inside the tube. The outer coil derives current, through an adjustable resistance R, from a constant cell B_2; its object is to produce inside the tube a magnetic field equal and opposite to that due to the earth's magnetism. C is a "compensating coil" consisting of a few turns of wire through which the magnetizing current passes; it serves to neutralize the effect produced upon the magnetometer by the magnetizing coil, and its distance from the magnetometer is so adjusted that when the circuit is closed, no ferromagnetic metal being inside the magnetizing coil, the magnetometer needle undergoes no deflection. K is a commutator for reversing the direction of the magnetizing current, and G a galvanometer for measuring it. The strength of the magnetizing current is regulated by adjusting the position of the sliding contact E upon the resistance DF. In Ewing's experiments the resistance employed was a liquid one, but except when variations of the current are required to be absolutely continuous, it is less troublesome to use a spiral of bare German silver wire wound rather closely upon a long insulating cylinder. The current increases to a maximum as E approaches F, and diminishes to almost nothing when E is brought up to D; it can be completely interrupted by means of the switch H.

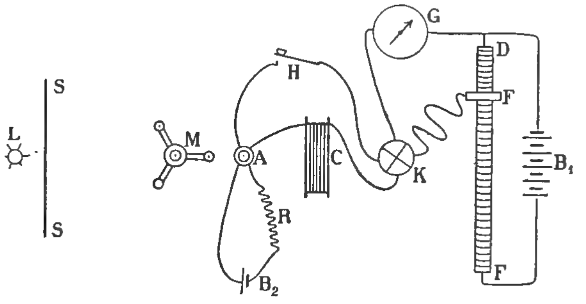

Fig. 4

The specimen upon which an experiment is to be made generally consists of a wire having a "dimensional ratio" of at least 300 or 400; its length should be rather less than that of the magnetizing coil, in order that the field H_0, to which it is subjected, may be approximately uniform from end to end. The wire is supported inside the glass tube A with its upper pole at the same height as the magnetometer needle. Various currents are then passed through the magnetizing coil, the galvanometer readings and the simultaneous magnetometer deflections being noted. From the former we deduce H_0, and from the latter the corresponding value of I, using the formulæ $H_0 = 4\pi in/l$ and

$$I = \frac{d_1^2 H_E}{2n\pi r^2\left\{1 - \left(\frac{d_1}{d_2}\right)^3\right\}} \times s,$$

where s is the deflection in scale-divisions, n the distance in scale-divisions between the scale and the mirror, and r the radius of the wire.

The curve, Fig. 5, shows the result of a typical experiment made upon a piece of soft iron (Ewing, *Phil. Trans.* vol. clxxvi. plate 59), the magnetizing field H_0 being first gradually increased and then diminished to zero. When the length of the wire exceeds 400 diameters, or thereabouts, H_0 may generally be considered as equivalent to H, the actual strength of the field as modified by the magnetization of the wire; but if great accuracy is desired, the value of H_i ($=\overline{N}I$) may be found by the help of du Bois's table and subtracted from H_0. For a dimensional ratio of 400, $\overline{N} = 0·00028$, and therefore $H = H_0 - 0·00028\ I$. This correction may be indicated in the diagram by a straight line drawn from 0 through the point at which the line of $I = 1000$ intersects that of $H = 0·28$ (Rayleigh, *Phil. Mag.* vol. xxii. p. 175), the true value of H for any point on the curve being that measured from the sloping line instead of from the vertical axis. The effect of the ends of the wire is, as Ewing remarks, to *shear* the diagram in the horizontal direction through the angle which the sloping line makes with the vertical.

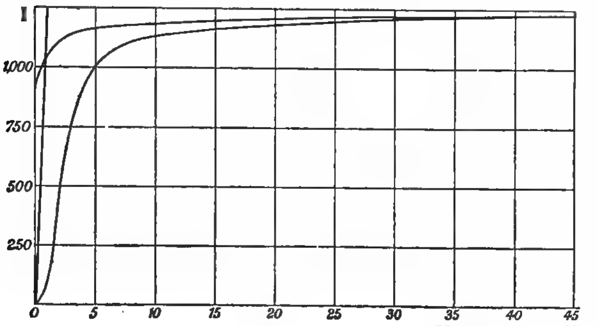

Fig. 5.

Since the induction B is equal to $H + 4\pi I$, it is easy from the results of experiments such as that just described to deduce the relation between B and H; a curve indicating such relation is called a curve of induction. The general character of curves of magnetization and of induction will be discussed later. A notable feature in both classes of curves is that, owing to hysteresis, the ascending and descending limbs do not coincide, but follow very different courses. If it is desired to annihilate the hysteretic effects of previous magnetization and restore the metal to its original condition, it may be demagnetized by reversals. This is effected by slowly moving the sliding contact E (Fig. 4) from F to D, while at the same time the commutator K is rapidly worked, a series of alternating currents of gradually diminishing strength being thus caused to pass through the magnetizing coil.

Several pieces of apparatus in which a magnetometer is employed have been devised for comparing the magnetic quality of a sample with that of a standard iron rod by a zero method analogous to that of the Wheatstone bridge. An excellent instrument of the class is Ewing's "permeability bridge," a description of which will be found under ELECTROMAGNET.

Ballistic Methods.—The so-called "ballistic" method of measuring induction is based upon the fact that a change of the induction through a closed linear conductor sets up in the conductor an electromotive force which is proportional to the rate of change. (See *Ency. Brit.*, ELECTRICITY, vol. viii. p. 75; and MAGNETISM, vol. xv. p. 240.) If the conductor consists of a coil of wire the ends of which are connected with a suitable galvanometer, the integral electromotive force due to a sudden increase or decrease of the induction through the coil displaces in the circuit a quantity of electricity $Q = \delta Bns/R$, where δB is the increment or decrement of induction per square centimetre, s is the area of the coil, n the number of turns of wire, and R the resistance of the circuit. Under the influence of the transient current, the galvanometer needle undergoes a momentary deflection, or "throw," which is proportional to Q, and therefore to δB, and thus, if we know the deflection produced by the discharge through the galvanometer of a given quantity of electricity, we have the means of determining the value of δB.

The galvanometer which is used for ballistic observations should have a somewhat heavy needle with a period of vibration of not less than five seconds, so that the transient current may have ceased before the swing has well begun; an instrument of the d'Arsonval form is recommended, not only because it is unaffected by outside magnetic influence, but also because the moving part can be instantly brought to rest by means of a short-circuit key, thus effecting a great saving of time when a series of observations is being made. In practice it is usual to standardize or "calibrate" the galvanometer by causing a known change of induction to take place within a standard coil connected with it, and noting the corresponding deflection on the galvanometer scale. Let s be the area of a single turn of the standard coil, n the number of its turns, and r the resistance of the circuit of which the coil forms part; and let S, N, and R be the corresponding constants for a coil which is to be used in an experiment. Then if a known change of induction δB_a inside the standard coil is found to cause a throw of d scale-divisions, any change of induction δB through the experimental coil will be numerically equal to the corresponding throw D multiplied by $snRB_a/SNrd$. For a series of experiments made with the same coil this fraction is constant, and we may write $\delta B = kD$. Rowland and others (*Ency. Brit.* vol. xv. p. 255) have used an earth coil for calibrating the galvanometer, a known change of induction through the coil being produced by turning it over in the earth's magnetic field, but for several reasons it is preferable to employ an electric current as the source of a known induction. A primary coil of length l, having n turns, is wound upon a cylinder made of non-conducting and non-magnetic material, and upon the middle of the primary a secondary or induction coil is closely fitted. When a current of strength i is suddenly interrupted in the primary, the increment of induction through the secondary is sensibly equal to $4\pi in/l$ units. All the data required for standardizing the galvanometer can in this way be determined with accuracy.

The ballistic method is largely employed for determining the relation of induction to magnetizing force in samples of the iron and steel used in the manufacture of electrical machinery, and especially for the observation of hysteresis effects. The sample may have the form of a closed ring, upon which are wound the induction coil and another coil for taking the magnetizing current; or it may consist of a long straight rod or wire which can be slipped into a magnetizing coil such as is used in magnetometric experiments, the induction coil being wound upon the middle of the wire. With these arrangements there is no demagnetizing force to be considered, for the ring has not any ends to produce one, and the force due to the ends of a rod 400 or 500 diameters in length is quite insensible at the middle portion; H therefore is equal to H_0.

Induction and Hysteresis Curves.—Some typical induction curves, copied from a paper by Ewing (*Proc. Inst. C.E.* vol. cxxvi.), are given in Figs. 6, 7, and 8. Fig. 6 shows the relation of B to H in a specimen which has never before been magnetized. The experiment may be made in two different ways: (1) the magnetizing current is increased by a series of sudden steps, each of which produces a ballistic throw, the value of B after any one throw being proportional to the sum of that and all the previous throws; (2) the magnetizing current having been brought to any desired value, is suddenly reversed, and the observed throw taken as measuring twice the actual induction. Fig. 7 shows the nature of the course taken by the curve when the magnetizing current, after having been raised to the value corresponding to the point *a*, is diminished by steps until it is nothing, and then gradually increased in the reverse direction. The downward course of the curve is, owing to hysteresis, strikingly different from its upward course, and when the magnetizing force has been reduced to zero, there is still remaining an induction of 7500 units. If the operation is again reversed, the upward course will be nearly, but not exactly, of the form shown by the line *d e a*, Fig. 8. After a few repetitions of the reversal, the process becomes strictly cyclic, the upward and downward curves always following with precision the paths indicated in the figure. In order to establish the cyclic condition, it is sufficient to apply alternately the greatest positive and negative forces employed in the test (greatest $H =$ about ± 5 C.G.S. units in the case illustrated in the figure), an operation which is performed by simply reversing the direction of the maximum magnetizing current a few times.

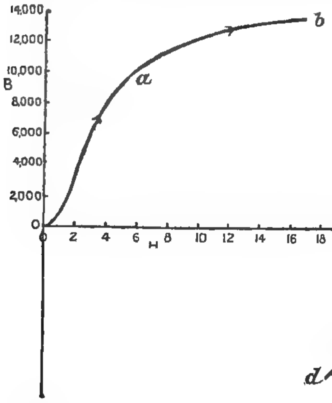

Fig. 6.

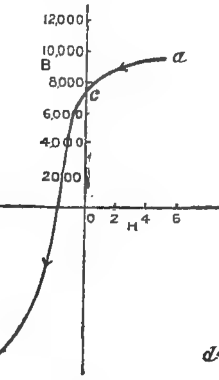

Fig. 7.

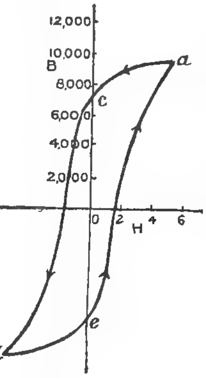

Fig 8.

The closed figure *a c d e a* is variously called a *hysteresis curve* or *diagram* or *loop*. The area $\int H dB$ enclosed by it represents the work done in carrying a cubic centimetre of the iron through the corresponding magnetic cycle; expressed in ergs this work is $\frac{1}{4\pi}\int H dB$.[1] To quote an example given by Fleming, it requires about 18 foot-pounds of work to make a complete magnetic cycle in a cubic foot of wrought iron, strongly magnetized first one way and then the other, the work so expended taking the form of heat in the mass.

Fig. 9 shows diagrammatically a convenient arrangement described by Ewing (see *Proc. Inst. C.E.* vol. cxxvi., and *Phil. Trans.*, 1893A, p. 987) for carrying out ballistic tests by which either the simple B–H curve (Fig. 6) or the hysteresis curve (Figs. 7 and 8) can be determined. The sample under test is prepared in the form of a ring A, upon which are wound the induction and the magnetizing coils; the latter should be wound evenly over the whole ring, though for the sake of clearness only part of the winding is indicated in the diagram. The magnetizing current, which is derived from the storage battery B, is regulated by the adjustable resistance R and measured by the galvanometer G. The current passes through the rocking key K, which, when thrown over to the right, places *a* in contact with *c* and *b* with *d*, and when thrown over to the left, places *a* in contact with *e* and *b* with *f*. When the switch S is closed, K acts simply as a commutator or current-reverser, but if K is thrown over from right to left while S is opened, not only is the current reversed, but its strength is at the same time diminished by the interposition of the adjustable resistance R_2. The induction coil wound upon the ring is connected to the ballistic galvanometer G_2 in series with a large permanent resistance R_3. In the same circuit is also included the induction coil E, which is used for standardizing the galvanometer; this secondary coil is represented in the diagram by three turns of wire wound over a much longer primary coil. The short-circuit key F is kept closed except when an observation is about to be made; its object is to arrest the swing of the d'Arsonval galvanometer G_2. By means of the three-way switch C the battery current may be sent either into the primary of E, for the purpose of calibrating the galvanometer, or into the magnetizing coil of the ring under test. When it is desired to obtain a simple curve of induction such as that in Fig. 6, S is kept permanently closed, and corresponding values of H and B are determined by one of the two methods already described, the strength of the battery-current being varied by means of the adjustable resistance R. When a hysteresis curve is to be obtained, the procedure is as follows:—the current is first adjusted by means of R to such a strength as will fit it to produce the greatest + and − values of the magnetizing force which it is intended to apply in the course of the cycle; then it is reversed several times, and when the range of the galvanometer throws has become constant, half the extent of an excursion indicates the induction corresponding to the extreme value of H, and gives the point *a* in the curve Fig. 7. The reversing key K having been put over to the left side, the short-circuit key S is suddenly opened; this inserts the resistance R, which has been suitably adjusted beforehand, and thus reduces the current and therefore the magnetizing force to a known value. The galvanometer throw which results from the change of current measures the amount by which the induction is reduced, and thus a second point on the curve is found. In a similar manner, by giving different values to the resistance R, any desired number of points between *a* and *c* in the curve can be determined. To continue the process, the key K is turned over to the right-hand side, and then, while S is open, is turned back, thereby not only reversing the direction of the current, but diminishing its strength by an amount depending upon the previous adjustment of R_2. In this way points can be found lying anywhere between *c* and *d* of Fig. 7, and the determination of the downward limb of the curve is therefore completed. As the return curve, shown in Fig. 8, is merely an inverted copy of the other, no separate determination of it is necessary.

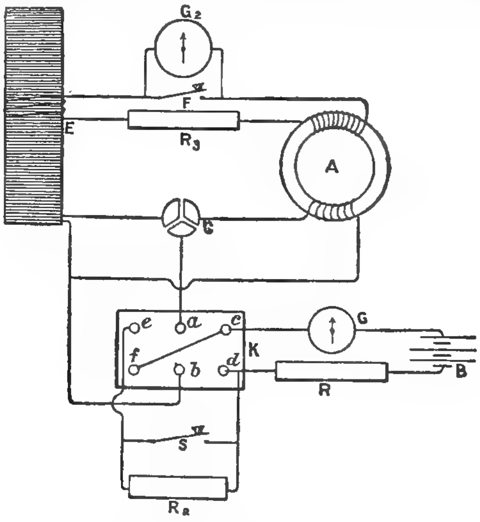

Fig. 9.

In Fig. 10 (Fleming, *Magnets and Electric Currents*, p. 193) are shown three very different types of hysteresis curves, characteristic of the special qualities of the metals from which they were respectively obtained. The distinguishing feature of the first is the steepness of its outlines; this indicates that the induction increases rapidly in relation to the magnetic force, and hence the metal is well suited for the construction of dynamo magnets. The second has a very small area, showing that the work done in reversing the magnetization is small; the metal is therefore adapted for use in alternating current transformers. On the other hand, the form of the third curve, with its large intercepts on the axes of H and B, denotes that the specimen to which it relates possesses both retentiveness and coercive force in a high degree; such a metal would be chosen for making good permanent magnets.

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[1] Warburg, *Wied. Ann.* vol. xiii. (1881), p. 141; Ewing, *Phil. Trans.*, 1885, vol. ii. p. 549; Hopkinson, *Phil. Trans.*, 1885, vol. ii. p. 466. For a simple proof, see Ewing, *Magnetic Induction* (London, 1900), p. 99. Hopkinson pointed out that the greatest dissipation of energy which can be caused by a to-and-fro reversal is approximately represented by

Coercive force × maximum induction /π.

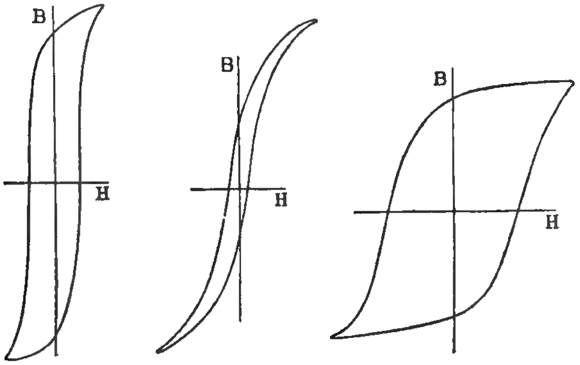

Fig. 10

Steinmetz (*Electrician*, vol. xxvi. p. 261; vol. xxviii. pp. 384, 408, 425) has called attention to a simple relation which appears to exist between the amount of energy dissipated in carrying a piece of iron or steel through a magnetic cycle, and the limiting value of the induction reached in the cycle. Denoting by W the work in ergs done upon a cubic centimetre of the metal $\left(=\frac{1}{4\pi}\int H dB \text{ or} \int H dI\right)$, he finds $W=\eta B^{1\cdot 6}$ approximately, where η is a number, called the *hysteretic constant*, depending upon the metal, and B is the maximum induction. The value of the constant η ranges in different metals from about 0·001 to 0·04; in soft iron and steel it is said to be generally not far from 0·002. Steinmetz's formula may be tested by taking a series of hysteresis curves between different limits of B, measuring their areas by a planimeter, and plotting the logarithms of these divided by 4π as ordinates against logarithms of the corresponding maximum values of B as abscissæ. The curve thus constructed should be a straight line inclined to the horizontal axis at an angle θ, the tangent of which is 1·6. Ewing and Klaassen (*Phil. Trans.*, 1893A, p. 1017) have in this manner examined how nearly and within what range a formula of the type $W=\eta B^{\epsilon}$ may be taken to represent the facts. The results of an example which they quote in detail may be briefly summarized as follows:—

Limits of B.	Hysteretic Constant. η	Index. ϵ $(=\tan\theta)$	Degrees. θ
200 to 500	...	1·9	62·25
500 to 1000	...	1·68	59·25
1000 to 2000	...	1·55	57·25
2000 to 8000	0·01	1·475	55·75
8000 to 14000	0·00134	1·70	59·50

It is remarked by the experimenters that the value of the index ϵ is by no means constant, but changes in correspondence with the successive well-marked stages in the process of magnetization. But though a formula of this type has no physical significance, and cannot be accepted as an equation to the actual curve of W and B, it is nevertheless the case that by making the index $\epsilon=1\cdot 6$, and assigning a suitable value to η, a formula may be obtained giving an approximation to the truth which is sufficiently close for the ordinary purposes of electrical engineers, especially when the limiting value of B is neither very great nor very small. Mr Alexander Siemens (*Journ. Inst. Elec. Eng.*, 1894, p. 229) states that in the hundreds of comparisons of test pieces which have been made at the works of his firm, Steinmetz's law has been found to be practically correct.[1] An interesting collection of W-B curves embodying the results of actual experiments by Ewing and Klaassen on different specimens of metal is given in Fig. 11. It has been shown by Kennelly (*Electrician*, vol. xxviii. p. 666) that Steinmetz's formula gives approximately correct results in the case of nickel. Working with two different specimens, he found that the hysteresis loss in ergs per cubic centimetre (W) was fairly represented by $0\cdot 00125B^{1\cdot 6}$ and $0\cdot 00101B^{1\cdot 6}$ respectively, the maximum induction ranging from about 300 to 3000. The applicability of the law to cobalt has been investigated by Fleming (*Phil. Mag.*, Sept. 1899, p. 271), who used a ring of cast cobalt containing about 96 per cent. of the pure metal. The logarithmic curves which accompany his paper demonstrate that within wide ranges of maximum induction $W=0\cdot 01B^{1\cdot 6}=0\cdot 527I^{1\cdot 62}$ very nearly. Fleming rightly regards it as not a little curious that, for materials differing so much as this cast cobalt and soft annealed iron, the hysteretic exponent should in both cases be so near to 1·6. After pointing out that, since the magnetization of the metal is the quantity really concerned, W is more appropriately expressed in terms of I, the magnetic moment per unit of volume, than of B, he suggests an experiment to determine whether the mechanical work required to effect the complete magnetic reversal of a crowd of small compass needles (representative of magnetic molecules) is proportional to the 1·6th power of the aggregate maximum magnetic moment before or after completion of the cycle.

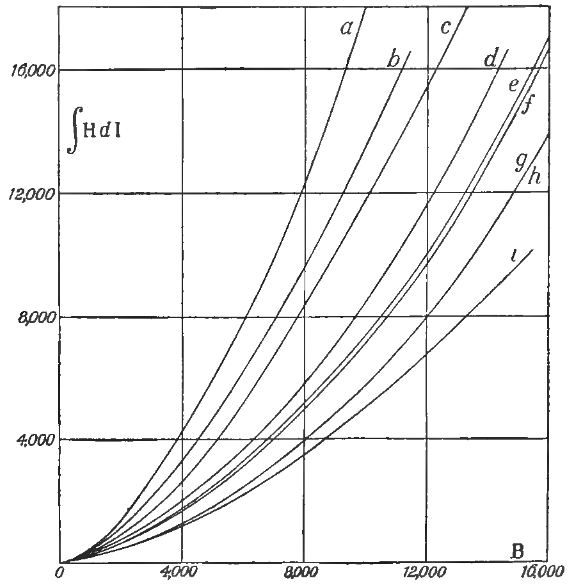

FIG. 11.—*a*, Fine steel wire 0·257 mm. diam.; *b*, fine iron wire 0·34 mm. diam.; *c*, fine iron wire 0·2475 mm. diam.; *d*, thin sheet iron 0·47 mm. thick; *e*, iron wire 0·602 mm. diam.; *f*, iron wire 0·975 mm. diam.; *g*, sheet iron 1·95 mm. thick; *h*, thin sheet iron 0·367 mm. thick; *i*, very soft iron wire.

The diagram, Fig. 12, contains examples of ascending induction curves characteristic of wrought iron, cast iron, cobalt, and nickel. These are to be regarded merely as typical specimens, for the details of a curve depend largely upon the physical condition and purity of the material; but they show at a glance how far the several metals

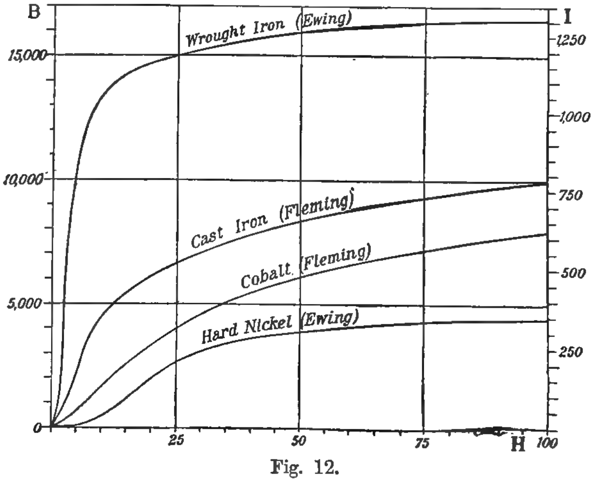

Fig. 12.

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[1] Some experiments by Baily showed that hysteresis ceased to increase when B was carried beyond 23,000. This value of B corresponds to I=1640, the saturation point for soft iron.—*Brit. Assoc. Rep.*, 1895, p. 636.

differ from and resemble one another as regards their magnetic properties. Curves of magnetization (which express the relation of I to H) have a close resemblance to those of induction; and indeed, since $B = H + 4\pi I$, and $4\pi I$ (except in extreme fields) greatly exceeds H in numerical value, we may generally, without serious error, put $I = B/4\pi$, and transform curves of induction into curves of magnetization by merely altering the scale to which the ordinates are referred. A scale for the approximate transformation for the curves in Fig. 12 is given at the right-hand side of the diagram, the greatest error introduced by neglecting $H/4\pi$ not exceeding 0·6 per cent. A study of such curves as these reveals the fact that there are three distinct stages in the process of magnetization. During the first stage, when the magnetizing force is small, the magnetization (or the induction) increases rather slowly with increasing force; this is well shown by the nickel curve in the diagram, but the effect would be no less conspicuous in the iron curve if the abscissæ were plotted to a larger scale. During the second stage small increments of magnetizing force are attended by relatively large increments of magnetization, as is indicated by the steep ascent of the curve. Then the curve bends over, forming what is often called a "knee," and a third stage is entered upon, during which a considerable increase of magnetizing force has little further effect upon the magnetization. When in this condition the metal is popularly said to be "saturated." Under increasing magnetizing forces, greatly exceeding those comprised within the limits of the diagram, the magnetization does practically reach a limit, the maximum value being attained with a magnetizing force of less than 2000 for wrought iron and nickel, and less than 4000 for cast iron and cobalt. The induction, however, continues to increase indefinitely, though very slowly. These observations have an important bearing upon the molecular theory of magnetism, which will be referred to later.

Curves of Permeability and of Susceptibility.—The relations of μ ($=B/H$) to B, and of κ ($=I/H$) to I, may be instructively exhibited by means of curves like those constructed by Rowland (see *Ency. Brit.*, MAGNETISM, vol. xv. p. 256). Recent experiments show that if the magnetizing force is carried far enough, the permeability curve always becomes convex to the horizontal axis, instead of meeting it in the manner indicated in Rowland's diagrams. In Fig. 13 a curve given by an experiment in which the highest magnetizing force was 585 is compared with Rowland's curve for iron (Bidwell, *Proc. Roy. Soc.* vol. xl. (1886), p. 495). Rowland's experiment was carried only as far as the point marked X, corresponding to a magnetizing force of 65 and an induction of nearly 17,000. In the other experiment, though the magnetizing force was further increased no less than ninefold, the induction reached only 19,800. It is seen that soon after the limit of Rowland's observations is passed, the curve, instead of continuing in an almost straight line to meet the horizontal axis, bends off asymptotically, the ultimate value of the permeability still being as much as 33·9.

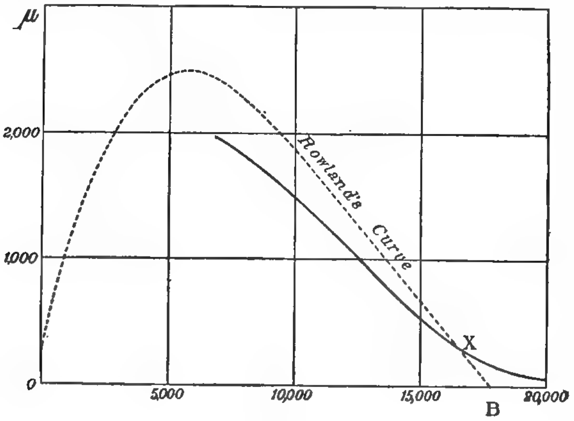

Fig. 13.

Ballistic Method with Yoke.—Hopkinson (*Phil. Trans.*, 1885, part ii. p. 455) introduced a modification of the usual ballistic arrangement which presents the following advantages:—(1) very considerable magnetizing forces can be applied with ordinary means; (2) the samples to be tested, having the form of cylindrical bars, are more easily prepared than rings or wires; (3) the actual induction at any time can be measured, and not only changes of induction. On the other hand, a very high degree of accuracy is not claimed for the results. Fig. 14 shows the apparatus by which the ends of the bar are prevented from exerting any material demagnetizing force, while the permeance of the magnetic circuit is at the same time increased. AA, called the "yoke," is a block of annealed wrought iron about 18 inches long, $6\frac{1}{2}$ inches wide, and 2 inches thick, through which is cut a rectangular opening to receive the two magnetizing coils BB. The test bar CC, which slides through holes bored in the yoke, is divided near the middle into two parts, the ends which come into contact being faced true and square. Between the magnetizing coils is a small induction coil D, which is connected with a ballistic galvanometer. The induction coil is carried upon the end of one portion of the test bar, and when this portion is suddenly drawn back, the coil slips off and is pulled out of the field by an india-rubber spring. This causes a ballistic throw proportional to the induction through the bar at the moment when the two portions were separated. With such an arrangement it is possible to submit the sample to any series of magnetic forces, and to measure its magnetic state at the end. The uncertainty with which the results are affected depends chiefly upon the imperfect contact between the bar and the yoke and also between the ends of the divided bar. It is probable that Hopkinson did not attach sufficient importance to the demagnetizing action of the cut (cf. Ewing, *Phil. Mag.*, Sept. 1888, p. 274), and that the values which he assigned to H are consequently somewhat too high. He applied his method with good effect, however, in testing a large number of commercial specimens of iron and steel, the magnetic constants of which are given in a table accompanying his paper. When it is not required to determine the residual magnetization, there is no necessity to divide the sample bar, and ballistic tests may be made in the ordinary way—by steps or by reversals—the source of error due to the transverse cut thus being avoided. Ewing has devised an arrangement in which two similar test bars are placed side by side; each bar is surrounded by a magnetizing coil, the two coils being connected to give opposite directions of magnetization, and each pair of ends is connected by a short massive block of soft iron having holes bored through it to fit the bars, which are clamped in position by

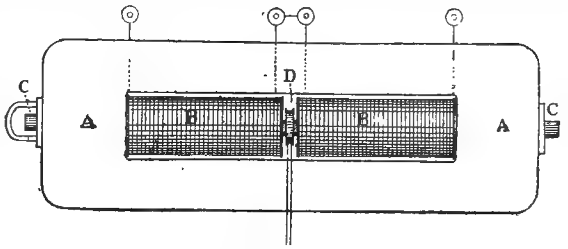

Fig. 14

set-screws. Induction coils are wound on the middle parts of both bars, and are connected in series. With this arrangement it is possible to find the actual value of the magnetizing force, corrected for the effects of joints and other sources of error. Two sets of observations are taken, one when the blocks are fixed at the ends of the bars, and another when they are nearer together, the clear length of the bars between them and of the magnetizing coils being reduced to one-half. If H_1 and H_2 be the values of $4\pi in/l$ and $4\pi i'\frac{n}{2}\Big/\frac{l}{2}$ for the same induction B, it can be shown that the true magnetizing force is $H = H_1 - (H_2 - H_1)$. The method, though tedious in operation, is very accurate, and is largely employed for determining the magnetic quality of bars intended to serve as standards.

Traction Methods.—The induction or the magnetization may be measured by observing the force required to draw apart the two portions of a divided rod or ring when held together by their mutual attraction. If a transverse cut is made through a bar whose magnetization is I and the two ends are placed in contact, it can be shown that this force is $2\pi I^2$ dynes per unit of area (see MAGNETISM, *Ency. Brit.* vol. xv. p. 243); and if the magnetization of the bar is due to an external field H produced by a magnetizing coil or otherwise, there is an additional force equal to HI. Thus the whole force, when the two portions of the bar are surrounded by a loosely-fitting magnetizing coil, is

$$F = 2\pi I^2 + HI$$

expressed as dynes per square centimetre. If each portion of the bar has an independent magnetizing coil wound tightly upon it, we have further to take into account the force due to the mutual action of the two magnetizing coils, which assists the forces already considered. This is equal to $H^2/8\pi$ per unit of sectional area. In the case supposed therefore the total force per square centimetre is

$$\begin{aligned} F &= 2\pi I^2 + HI + \frac{H^2}{8\pi} \\ &= \frac{(4\pi I + H)^2}{8\pi} \\ &= \frac{B^2}{8\pi}. \end{aligned}$$

The equation $F = B^2/8\pi$ is often said to express "Maxwell's law of magnetic traction" (Maxwell, *Electricity and Magnetism*, §§ 642–646). It is of course true for permanent magnets, where $H = 0$, since then $F = 2\pi I^2$; but if the magnetization is due to electric currents, the formula is only applicable in the special case when the mutual action of the two magnets upon one another is supplemented by the electrodynamic attraction between separate magnetizing coils rigidly attached to them.[1]

The traction method was first employed by Bidwell (*Proc. Roy. Soc.* vol. xl. p. 486), who in 1886 published an account of some experiments in which the relation of magnetization to magnetic field was deduced from observations of the force in grammes weight which just sufficed to tear asunder the two halves of a divided ring electromagnet when known currents were passing through the coils. He made use of the expression

$$F = Wg = 2\pi I^2 + HI,$$

where W is the weight in grammes per square centimetre of sectional area, and g is the acceleration due to gravity, which was taken as 981. The term for the attraction between the coils was omitted as negligibly small (see *Phil. Mag.* vol. xxix. p. 440). The values assigned to H were calculated from $H = 2ni/r$, and ranged from 3·9 to 585, but inasmuch as no account was taken of any demagnetizing action which might be due to the two transverse cuts, it is probable that they are somewhat too high. The results nevertheless agree very well with those for annealed wrought iron obtained by other methods. Below is given a selection from Bidwell's tables showing corresponding values of magnetizing force, weight supported, magnetization, induction, susceptibility, and permeability:—

H	W	I	B	κ	μ
3·9	2,210	587	7,390	151·0	1889·1
5·7	3,460	735	9,240	128·9	1621·3
10·3	5,400	918	11,550	89·1	1121·4
22·2	8,440	1147	14,450	51·7	650·9
40	9,680	1226	15,460	30·7	386·4
115	12,170	1370	17,330	11·9	150·7
208	13,810	1452	18,470	7·0	88·8
362	14,740	1489	19,080	4·1	52·7
465	15,275	1508	19,420	3·2	41·8
585	15,905	1530	19,820	2·6	33·9

A few months later Bosanquet (*Phil. Mag.* vol. xxii. p. 535) experimented on the relation of tractive force to magnetic induction. Instead of a divided ring he employed a divided straight bar, each half of which was provided with a magnetizing coil. The joint was surrounded by an induction coil connected with a ballistic galvanometer, an arrangement which enabled him to make an independent measurement of the induction at the moment when the two portions of the bar were separated. He showed that there was, on the whole, a fair agreement between the values determined ballistically and those given by the formula $B = \sqrt{8\pi F}$. The greatest weight supported in the experiments was 14,600 grammes per square cm., and the corresponding induction 18,500 units. Taylor Jones more recently found a good agreement between the theoretical and the observed values of the tractive force in fields ranging up to very high intensities (*Phil. Mag.* vol. xxxix. (1895), p. 254, and vol. xli. (1896), p. 153).

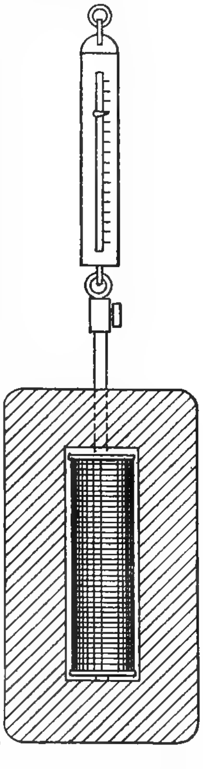
Fig. 15.

Permeameters.—Several instruments in which the traction method is applied have been devised for the rapid measurement of induction or of magnetization in commercial samples of iron and steel. The earliest of these is S. P. Thompson's permeameter (*Journ. Sci. Arts*, vol. xxxviii. (1890), p. 885), which consists of a rectangular block of iron shaped like Hopkinson's yoke, and slotted out in the same way to receive a magnetizing coil (Fig. 15); the block is bored through at the upper end only, and its inner face opposite the hole is made quite flat and smooth. The sample has the form of a thin rod, one end of which is faced true; it is slipped into the magnetizing coil from above, and when the current is turned on, its smooth end adheres tightly to the surface of the yoke. The force required to detach it is measured by a registering spring balance, which is clamped to the upper end of the rod, and thence the induction or the magnetization is deduced by applying the formula

$$\frac{(B-H)^2}{8\pi} = 2\pi I^2 = \frac{Pg}{S},$$

where P is the pull in grammes weight, S the sectional area of the rod in square cm., and $g = 981$. If the pull is measured in pounds and the area in square inches, the formula may be written $B = 1317 \times \sqrt{P/S} + H$. The instrument exhibited by Thompson would, without undue heating, take a current of 30 amperes, which was sufficient to produce a magnetizing force of 1000 units. A testing apparatus of a similar type devised by Kapp (*Journ. Inst. Elec. Eng.* vol. xxiii. p. 199) differs only in a few details from Thompson's permeameter. Ewing has described an arrangement in which the test bar has a soft-iron pole piece clamped to each of its ends; the pole pieces are joined by a long well-fitting block of iron, which is placed upon them (like the "keeper" of a magnet), and the induction is measured by the force required to detach the block. In all such measurements a correction should be made in respect of the demagnetizing force due to the joint, and unless the fit is very accurate the demagnetizing action will be variable. In the magnetic balance of du Bois (*Magnetic Circuit*, p. 346) the uncertainty arising from the presence of a joint is avoided, the force measured being that exerted between two pieces of iron separated from each other by a narrow air-gap of known width. The instrument is represented diagrammatically in Fig. 16. The test-piece A, surrounded by a magnetizing coil, is clamped between two soft-iron blocks B, B′. YY′ is a soft-iron yoke, which rocks upon knife-edges K, and constitutes the beam of the balance. The yoke has two projecting pieces C, C′ at unequal distances from the knife-edges, and separated from the blocks B, B′ by narrow air-gaps. The play of the beam is limited by a stop S and a screw R, the latter being so adjusted that when the end Y of the beam is held down the two air-gaps are of equal width. W is a weight capable of sliding from end to end of the yoke along a graduated scale. When there is no magnetization, the yoke is in equilibrium; but as soon as the current is turned on, the block C is drawn downwards as far as the screw R will allow, for though the attractive forces F between B and C and between B′ and C′ are equal, the former has a greater moment. The weight W is moved along the scale until the yoke just tilts over upon the stop S; the distance of W from its zero position is then, as can easily be shown, proportional to F, and therefore to B^2, and approximately to I^2. The scale is graduated in such a manner that by multiplying the reading by a simple factor (generally 10 or 2) the absolute value of the magnetization is obtained. The actual magnetizing force H is of course less than that due to the coil; the corrections required are effected automatically by the use of a set of demagnetization lines drawn on a sheet of celluloid which is supplied with the instrument. The celluloid sheet is laid upon the squared paper, and in plotting a curve horizontal distances are reckoned from the proper demagnetization line instead of from the vertical axis. An improved but somewhat more complex form of the instrument is described in *Ann. d. Phys.* vol. ii. (1900), p. 317.

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[1] Since in most practicable experiments H^2 is negligible in comparison with B^2, the force may be taken as $B^2/8\pi$ without sensible error.

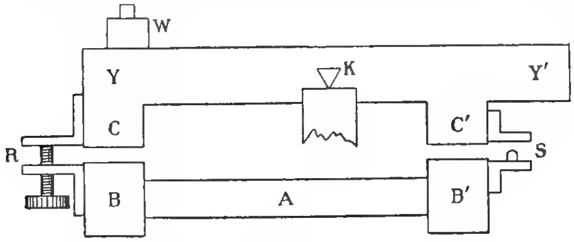

Fig. 16.

In Ewing's *magnetic balance* (*Journ. Inst. Elec. Eng.* vol. xxvii. p. 526) the value of the magnetic induction corresponding to a single stated magnetizing force is directly read off on a divided scale. The specimen, which has the form of a turned rod, 4 inches long and ¼ inch in diameter, is laid across the poles of a horseshoe electromagnet, excited by a current of such strength as to produce in the rod a magnetizing force H = 20. One pole has a V-shaped notch for the rod to rest in; the surface of the other is slightly rounded, forming a portion of a cylinder, the axis of which is perpendicular to the direction of the length of the rod. The rod touches this pole at a single point, and is pulled away from it by the action of a lever, the long arm of which is graduated and carries a sliding weight. The position of the weight at the moment when contact is broken indicates the induction in the rod. The standard force H = 20 was selected as being sufficiently low to distinguish between good and bad specimens, and at the same time sufficiently high to make the order of merit the same as it would be under stronger forces.

Measurement of Field Strength. Exploring Coil.—The old method of measuring field intensity by means of an induction coil with a standardized ballistic galvanometer (see *Ency. Brit.* vol. xv. p. 240) is still the one most generally employed. Convenient arrangements have been devised whereby the coil is suddenly reversed or withdrawn from the field by the action of a spring.

Bismuth Resistance.—The fact, which will be referred to later, that the electrical resistance of bismuth is very greatly affected by a magnetic field has been applied in the construction of apparatus for measuring field intensity. A little instrument, supplied by Hartmann and Braun, contains a short length of fine bismuth wire wound into a flat double spiral, half an inch or thereabouts in diameter, and attached to a long ebonite handle. Unfortunately the effects of magnetization upon the specific resistance of bismuth vary enormously with changes of temperature; it is therefore necessary to take two readings of the resistance, one when the spiral is in the magnetic field, the other when it is outside.

Electric Circuit.—If a coil of insulated wire is suspended so that it is in stable equilibrium when its plane is parallel to the direction of a magnetic field, the transmission of a known electric current through the coil will cause it to be deflected through an angle which is a function of the field intensity.

Among recent applications of this principle one of the neatest is that described by Edser and Stansfield (*Phil. Mag.* vol. xxxiv. p. 186), and used by them to test the stray fields of dynamos. An oblong coil about an inch in length is suspended from each end by thin strips of rolled German silver wire, one of which is connected with a spiral spring for regulating the tension, the other being attached to a torsion-head. Inside the torsion-head is a commutator for automatically reversing the current, so that readings may be taken on each side of zero, and the arrangement is such that when the torsion-head is exactly at zero the current is interrupted. To take a reading the torsion-head is turned until an aluminium pointer attached to the coil is brought to the zero position on a small scale; the strength of the field is then proportional to the angular torsion. The small current required is supplied to the coil from a single dry cell. The advantages of portability, very considerable range (from H = 1 upwards), and fair accuracy are claimed for the instrument.

Polarized Light.—The intensity of a field may be measured by the rotation of the plane of polarization of light passing in the direction of the magnetic force through a transparent substance. If the field is uniform, $H = \theta/\omega d$, where θ is the rotation, d the thickness of the substance arranged as a plate at right angles to the direction of the field, and ω Verdet's constant for the substance.

For the practical measurement of field intensity du Bois has used plates of the densest Jena flint glass. These are preferably made slightly wedge-shaped, to avoid the inconvenience resulting from multiple internal reflections, and they must necessarily be rather thin, so that double refraction due to internal strain may not exert a disturbing influence. Since Verdet's constant is somewhat uncertain for different batches of glass even of the same quality, each plate should be standardized in a field of known intensity. As the source of monochromatic light a bright sodium burner is used, and the rotation, which is exactly proportional to H, is measured by an accurate polarimeter. Such a plate about 1 mm. in thickness is said to be adapted for measuring fields of the order of 1000 units. A part of one surface of the plate may be silvered, so that the polarized ray, after having once traversed the glass, is reflected back again; the rotation is thus doubled, and moreover, the arrangement is, for certain experiments, more convenient than the other.

MAGNETIZATION IN STRONG FIELDS.

Fields due to Coils.—The most generally convenient arrangement for producing such magnetic fields as are required for experimental purposes is undoubtedly a coil of wire through which an electric current can be caused to flow. The field due to a coil can be made as nearly uniform as we please throughout a considerable space; its intensity, when the constants of the coil are known, can be calculated with ease and certainty and may be varied at will through wide ranges, while the apparatus required is of the simplest character and can be readily constructed to suit special purposes. But when exceptionally strong fields are desired, the use of a coil is limited by the heating effect of the magnetizing current, the quantity of heat generated per unit of time in a coil of given dimensions increasing as the square of the magnetic field produced in its interior. In experiments on magnetic strains carried out by Nagaoka and Honda (*Phil. Mag.* vol. xlix. (1900),

p. 329) the intensity of the highest field reached in the interior of a coil was 2200 units. The coil used was 30 cm. in length, and was wound with twelve layers of wire having a total resistance of 0·63 ohm, the field produced by 1 ampere having the intensity of 38 units. The current employed must therefore have been nearly 60 amperes, and the quantity of heat generated per second upwards of 500 calories. This is probably the strongest field produced by a coil which has hitherto been employed in experimental work. There are indeed few purposes for which the field thus obtained would be available, because, if the circuit were closed for more than a brief period, the heat generated would quickly destroy the insulation of the wire. In 1890 some experiments in which a coil was used were made by du Bois (*Phil. Mag.* vol. xxix. pp. 253, 293) on the magnetization of iron, nickel, and cobalt under forces ranging from about 100 to 1250 units. Since the demagnetizing factor was 0·052, the strongest field due to the coil was about 1340; but though arrangements were provided for cooling the apparatus by means of ice, great difficulty was experienced owing to heating. Du Bois's results, which, as given in his papers, show the relation of H to the magnetic moment per unit of mass, have been reduced by Ewing to the usual form, and are indicated in Fig. 17, the earlier portions of the curves being sketched in from other data.

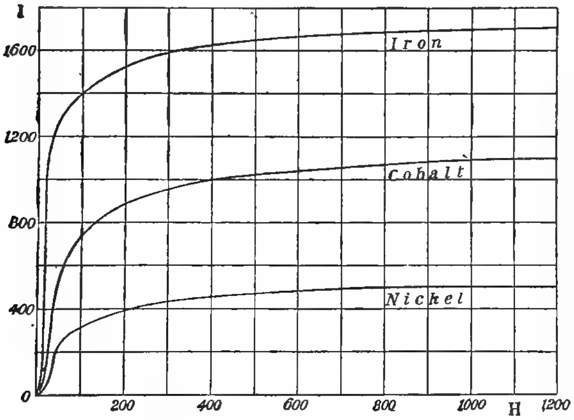

Fig. 17.

Fields due to Electromagnets.—The problem of determining the magnetization of iron and other metals in the strong fields formed between the poles of an electromagnet was first attacked by Ewing and Low. An account of their preliminary experiments by what they call the *isthmus method* was published in 1887 (*Proc. Roy. Soc.* vol. xlii. p. 200), and in the following year they described a more complete and perfect series (*Phil. Trans.* vol. clxxx. p. 221).

The sample to be inserted between the magnet poles was prepared in the form of a bobbin resembling an ordinary cotton reel, with a short narrow neck (constituting the "isthmus") and conical ends. Upon the central neck was wound a coil consisting of one or two layers of very fine wire, which was connected with a ballistic galvanometer for measuring the induction in the iron; outside this coil, and separated from it by a small and accurately determined distance, a second coil was wound, serving to measure the induction in the iron, together with that in a small space surrounding it. The difference of the ballistic throws taken with the two coils measured the intensity of the field in the space around the iron, and it also enabled a correction to be made for the non-ferrous space between the iron neck and the centre of the thickness of the inner coil. The pole-pieces of the electromagnet (see Fig. 18) were furnished with a pair of truncated cones *b b*, of soft iron forming an extension of the conical ends of the bobbin *c*. The most suitable form for the pole faces is investigated in the paper, and the conclusion arrived at is that to produce the greatest concentration of force upon the central neck, the cones should have a common vertex in the middle of the neck with a semi-vertical angle of 54° 44′, while the condition for a uniform field is satisfied when the cones have a semi-vertical angle of 39° 14′; in the latter case the magnetic force in the air just outside is sensibly equal to that within the neck. A pair of cones having a semi-vertical angle of 45° were considered to combine high concentrative power with a sufficient approximation to uniformity of field.

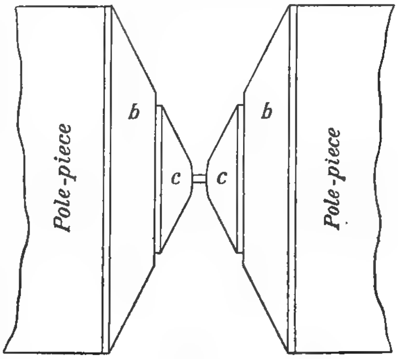

Fig. 18.

In most of the experiments the measurements were made by suddenly withdrawing the bobbin from its place between the pole-pieces. Two groups of observations were recorded, one giving the induction in the inner coil and the other that in the outer coil. The value of the residual induction which persisted when the bobbin was drawn out was added to that of the induction measured, and thus the total induction in the iron was determined. The highest induction reached in these experiments was 45,350 units, more than twice the value of any previously recorded. The corresponding intensity of the outside field was 24,500, but, owing to the wide angle of the cones used (about 2 × 63°), this was probably greater than the value of the magnetic force within the metal. The following table shows some results of other experiments in which H was believed to have sensibly the same value inside as outside the metal. Values of I are derived from $(B-H)/4\pi$ and of μ from B/H.

Metal.	H	B	I	μ
Swedish Iron	1,490	22,650	1680	15·20
	6,070	27,130	1680	4·47
	8,600	30,270	1720	3·52
	19,450	40,820	1700	2·10
	19,880	41,140	1700	2·07
Cast Iron	4,560	20,070	1230	4·40
	13,460	28,710	1210	2·13
	16,200	30,920	1170	1·91
	16,900	31,760	1180	1·88
Tool Steel	6,210	25,480	1530	4·10
	9,970	29,650	1570	2·97
	12,170	31,620	1550	2·60
	14,660	34,550	1580	2·36
	15,530	35,820	1610	2·31
Hard Nickel	2,220	7,100	390	3·20
	4,440	9,210	380	2·09
	7,940	12,970	400	1·63
	14,660	19,640	400	1·34
	16,000	21,070	400	1·32
Cobalt	1,350	16,000	1260	12·73
	4,040	18,870	1280	4·98
	8,930	23,890	1290	2·82
	14,990	30,210	1310	2·10

These results are of extreme interest, for they show that under sufficiently strong magnetizing forces the intensity of magnetization I reaches a maximum value, as required by Weber's theory of molecular magnetism. There appears to be no definite limit to the value to which the induction B may be raised, but the magnetization I attains a true saturation value under magnetizing forces which are in most cases comparatively moderate. Thus the magnetization which the sample of Swedish iron received in a field of 1490 was not increased (beyond the limits of experimental error) when the intensity of the field was multiplied more than 13-fold, though the induction was nearly doubled. When the saturation value of I has been reached, the relation of magnetic induction to magnetic force may be expressed by

$$B = H + \text{constant}.$$

The annexed table gives the saturation values of I for the particular metals examined by Ewing and Low :—

	Saturation Value of I.
Wrought iron	1700
Cast iron	1240
Nickel (0·75 per cent. iron) . . .	515
,, (0·56 ,, ,,) . . .	400
Cobalt (1·66 ,, ,,) . . .	1300

It is shown in the paper that the greatest possible force which the isthmus method can apply at a point in the axis of the bobbin is

$$F = 11{\cdot}137\, I_s \log_{10} \frac{b}{a},$$

I_s being the saturation value of the magnet poles, a the radius of the neck on which the cones converge, and b the radius of the bases of the cones.

Some experiments made by du Bois (*Phil. Mag.* vol. xxix. p. 293) with an electromagnet specially designed for the production of strong fields, confirm Ewing's results for iron, nickel, and cobalt. The method employed did not admit of the production of such high magnetizing forces, but was of special interest in that both B and I were measured optically—B by means of the rotation of a polarized ray inside a glass plate, as before described, and I by the rotation of a polarized ray reflected from the polished surface of the magnetized metal (see "Kerr's constant," MAGNETO-OPTICS). $H\ (= B - 4\pi I)$ was calculated from corresponding values of I and B.

In 1896 Taylor Jones (*Wied. Ann.* vol. lvii. p. 258, and *Phil. Mag.* vol. xxix. p. 293), working with du Bois's electromagnet and using a modification of the isthmus method, succeeded in pushing the induction B up to 74,200 with $H = 51{,}600$, the corresponding value of I being 1798, and of μ only 1·44. The diameter of the isthmus was 0·241 mm., and the electromagnet was excited by a current of 40 amperes.

Tractive Force of a Magnet.—Closely connected with the results just discussed is the question what is the greatest tractive force that can be exerted by a magnet. In the year 1852 Joule (*Phil. Mag.* [4], vol. iii. p. 32) expressed the opinion that no "force of current could give an attraction equal to 200 ℔ per square inch," or 14,000 grms. per square centimetre, and a similar view prevailed among high authorities more than twenty years later. For the greatest possible "lifting power" of permanent magnets this estimate is probably not very far from the truth, but it is now clearly understood that the force which can be exerted by an electromagnet, or by a pair of electromagnets with opposite poles in contact, is only limited by the greatest value to which it is practically possible to raise the magnetizing force H. This is at once evident when the tractive force due to magnetization is expressed as $2\pi I^2 + HI$. For fields of moderate intensity the first term of the expression is the most important, but when the value of H exceeds 12,000 or thereabouts, the second preponderates, and with the highest values that have been actually obtained, HI is several times greater than $2\pi I^2$. If H could be increased without limit, so also could the tractive force. The following table shows the greatest "lifting powers" experimentally reached at the dates mentioned :—

Observer.	Kilos per sq. cm.	Lb. per sq. in.	Date
Joule . .	12·3	175	1852
Bidwell . .	15·9	226	1886
Wilde . .	26·8	381	1891
T. Jones . .	114·9	1634	1896

MAGNETIZATION IN VERY WEAK FIELDS.

Some interesting observations have been made of the effects produced by very small magnetic forces. It was first pointed out by Baur (*Wied. Ann.* vol. xi. (1880), p. 399) that in weak fields the relation of the magnetization I to the magnetizing force H is approximately expressed by an equation of the form

$$I = aH + bH^2,$$

or

$$\kappa = \frac{I}{H} = a + bH,$$

whence it appears that within the limits of Baur's experiments the magnetization curve is a parabola, and the susceptibility curve an inclined straight line, κ being therefore a known function of H. If these equations could be assumed to hold when H is indefinitely small, it would follow that κ has a finite initial value, from which there would be no appreciable deviation in fields so weak that bH was negligibly small in comparison with a. Such an assumption could not, however, without dangerous extrapolation, be founded upon the results of Baur's experiments, which did not go far enough to justify it. In some experiments carried out in 1887, Rayleigh (*Phil. Mag.* vol. xxiii. p. 225) approached very much more nearly than Baur to the zero of magnetic force. Using an unannealed Swedish iron wire, he found that when H was gradually diminished from 0·04 to 0·00004 C.G.S. unit, the ratio of magnetization to magnetizing force remained sensibly constant at 6·4, which may therefore with great probability be assumed to represent the initial value of κ for the specimen in question. Experiments with annealed iron gave less satisfactory results, on account of the slowness with which the metal settled down into a new magnetic state, thus causing a "drift" of the magnetometer needle, which sometimes persisted for several seconds. Apart from this complication, it appeared that I was proportional to H when the value of H was less than 0·02.

The observations of Baur and Rayleigh have been confirmed and discussed by (among others) Schmidt (*Wied. Ann.* vol. liv. p. 655), who found the limiting values of κ to be 7·5 to 9·5 for iron, and 11·2 to 13·5 for steel, remaining constant up to $H = {\cdot}06$; by Culmann (*Elekt. Zeit.* vol. xiv. p. 345; *Wied. Ann.* vol. lvi. p. 602); and by Holborn (*Berl. Ber.* 1897, p. 95, and *Wied. Ann.* vol. lxi. p. 281). The latter gives values of the constants a and b for different samples of iron and steel, some of which are shown in the following table :—

$$\kappa = a + bH$$

Metal.	a	b
English tungsten steel .	8·90	0·264
Tungsten steel, hardened .	2·23	0·032
Silver steel . . .	8·66	0·384
Tool steel	8·30	0·400
Refined steel . . .	11·28	1·92
Cast iron	3·16	0·236
Soft iron	16·6	18·6
Hard drawn iron . .	5·88	1·76

For most samples of steel the straight-line law was found to hold approximately up to $H = 3$; in the case of iron and of soft steel the approximation was less close.

The behaviour of nickel in weak fields has been observed by Ewing (*Phil. Trans.* vol. clxxix.A (1888), p. 325), who found that the initial value of κ was 1·7, and that it remained sensibly constant until H had reached a value of about five units. While therefore the initial susceptibility of nickel is less than that of iron and steel, the range of magnetic force within which it is approximately constant is about one hundred times greater. Ewing has also made a careful study (*Proc. Roy. Soc.* vol. xlvi. (1889), p. 269) of "magnetic viscosity" under small forces—the cause of the magnetometer "drift" referred to by Rayleigh. On the application of a small magnetizing force to a bar of soft annealed iron, a certain intensity of magnetization is instantly produced; this, however, does not remain constant, but slowly increases for some seconds or even minutes, and may ultimately attain a value nearly twice as great as that observed immediately after the force was applied.[1] When the magnetizing current is broken, the magnetization at once undergoes considerable diminution, then gradually falls to zero, and a similar sudden change followed by a slow one is observed when a feeble current is reversed. Ewing draws attention to a curious consequence of this time-lag. By the alternate application and withdrawal of a small magnetizing force a cyclic condition may be established in an iron rod. If now the alternations are performed so rapidly that time is not allowed for more than the first sudden change in the magnetization, there will be no hysteresis loss, the magnetization exactly following the magnetizing force. Further, if the alternations take place so slowly that the full maximum and minimum values of the magnetization are reached in the intervals between the reversals, there will again be no dissipation of energy. But at any intermediate frequency the ascending and descending curves of magnetization will enclose a space and energy will be dissipated. It is remarkable that the phenomena of magnetic viscosity are much more evident in a thick rod than in a thin wire, or even in a large bundle of thin wires. In hardened iron and steel the effect can scarcely be detected, and in weak fields these metals exhibit no magnetic hysteresis of any kind.

CHANGES OF DIMENSIONS ATTENDING MAGNETIZATION.

It is well known that the form of a piece of ferromagnetic metal is in general slightly changed by magnetization. The phenomenon was first noticed by Joule, whose experiments are described in papers published in 1842 and 1847. For nearly forty years nothing of importance was added to Joule's results, with the exception of Barrett's discovery that a nickel bar contracts when magnetized, and the short statement in *Ency. Brit.* vol. xv. p. 268, included nearly all that was known on the subject down to the year 1883. Much new light has, however, been recently thrown upon a class of phenomena which cannot fail to have an important bearing upon any complete molecular theory of magnetism.[2] According to Joule's observations, the length of a bar of iron or soft steel was increased by magnetization, the elongation being proportional up to a certain point to the square of the intensity of magnetization; but when the "saturation point" was approached the elongation was less than this law would require, and a stage was finally reached at which further increase of the magnetizing force produced little or no effect upon the length. From data contained in Joule's paper it may be calculated that the strongest external field H_0 produced by his coil was about 126 C.G.S. units, but since the dimensional ratio of his bars was comparatively small, the actual magnetizing force H must have been materially below that value. In 1885 it was shown by Bidwell, in the first of a series of papers on the subject, that if the magnetizing force is pushed beyond the point at which Joule discontinued his experiments, the extension of the bar does not remain unchanged, but becomes gradually less and less, until the bar, after first returning to its original length, ultimately becomes actually shorter than when in the unmagnetized condition. The elongation is generally found to reach a maximum under a magnetizing force of 50 to 120 units, and to vanish under a force of 200 to 400, retraction occurring when still higher forces are applied. In order to meet the objection that the phenomenon might be due to electromagnetic action between the coil and the rod, Bidwell made some experiments with iron rings, and found that the length of their diameters varied under magnetization in precisely the same manner as the length of a straight rod. Fig. 19 shows the changes observed in the dimensions of two iron rings and an iron rod in fields up to 450 units. Experiments were afterwards made with rods of iron, nickel, and cobalt, the external field being carried up to the high value of 1500 units. The results are indicated in Fig. 20. It appears that the contraction which followed the initial extension of the iron reached a limit in fields of 1000 or 1100. Nickel exhibited retraction from the very beginning (as observed by Barrett), its greatest change of length considerably exceeding that undergone by iron; in a field of 800 the original length was diminished by as much as 1/40,000 part, but stronger forces failed to produce any further effect. The curve for cobalt is a very remarkable one. Little or no change of length was observed until the strength of the field H_0 reached about 50; then the rod began to contract, and after passing a minimum at

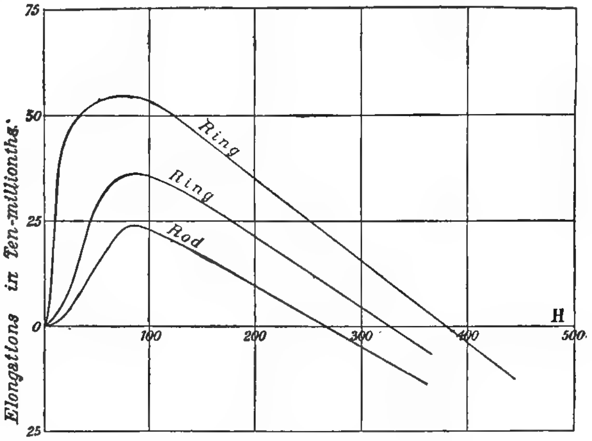

Fig. 19.

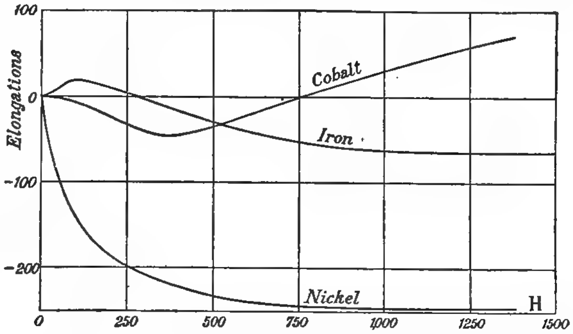

Fig. 20.

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[1] The same phenomenon is exhibited in a less marked degree when soft iron is magnetized in stronger fields (Ewing, *Phil. Trans.* vol. clxxvi. (1885), p. 569.

[2] Publications since 1883 are:—BIDWELL, *Phil. Trans.* vol. clxxix. A (1888), p. 205; *Proc. Royal Soc.* vol. xl. (1886) pp. 109, 257, vol. xliii. (1888) p. 406, vol. xlvii. (1890) p. 469, vol. li. (1892) p. 495, vol. lv. (1894) p. 228, vol. lvi. (1894) p. 94; *Nature*, vol. lx. (1899), p. 222.—CANTONE, *Mem. d. Acc. d. Lincei*, vol. vi. (1889), p. 487; *Rend. d. Acc. d. Lincei*, vol. vi. (1890), p. 252.—BERGET, *C. R.* vol. cxv. (1892), p. 722.—VAN AUBEL, *Journ. de Phys.* [3], vol. i. (1892), p. 424.—LOCHNER, *Phil. Mag.* vol. xxxvi. (1893), p. 498.—NAGAOKA, *Phil. Mag.* vol. xxxvii. (1894), p. 131; *Wied. Ann.* vol. liii. (1894), p. 487.—ROSING, *Phil. Mag.* vol. xxxix. (1895), p. 226.—KNOTT, *Proc. Roy. Soc. Ed.* (1890–91), p. 315; *Phil. Mag.* vol. xxxvii. (1894), p. 141; *Trans. R. S. Ed.* vol. xxxviii. (1896), p. 527; vol. xxxix. (1898), p. 457.—KNOTT and SHAND, *Proc. R. S. Ed.* (1891–92), pp. 85, 249; (1893–94), p. 295.—MORE, *Phil. Mag.* vol. xl. (1895), p. 345.—GALLANDET, *Johns Hopkins Univ. Thesis*, 1896.—KLINGENBERG, *Rostock Univ. Thesis*, Berlin, 1897.—TAYLOR JONES, *Phil. Trans.* vol. clxxxix. A (1897), p. 189.—BRACKETT, *Phys. Rev.* vol. v. (1897), p. 257.—NAGAOKA and HONDA, *Phil. Mag.* vol. xlvi. (1898), p. 261; vol. xlix. (1900), p. 329; *Journ. Coll. Sci. Tôkyô*, vol. xiii. (1900), p. 57.—STEVENS, *Phys. Rev.* vol. vii. (1898), p. 19.—RHOADS, *Phys. Rev.* vol. vii. (1898), p. 65; *Phil. Mag.* vol. ii. (1901), p. 463.—SHAKESPEAR, *Phil. Mag.* vol. xlvii. (1899), p. 539.—HONDA, *Journ. Coll. Sci. Tôkyô*, vol. xiii. (1900), p. 77.—AUSTIN, *Phys. Rev.* vol. x. (1900), p. 180.

$H_0 = 400$, recovered its original length at $H_0 = 750$; beyond this point there was extension, the amount of which was still increasing fast when the experiment was stopped at $H_0 = 1400$. Similar results were obtained with three different samples of the metal. Roughly speaking, therefore, cobalt behaves oppositely to iron.

Joule and others experimented with hardened steel, but failed to find a key to the results they obtained, which are rather complex, and have been thought to be inconsistent. The truth appears to be that a hardened steel rod generally behaves like one of iron or soft steel in first undergoing extension under increasing magnetizing force, and recovering its original length when the force has reached a certain critical value, beyond which there is contraction. But this "critical value" of the force is found to depend in an unexpected manner upon the hardness of the steel; the critical value diminishes as the hardness becomes greater *up to a certain point*, corresponding to a yellow temper, after which it increases and with the hardest steel becomes very high. For steel which has been made red-hot, suddenly cooled, and then let down to a yellow temper, the critical value of the magnetizing force is smaller than for steel which is either softer or harder; it is indeed so small that the metal contracts like nickel even under weak magnetizing forces, without undergoing any preliminary extension that can be detected.

Joule also made experiments upon iron wires under tension, and appears to have formed the conclusion (which has been often quoted as if it were a demonstrated fact) that under a certain critical tension (differing for different specimens of iron but independent of the magnetizing force) magnetization would produce no effect whatever upon the dimensions of the wire.[1] What actually happens when an iron wire is loaded with various weights is clearly shown in Fig. 21. Increased tension merely has the effect of diminishing the maximum elongation and hastening the contraction; with the two greatest loads used in the experiment there was indeed no preliminary extension at all.[2] The effects of tension upon the behaviour of a nickel wire are of a less simple character. In weak fields the magnetic contraction is always diminished by pulling stress; in strong fields the contraction increases under a small load and diminishes under a heavy one. Cobalt, curiously enough, was found to be quite unaffected by tensile stress.

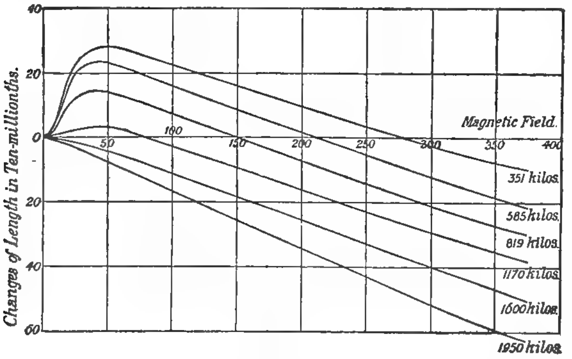

Fig. 21.

Certain experiments by Knott on magnetic twist, which will be referred to later, led him to form the conclusion that in an iron wire carrying an electric current the magnetic elongation would be increased. This forecast was shown by Bidwell to be well founded. The effect produced by a current is exactly opposite to that of tension, raising the elongation curve instead of depressing it. In the case of a wire 0·75 mm. in diameter the maximum elongation was nearly doubled when a current of two amperes was passing through the iron, while the "critical value" of the field was increased from 130 to 200. Yet notwithstanding this enormous effect in iron, the action of a current upon nickel and cobalt turned out to be almost inappreciable.

Some experiments were next undertaken with the view of ascertaining how far magnetic changes of length in iron were dependent upon the hardness of the metal, and the unexpected result was arrived at that softening produces the same effect as tensile stress; it depresses the elongation curve, diminishing the maximum extension, and reducing the "critical value" of the magnetizing force. A hard drawn wire showed a maximum elongation of 45 ten-millionths, the critical field being (by extrapolation) 560. After the wire had been annealed, its maximum elongation was only 7 and the critical field 140. A thoroughly well annealed ring of soft iron showed no extension at all, beginning to contract under the smallest magnetizing forces; in a field of 506, when the experiment had to be stopped owing to the heating of the coil, the retraction had reached 75 ten-millionths, and appeared to be still far from its limiting value. A ring made of the same iron, but unannealed, showed a maximum elongation of 33, the critical value of the field being 420. The experiments were not sufficiently numerous to indicate whether, as is possible, there is a critical degree of hardness for which the height of the elongation curve is a maximum.

Finally, experiments were made to ascertain the effect of magnetization upon the dimensions of iron rings in directions perpendicular to the magnetization, and upon the volume of the rings. Four brass rods were hard-soldered to a short cylindrical iron ring, two of them forming prolongations of a diameter, while the other two were attached to the edges, opposite to one another and parallel to the axis of the ring. The first pair served to communicate to the measuring instrument the effects of changes along the lines of magnetization, the other pair those perpendicular to the magnetization. It was found that the curve showing the relation of transverse changes of dimensions to magnetizing force was similar in general character to the familiar elongation curves, but the signs were reversed; the curve was inverted, indicating at first retraction, which, after passing a maximum and vanishing in a critical field, was succeeded by elongation. The curve showing the circumferential (or longitudinal) changes was also plotted, and from the two curves thus obtained it was easy, on the assumption that the metal was isotropic in directions at right angles to the magnetization, to calculate changes of volume; for if circumferential elongation be denoted by l_1, and transverse elongation by l_2, then the cubical dilatation $(+ \text{ or } -) = l_1 + 2l_2$ approximately. If l_1 were exactly equal to $-2l_2$ for all values of the magnetizing force, it is clear that the volume of the ring would be unaffected by magnetization. In the case of the ring in question, the circumferential changes were in weak fields less than twice as great as the transverse ones, while in strong fields they were more; under increasing magnetic force therefore the volume of the ring was first diminished, then it regained its original value (for $H = 90$), and ultimately increased. It was also shown that annealing, which has such a large effect upon circumferential (or longitudinal) changes, has almost none upon transverse ones. Hence the changes of volume undergone by a given sample of wrought iron under increasing magnetization must depend largely upon the state of the metal as regards hardness; there may be always contraction, or always expansion, or first one and then the other.

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[1] In *Ency. Brit.* vol. xv. p. 269 it is stated that in the case of a certain wire loaded with a weight of 600 ℔ there was neither extension nor contraction, even with a very large current. This, however, was merely a conjecture of Joule's which an experiment would have disproved.

[2] The loads were successively applied in decreasing order of magnitude. They are indicated in Fig. 21 as kilos per sq. cm.

Many of the above-described experiments have been repeated, and the results confirmed by other workers. As regards the effect of magnetization upon volume there are some discrepancies. Nagaoka and Honda, employing a fluid dilatometer, found that the volume of several specimens of iron and steel was always slightly increased, no diminution in low fields being indicated. Rhoads, finding that the height of the elongation curve is greater for strips of sheet iron cut parallel to the direction of the fibrous structure than for strips cut at right angles to it, conjectures that in perfectly isotropic iron there would be no change of volume. In order to avoid complications arising from imperfect homogeneity and isotropy, by which metallic solids must always be in some degree affected, Hurmuzescu experimented with solutions of salts of iron, and found that their volume was diminished by the action of a magnetic field. Nickel, according to Cantone's observations, appeared to be slightly diminished in volume by magnetization; and a similar result was at first obtained by Nagaoka and Honda, but when they afterwards tested a specimen of greater purity a small increase of volume was observed. The question again arises how far these results are dependent upon the physical condition of the metal. Knott has carried out an exhaustive series of experiments on the strains produced in iron, steel, nickel, and cobalt *tubes* in the magnetic field. Tubes of various dimensions were subjected to fields of various intensities, and measurements were made of changes in (1) volume of the bore, (2) length of the tube, (3) volume of the material of the tube, (4) external changes of volume when the tube was plugged. The important results obtained are of too complex a nature to be fully described here; the following are the general conclusions drawn:—(i.) the strain is one in which there is comparatively little change of volume, but considerable change of form; (ii.) except in the case of very thin walls, a circular element in any transverse plane perpendicular to the axis of the cylinder becomes, when the cylinder is magnetized parallel to its axis, an ellipse with its major axis pointing towards the axis of the tube. When the walls are thin, the ellipse has its minor axis pointing towards the axis of the tube. The ellipse in both cases increases in eccentricity as the distance from the axis diminishes. It may be added that the measurements of class (3) showed that in iron there was always a slight increase of volume, and in nickel and cobalt a slight decrease. Honda subjected tubes of iron, steel, and nickel to the simultaneous action of longitudinal and circular fields, and observed the changes of length which occurred when one of the fields was varied, while the other remained constant at different successive values from zero upwards. The experimental results agreed in sign though not in magnitude with those calculated from the changes produced by simple longitudinal magnetization, discrepancies being partly accounted for by the fact that the metals employed were not actually isotropic. The complicated hysteresis effects which attend the magnetic elongation and contraction of iron, nickel, and cobalt have been studied by Nagaoka.

Attempts have been made to explain magnetic deformation by various theories of magnetic stress,[1] notably that elaborated by Kirchhoff (*Wied. Ann.* vol. xxiv. (1885), p. 52, and vol. xxv. p. 601), but so far without any great success. Taylor Jones showed in 1897 that only a small proportion of the contraction exhibited by a nickel wire when magnetized could be accounted for on Kirchhoff's theory from the observed effects of pulling stress upon magnetization; and in a more extended series of observations Nagaoka and Honda found wide quantitative divergences between the results of experiment and calculation, though in nearly all cases there was agreement as to quality. They consider, however, that Kirchhoff's theory, which assumes change of magnetization to be simply proportional to strain, is still in its infancy, the present stage of its evolution being perhaps comparable with that reached by the theory of magnetization at the time when the ratio I/H was supposed to be constant. In the light of future researches further development may reasonably be expected.

EFFECTS OF MECHANICAL STRESS UPON MAGNETIZATION.

Certain effects of traction, compression, and torsion in relation to magnetism have been noticed in *Ency. Brit.* vol. xv. pp. 269–271. Since the publication of the ninth edition, the behaviour of the magnetic metals under various kinds of stress has formed the subject of much patient investigation, especially at the hands of Ewing, Nagaoka, and Knott. The results of their experiments embrace a multiplicity of details of which it is impossible to give a brief summary. Only a few of the most important can be mentioned here; the reader who wishes for fuller information should consult the original papers.[2]

It was first discovered by Villari in 1868 that the magnetic susceptibility of an iron wire was increased by stretching when the magnetization was below a certain value, but diminished when that value was exceeded; this phenomenon has been termed the "Villari reversal," and the value of the magnetization for which stretching by a given load produces no effect is known as the "Villari critical point" for that load. The Villari critical point for a given sample of iron is reached with a smaller magnetizing force when the stretching load is great than when it is small; the reversal also occurs with smaller loads and with weaker fields when the iron is soft than when it is hard. The following table shows the values of I and H corresponding to the Villari critical point in some of Ewing's experiments:—

Soft Iron.			Hard Iron.		
Kilos per sq. mm.	I.	H.	Kilos per sq. mm.	I.	H.
2·15	1220	7·3	27·6	1180	34
4·3	1040	4·3	32·2	1150	32
8·6	840	3·4	37·3	1110	29
12·9	690	3·05	42·5	1020	25

The effects of pulling stress may be observed either when the wire is stretched by a constant load while the magnetizing force is varied, or when the magnetizing force is kept constant while the load is varied. In the latter case the first application of stress is always attended by an increase—often a very great one—of the magnetization, whether the field is weak or strong, but after a load has been put on and taken off several times the changes of magnetization become cyclic. From experiments of both classes it appears that for a given field there is a certain value of the load for which the magnetization is a maximum, the maximum occurring at a smaller load the stronger the field. In very strong fields the maximum may even disappear altogether, the effect of the smallest stress being to diminish the magnetization; on the other hand, with very weak fields the maximum may not have been reached with the greatest load that the wire can support without permanent deformation. When the load on a hardened wire is gradually increased, the maximum value of I is found to correspond with a greater stress than when the load is gradually diminished, this being an effect of hysteresis. Analogous changes are observed in the residual magnetization which remains after the wire has been subjected to fields of different strength. The effects of longitudinal pressure are opposite to those of traction; when the cyclic condition has been reached, pressure reduces the magnetization of iron in weak fields and increases it in strong fields (Ewing, *Magnetic Induction* (1900), p. 223).

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[1] For a discussion of theories of magnetic stress, with copious references, see Nagaoka, *Rap. du Congrès International de Physique*, Paris, 1900, vol. ii. p. 536. Also Nagaoka and Jones, *Phil. Mag.* vol. xli. (1896), p. 454. As to the disputed question whether there exists a compressive stress equal to $B^2/8\pi$ or $(B^2-H^2)/8\pi$, see letters by Chree, Jones, Ewing, and Wilberforce, *Nature*, vol. liii. (1896). Also More, Klingenberg, and Brackett, *loc. cit.*

[2] EWING, *Phil. Trans.* vol. clxxvi. (1885), p. 580; vol. clxxix. (1888), p. 333; *Magnetic Induction* (1900), ch. ix.—EWING and COWAN, *Phil. Trans.* vol. clxxix. A (1888), p. 325.—NAGAOKA, *Phil. Mag.* vol. xxvii. (1889), p. 117; vol. xxix. (1890), p. 123.—KNOTT, *Trans. R. S. Ed.* vol. xxxii. (1882–83), p. 193; vol. xxxv. (1889), p. 377; vol. xxxvi. (1891), p. 485; *Proc. R. S. Ed.*, 1899, p. 586.—NAGAOKA and HONDA, *Journ. Coll. Sci. Tôkyô*, vol. xiii. part 2 (1900), p. 263.

The influence of traction in diminishing the susceptibility of nickel was first noticed by Kelvin (Thomson), and has been more recently investigated by Ewing and Cowan. The latter found the effect to be enormous, not only upon the induced magnetization, but in a still greater degree upon the residual. Even under so "moderate" a load as 33 kilogrammes per square mm., the induced magnetization of a hard-drawn nickel wire in a field of 60 fell from 386 to 72 units, while the residual was reduced from about 280 to 10. Ewing has also examined the effects produced by longitudinal compression upon the susceptibility and retentiveness of nickel, and found, as was to be expected, that both were greatly increased by pressure. The maximum susceptibility of one of his bars rose from 5·6 to 29 under a stress of 19·8 kilos per square mm. There were reasons for believing that no Villari reversal would be found in nickel. Ewing and Cowan looked carefully for it, especially in weak fields, but failed to discover anything of the kind.[1] In some experiments by Heydweiller (*Wied. Ann.* vol. lii. (1894), p. 462, and *Electrician*, vol. xxxiv. p. 143) the magnetization of a nickel wire in weak fields (corresponding to $I=5$ or thereabouts) was first diminished and then augmented under increasing tensile stress; but since a cyclic condition does not appear to have been even approximately established before the observations were made, they can hardly be regarded as demonstrating a true Villari effect. Nagaoka and Honda (*Phil. Mag.* vol. xlvi. (1898), p. 26) found that the magnetization of a nickel rod under feeble pulling stress was increased by a little more than half a unit in a weak field. The loads applied were equal to 0·19 and 0·38 kilogramme per square mm., the smallest employed by Ewing having been 5·5. If, therefore, a Villari reversal does occur in the case of nickel, the phenomenon is a very inconspicuous one.

The effects of longitudinal pressure upon the magnetization of cobalt have been examined by Chree (*Phil. Trans.* vol. clxxxi. (1890), p. 329) and also by Ewing (*Magnetic Induction* (1892), p. 210). Chree's experiments were undertaken at the suggestion of J. J. Thomson, who, from the results of Bidwell's observations on the magnetic deformation of cobalt, was led to expect that that metal would exhibit a Villari reversal opposite in character to that observed in iron. The anticipated reversal was duly found by Chree, the critical point corresponding, under the moderate stress employed, to a field of about 120 units. Ewing's independent experiments showed that the magnetization curve for a cobalt rod under a load of 16·2 kilos per square mm. crossed the curve for the same rod when not loaded at $H=53$. Both observers noticed analogous effects in the residual magnetization. Meyer (*Wied. Ann.* vol. lix. (1896), p. 134) appears to have found a Villari effect of the opposite sign in feebly magnetized cobalt under pulling stress ($I=3\cdot64$).

It has been shown by J. J. Thomson (*Applications of Dynamics to Physics and Chemistry*, p. 47) that on dynamical principles there must be a reciprocal relation between the changes of dimensions produced by magnetization and the changes of magnetization attending mechanical strain. Since, for example, stretching diminishes the magnetization of nickel, it follows from theory that the length of a nickel rod should be diminished by magnetization and conversely. So, too, the Villari reversals in iron and cobalt might have been predicted—as indeed that in cobalt actually was—from a knowledge of the changes of length which those metals exhibit when magnetized.[2]

Nagaoka and Honda (*Phil. Mag.* vol. xlvi. (1898), p. 261) have investigated the effects of hydrostatic pressure upon magnetization, using the same pieces of iron and nickel as were employed in their experiments upon magnetic change of volume. In the iron cylinder and ovoid, which expanded when magnetized, compression caused a diminution of magnetization; in the nickel rod, which contracted when magnetized, pressure was attended by an increase of magnetization. The amount of the change was in both cases exceedingly small, that in iron being less than 0·1 C.G.S. unit with a pressure of 250 atmospheres and $H=54$. It would hardly be safe to generalize from these observations; the effects may possibly be dependent upon the physical condition of the metals. In the same paper Nagaoka and Honda describe an important experiment on the effect of transverse stress. An iron tube, having its ends closed by brass caps, was placed inside a compressing vessel into which water was forced until the pressure upon the outer surface of the tube reached 250 atmospheres. The experiment was the reverse of that made by Kelvin with a gun-barrel (*Ency. Brit.* vol. xv. p. 269), and the results were also the reverse. Under increasing magnetizing force the magnetization first increased, reached a maximum, and then diminished until its value ultimately became less than when the iron was in the unstrained condition.

The relations between torsion and magnetization have been discussed in *Ency. Brit.* vol. xv. p. 270. Some of the curious phenomena there referred to are direct consequences of the known effects of longitudinal stress upon magnetization and of magnetization upon form. An explanation due to Maxwell (*Electricity and Magnetism*, § 448) is given of the fact discovered by G. Wiedemann, that if an electric current is passed through a longitudinally magnetized iron wire which is fixed at one end and free at the other, the free end twists in a certain direction. According to Maxwell, the wire becomes helically magnetized, and the expansion of the iron along the lines of magnetization causes the twist. This explanation was not accepted by Wiedemann (*Phil. Mag.*, July 1886, p. 50), who thought the effect was to be accounted for by molecular friction. Now nickel contracts instead of lengthening when it is magnetized longitudinally, and an experiment made by Knott showed, as he expected, that *ceteris paribus* a nickel wire twists in a sense opposite to that in which iron twists. Further, although iron lengthens in fields of moderate strength, it contracts in strong ones; and if the wire is stretched, contraction occurs with smaller magnetizing forces than when it is unstretched. Bidwell (*Phil. Mag.*, September 1886, p. 251) accordingly found upon trial that the Wiedemann twist of an iron wire vanished when the magnetizing force reached a certain rather high value, and was reversed when that value was exceeded; he also found that the vanishing point was reached with lower values of the magnetizing force when the wire was stretched by a weight. These observations have been verified and extended by Knott, who has also studied the effect in cobalt, and has brought to light a large number of additional facts, all of which are in perfect harmony with Maxwell's explanation of the twist.

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[1] Tomlinson found a critical point in the "temporary magnetization" of nickel (*Proc. Phys. Soc.* vol. x. (1890), pp. 367, 445), but this does not correspond to a Villari reversal. Its nature is made clear by Ewing and Cowan's curves (*Phil. Trans.* vol. clxxix. (1888), places 15, 16).

[2] In *Ency. Brit.* vol. xv. p. 271, the first footnote is equivalent to a prediction of the changes of length in magnetized iron which were afterwards observed.

More experiments have been made by Ewing,[1] Knott,[2] Zehnder,[3] and Nagaoka,[4] on the polarity developed in a circularly magnetized wire by torsion, and on the transient electric currents, indicative of circular magnetization, induced when a longitudinally magnetized wire is twisted; it is noteworthy that both these effects have opposite directions in iron and in nickel. The effects of magnetization upon the torsion of a previously twisted wire have been further studied by F. J. Smith[5] and by Moreau.[6] Nagaoka[7] has described the remarkable influence of combined torsion and tension upon the susceptibility of nickel, and has made the extraordinary observation that, under certain conditions of stress, the magnetization of a nickel wire may have a direction opposite to that of the magnetizing force. It is not easy to co-ordinate these results with any other known phenomena of magnetism.

The mutual relations between torsion and magnetization in iron and nickel wires have recently been investigated by Nagaoka and Honda, who have succeeded in showing that all the experimental results contained in the following parallel statements are in qualitative agreement with an extension of Kirchhoff's theory :—

Strains produced by Magnetization.	*Effects of Stress on Magnetization.*
(1) A longitudinally magnetized wire is twisted by circular magnetization.	(i.) Twisting a longitudinally magnetized wire gives rise to circular magnetization.
(2) A circularly magnetized wire is twisted by longitudinal magnetization.	(ii.) Twisting a circularly magnetized wire gives rise to longitudinal magnetization.
(3) Up to moderate fields, the twist produced by the longitudinal and circular magnetizations of an iron wire is opposite to that in nickel.	(iii.) Up to moderate fields, the transient current (due to circular magnetization) or the longitudinal magnetization produced by twisting a longitudinally or circularly magnetized iron wire respectively, is opposite to that in nickel.
(4) The twist due to longitudinal magnetization of a circularly magnetized iron or nickel wire reaches a maximum in low fields.	(iv.) The transient current produced by twisting a longitudinally magnetized iron or nickel wire reaches a maximum in low fields.
(5) In strong fields the twist due to longitudinal magnetization of a circularly magnetized iron wire is reversed and takes place in the same direction as in nickel.	(v.) In strong fields the direction of the transient current produced by twisting a longitudinally magnetized iron wire is reversed and is in the same direction as in nickel.

Effects of Temperature upon Magnetism.

High Temperature.—It has long been known that iron, when raised to a certain "critical temperature" corresponding to dull red heat, loses its susceptibility and becomes magnetically indifferent, or, more accurately, is transformed from a ferromagnetic into a paramagnetic body. Recent researches have shown that other important changes in its properties occur at the same critical temperature. Abrupt alterations take place in its specific heat, thermo-electric quality, electrical conductivity, temperature-coefficient of electrical resistance, and in some at least of its mechanical properties. Ordinary magnetizable iron is in many respects an essentially different substance from the non-magnetizable metal into which it is transformed when its temperature is raised above a certain point (see *Brit. Assoc. Report,* 1890, p. 145). The first exact experiments demonstrating the changes which occur in the permeability of iron, steel, and nickel when heated up to high temperatures were those of Hopkinson (*Phil. Trans.* vol. clxxx. (1889), p. 443; *Proc. Roy. Soc.* vol. xliv. (1888), p. 317). The metal to be tested was prepared in the form of a ring, upon which were wound primary and secondary coils of copper wire insulated with asbestos. The primary coil carried the magnetizing current; the secondary, which was wound inside the other, could be connected either with a ballistic galvanometer for determining the induction, or with a Wheatstone's bridge for measuring the resistance, whence the temperature was calculated. The ring thus prepared was placed in a cast-iron box and heated in a gas furnace. The following are the chief results of Hopkinson's experiments: For small magnetizing forces the magnetization of iron steadily increases with rise of temperature till the critical temperature is approached, when the rate of increase becomes very high, the permeability in some cases attaining a value of about 11,000; the magnetization then with remarkable suddenness almost entirely disappears, the permeability falling to about 1·14. For strong magnetizing forces (which in these experiments did not exceed $H=48{\cdot}9$) the permeability remains almost constant at its initial value (about 400), until the temperature is within nearly 100° of the critical point; then the permeability diminishes more and more rapidly until the critical point is reached and the magnetization vanishes. Steel behaves in a similar manner, but the maximum permeability is not so high as in iron, and the fall, when the critical point is approached, is less abrupt. The critical temperature for various samples of iron and steel ranges from 690° C. to 870° C.; it is the temperature at which Barrett's "recalescence" occurs. The critical temperature for the specimen of nickel examined (which contained nearly 5 per cent. of impurities) was 310° C. Lydall and Pocklington found that the critical temperature of nearly pure iron was 874° C. (*Proc. Roy. Soc.* vol. lii. (1893), p. 228).

An exhaustive research into the effects of heating on the magnetic properties of iron has been carried out by D. K. Morris (*Proc. Phys. Soc.* vol. xv. (1897), p. 134; and *Phil. Mag.* vol. xliv. (1897), p. 213), the results being embodied in a paper containing twelve pages of tables and upwards of 120 curves. As in Hopkinson's experiments, ring magnets were employed; these were wound with primary and secondary coils of insulated platinum wire, which would bear a much higher temperature than copper without oxidation or fusion. A third platinum coil, wound non-inductively between the primary and the secondary, served to carry the current by which the ring was heated; a current of 4·6 amperes, with 16 volts across the terminals, was found sufficient to maintain the ring at a temperature of 1150° C. In the ring itself was embedded a platinum-thermometer wire, from the resistance of which the temperature was determined. The whole was wrapped in several coverings of asbestos and placed in a glass vessel from which the air was partially exhausted, additional precautions being taken to guard against oxidation of the iron.

Some preliminary experiments showed the striking difference in the effects of annealing at a red heat (840° C.) and at a low white heat (1150° C.). After one of the rings had been annealed at 840°, its maximum permeability at ordinary temperatures was 4000 for $H=1{\cdot}84$; when it had been subsequently annealed at 1150°, the maximum permeability rose to 4680 for $H=1{\cdot}48$, while the hysteresis loss for $B=\pm 4000$ was under 500 ergs per ccm. As regards the effects of temperature, Morris's results are in general agreement with those of Hopkinson, though no doubt they indicate details with greater clearness and accuracy. Specimens of curves showing the relation of induction to magnetic field at various temperatures, and of permeability to temperature with fields of different intensities, are given in Figs. 22 and 23. The most striking feature presented by these is the enormous value, 12,660, which, with $H=0{\cdot}153$, is attained by the permeability at 765° C., followed by a drop so precipitous that when the temperature is only 15° higher, the value of the permeability has become quite insignificant. The critical temperatures for three different specimens of iron were 795°, 780°, and 770° respectively. Above these temperatures the little permeability that remained was found to be independent of the magnetizing force, but it appeared to vary a little with the temperature, one specimen showing a permeability of 100 at 820°, 2·3 at 950°, and 17 at 1050°. These last observations are, however, regarded as uncertain.

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[1] *Proc. Roy. Soc.* 1883, p. 117.

[2] *Loc. cit.*

[3] *Wied. Ann.* vol. xxxviii. (1889), p. 68.

[4] *Phil. Mag.* vol. xxix. (1890), p. 123.

[5] *Phil. Mag.* vol. xxxii. (1891), p. 383.

[6] *C. R.* vol. cxxii. (1896), p. 1192; vol. cxxvi. (1898), p. 463.

[7] *Phil. Mag.* vol. xxvii. (1889), p. 117.

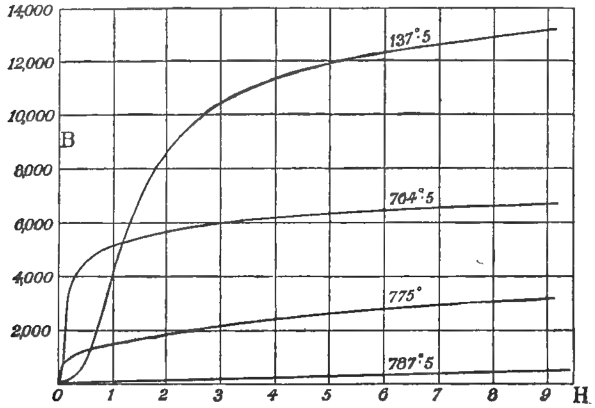

Fig. 22.

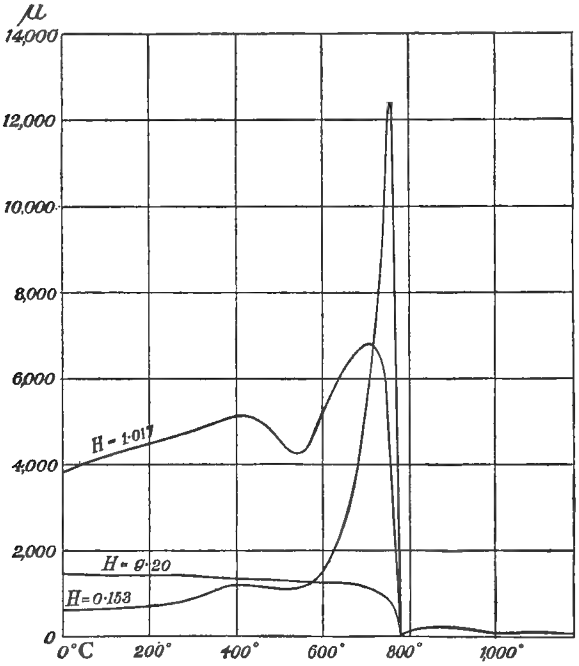

Fig. 23.

The effects of temperature upon hysteresis were also carefully studied, and many hysteresis loops were plotted. The results of a typical experiment are given in the annexed table, which shows how greatly the hysteresis loss is diminished as the critical temperature is approached. The coercive force at 764·5° is stated to have been little more than 0·1 C.G.S. unit; above the critical temperature no evidence of hysteresis could be obtained.

Hysteresis Loss in Ergs per ccm. Max. H = ± 6·83.

Temp. C°.	Ergs.	Temp. C°.	Ergs.
764·5	120	457	2025
748	328	352	2565
730	426	249	3130
695	797	137·5	3500
634	1010	24	3660
554	1345		

Experiments on the effect of high temperatures have also been made by Ledeboer,[1] Tomlinson,[2] Curie,[3] Wilde,[4] Kunz,[5] and Wills.[6]

Low Temperature.—Fleming and Dewar (*Proc. Roy. Soc.* vol. lx. (1896), p. 81) have conducted a unique series of experiments on the permeability and hysteresis of iron at low temperatures down to that of liquid air (– 186° C.). Induction curves of an annealed soft-iron ring were taken first at a temperature of 15° C., and afterwards when the ring was immersed in liquid air, the magnetizing force ranging from about 0·8 to 22. After this operation had been repeated a few times, the iron was found to have acquired a stable condition, and the curves corresponding to the two temperatures became perfectly definite. They showed that the permeability of this sample of iron was considerably diminished at the lower temperature. The maximum permeability (for $H = 2$) was 3400 at 15°, and only 2700 at – 186°, a reduction of more than 20 per cent.; but the percentage reduction became less as the magnetizing force departed from the value corresponding to maximum permeability. Observations were also made of the changes of permeability which took place as the temperature of the sample slowly rose from – 186° to 15°, the magnetizing force being kept constant throughout an experiment. The values of the permeability corresponding to the highest and lowest temperatures are given in the following table. Most of the permeability-temperature curves were more or less convex towards the axis of temperature, and in all the experiments, except those with annealed iron and steel wire, the permeability was greatest at the lowest temperature.[7] The hysteresis of the soft annealed iron turned out to be sensibly the same for equal values of the induction at – 186° as at 15°, the loss in ergs per ccm. per cycle being approximately represented by $0{\cdot}002B^{1{\cdot}56}$ when the maximum limits of B were ± 9000. Experiments with the sample of unannealed iron failed to give satisfactory results, owing to the fact that no constant magnetic condition could be obtained.

Sample of Iron.	H.	μ at 15°.	μ at – 186°.
Annealed Swedish	1·77	2835	2332
Unannealed ,, ...	1·78	917	1272
,, ,, ...	9·79	1210	1293
Hardened ,, ...	2·66	56	132
,, ,, ...	4·92	106·5	502
,, ,, ...	11·16	447·5	823
,, ,, ...	127·7	109	124
Steel wire	7·50	86	64·5
,, ...	20·39	361	144

Permanent Magnets.—The same experimenters (*loc. cit.* p. 57) also investigated the changes which occurred in permanently magnetized metals when cooled to the temperature of liquid air. The metals, which were prepared in the form of small rods, were magnetized between the poles of an electromagnet and tested with a magnetometer at temperatures of – 186° and 5°. The first immersion into liquid air generally produced a permanent decrease of magnetic moment, and there was sometimes a further decrease when the metal was warmed up again; but after a few alternations of temperature the changes of moment became definite and cyclic. When the permanent magnetic condition had been thus established, it was found that in the case of all the metals, except the two alloys containing large percentages of nickel, the magnetic moment was temporarily increased by cooling to – 186°. The following table shows the principal results. It is suggested that a permanent magnet might conveniently be "aged" (or brought into a constant condition) by dipping it several times into liquid air.

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[1] *C. R.* vol. cvi. (1888), p. 129.

[2] *Proc. Phys. Soc.* vol. ix. (1888), p. 181.

[3] *C. R.* vol. cxv. (1892), p. 805; and vol. cxviii. (1894), pp. 796, 859.

[4] *Proc. Roy. Soc.* vol. l. (1891), p. 109.

[5] *Elekt. Zeits.* vol. xv. (1894), p. 194.

[6] *Phil. Mag.* vol. l. (1900), p. 1.

[7] Thiessen (*Phys. Rev.* vol. viii. (1899), p. 65) and Claude (*C. R.* vol. cxxix. (1899), p. 409) found that for considerable inductions ($B = 15{,}000$) the permeability and hysteresis-loss remained nearly constant down to – 186°; for weak inductions both notably diminished with temperature.

Metal.	Percentage Gain or Loss of Moment at −186° C.	
	First Effect.	Cyclic Effect.
Carbon steel, hard	−6	+12
,, ,, medium . . .	Decrease	+22
,, ,, annealed . . .	−33	+33
Chromium steels (four samples) .	Increase	+12
Aluminium steels (three samples) .	−2	+10
Nickel steels, up to 7·65 per cent. .	Small	+10
,, ,, ,, 19·64 per cent.	−50	−25
,, ,, ,, 29 per cent. .	−20	−10
Pure nickel	Decrease	+3
Silicon steel, 2·67 per cent. . .	,,	+4
Iron, soft	None	+2·5
,, hard	Decrease	+10
Tungsten steel, 15 per cent. . .	,,	+6
,, ,, 7·5 per cent. . .	,,	+10
,, ,, 1 per cent. . .	,,	+12

Other experiments relating to the effect of temperature upon permanent magnets have been carried out by Ashworth,[1] who showed that the temperature coefficient of permanent magnets might be reduced to zero (for moderate ranges of temperature) by suitable adjustment of temper and dimension ratio; also by Pictet[2] and by Durward.[3]

Alloys of Nickel and Iron.—A most remarkable effect of temperature was discovered by Hopkinson (*Proc. Roy. Soc.* vol. xlvii. (1890), p. 23; vol. xlviii. (1891), p. 1) in 1889. An alloy containing about 3 parts of iron and 1 of nickel—both strongly magnetic metals—is under ordinary conditions practically non-magnetizable ($\mu = 1{\cdot}4$ for any value of H). If, however, this non-magnetic substance is cooled to a temperature a few degrees below freezing-point, it becomes as strongly magnetic as average cast-iron ($\mu = 62$ for $H = 40$), and retains its magnetic properties indefinitely at ordinary temperatures. But if the alloy is heated up to 580° C., it loses its susceptibility—rather suddenly when H is weak, more gradually when H is strong—and remains non-magnetizable till it is once more cooled down below the freezing-point. This material can therefore exist in either of two perfectly stable conditions, in one of which it is magnetizable, while in the other it is not. When magnetizable, it is a hard steel, having a specific electrical resistance of 0·000052; when non-magnetizable, it is an extremely soft, mild steel, and its specific resistance is 0·000072. Alloys containing different proportions of nickel were found to exhibit the phenomenon, but the two critical temperatures were less widely separated. The following approximate figures are deduced from Hopkinson's curves:—

Percentage of Nickel.	Susceptibility lost at temp. C.	Susceptibility gained at temp. C.
0·97	890	—
4·7	820	660
4·7	780	600
24·5	680	−10
30·0	140	125
33·0	207	193
73·0	202	202

Guillaume[4] has further investigated the properties of nickel-steels, and found that the temperature at which magnetic susceptibility is recovered is lowered by the presence of chromium; a certain nickel-chromium alloy was not rendered magnetic even by immersion in liquid air. Experiments on the subject have also been carried out by Dumont[5] and Osmond.[6]

Alloys and Compounds of Iron.

In 1885 Hopkinson (*Phil. Trans.* vol. clxxvi. (1885), p. 455) employed his yoke method to test the magnetic properties of thirty-five samples of iron and steel, among which were steels containing substantial proportions of manganese, silicon, chromium, and tungsten. The results, together with the chemical analysis of each sample, are given in a table contained in his paper, some of them being also represented graphically. The most striking phenomenon which they bring into prominence is the effect of any considerable quantity of manganese in annihilating the magnetic property of iron. A sample of Hadfield's manufacture, containing 12·36 per cent. of manganese, differed hardly at all from a non-magnetic substance, its permeability being only 1·27. According to Hopkinson's calculation, this sample behaved as if 91 per cent. of the iron contained in it had completely lost its magnetic property.[7] Another point to which attention is directed is the exceptionally great effect which hardening has upon the magnetic properties of chrome steel; one specimen had a coercive force of 9 when annealed, and of no less than 38 when oil-hardened. The effect of the addition of tungsten in increasing the coercive force is very clearly shown; in two specimens containing respectively 3·44 and 2·35 per cent. of tungsten the coercive force was 64·5 and 70·7. These high values render hardened tungsten-steel particularly suitable for the manufacture of permanent magnets. Hopkinson (*Proc. Roy. Soc.* vol. xlviii. (1890), p. 1) also noticed some peculiarities of an unexpected nature in the magnetic properties of the nickel-steel alloys already referred to. The permeability of the alloys containing from 1 to 4·7 per cent. of nickel, though less than that of good soft iron for magnetizing forces up to about 20 or 30, was greater for higher forces, the induction reached in a field of 240 being nearly 21,700. The induction for considerable forces was found to be greater in a steel containing 73 per cent. of nickel than in one with only 33 per cent., though the permeability of pure nickel is much less than that of iron.

The magnetic qualities of various alloys of iron have been submitted to a very complete examination by Barrett, Brown, and Hadfield (*Trans. Roy. Dub. Soc.* vol. vii. (1900), p. 67; *Journ. Inst. Elec. Eng.*, 1902).[8] More than fifty different specimens were tested, most of which contained a known proportion of manganese, nickel, tungsten, aluminium, chromium, copper, or silicon; in some samples two of the substances named were present. Of the very numerous results published, a few of the most characteristic are collected in the following table. The first column contains the symbols of the various elements which were added to the iron, and the second the percentage proportion in which each element was present; the sample containing 0·03 per cent. of carbon was a specimen of the best commercial iron, the values obtained for it being given for comparison. All the metals were annealed.

Element.	Per Cent.	B for $H=45$.	B residual.	μ for $H=8$.	Coercive Force.
C	0·03	16800	9770	1625	1·66
Cu	2·5	14300	10410	...	5·4
Mn	2·25	14720	10460	1080	6·0
Mn	15·2	0	...	...	...
Ni	3·82	16190	9320	1375	2·76
Ni	19·64	7770	4770	90	20·0
Ni	31·4	4460	1720	357	0·5
W	7·5	15230	13280	500	9·02
Al	2·25	16900	10500	1700	1·0
Cr	3·25	...	...	...	12·25
Si	2·5	16420	4080	1680	0·9
Si	5·5	15980	3430	1630	0·85

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[1] *Proc. Roy. Soc.* vol. lxii. (1898), p. 210.

[2] *C. R.* vol. cxx. (1895), p. 263.

[3] *Amer. Jour. Scien.* vol. v. (1898), p. 245.

[4] *C. R.* vol. cxxiv. (1897), p. 1515; *Journ. de Phys.* vol. vii. (1898), p. 262.

[5] *C. R.* vol. cxxvi. (1898), p. 741.

[6] *Ibid.* vol. cxxviii. (1899), pp. 304, 1395.

[7] See also Hopkinson, *Journ. Inst. Elect. Eng.* vol. xix. p. 20, and Ewing, *Phil. Trans.* vol. clxxx. (1889), p. 239.

[8] Many of the figures which, through an error, were inaccurately stated in the first paper are corrected in the second.

A few among several interesting points should be specially noticed. The addition of 15·2 per cent. of manganese produced an enormous effect upon the magnetism of iron, while the presence of only 2·25 per cent. was comparatively unimportant. When nickel was added to the iron in increasing quantities, the coercive force increased until the proportion of nickel reached 20 per cent.; then it diminished, and when the proportion of nickel was 32 per cent. the coercive force had fallen to the exceedingly low value of 0·5. In the case of iron containing 7·5 per cent. of tungsten (W), the residual induction had a remarkably high value; the coercive force, however, was not very great. The addition of silicon in small quantities considerably diminished permeability and increased coercive force; but when the proportion amounted to 2·5 per cent. the maximum permeability ($\mu=5100$ for $H=2$) was greater than that of the nearly pure iron used for comparison, while the coercive force was only 0·9.[1] A small percentage of aluminium produced still higher permeability ($\mu=6000$ for $H=2$), the induction in fields up to 60 being greater than in any other known substance, and the hysteresis-loss for moderate limits of B far less than in the purest commercial iron. Certain non-magnetizable alloys of nickel, chromium-nickel, and chromium-manganese were rendered magnetizable by annealing.

A number of iron alloys have been examined by Mme. Sklodowska-Curie (*Bull. Soc. d'Encouragement*, 1898, pp. 36–76), chiefly with the object of determining their suitability for the construction of permanent magnets. Her tests appear to show that molybdenum is even more effective than tungsten in augmenting the coercive force, the highest values observed being 70 to 74 for tungsten-steel, and 80 to 85 for steel containing 3·5 to 4 per cent. of molybdenum. For additional information regarding the composition and qualities of permanent magnet steels, reference may be made to the publications cited below.[2] Useful instructions have been furnished by Barus (*Terrestrial Magnetism*, vol. ii. (1897), p. 11) for the preparation of magnets calculated to withstand the effects of time, percussion, and ordinary temperature variations. The metal, having first been uniformly tempered glass-hard, should be annealed in steam at 100° C. for twenty or thirty hours; it should then be magnetized to saturation, and finally "aged" by a second immersion in steam for about five hours.

MISCELLANEOUS EFFECTS OF MAGNETIZATION.

Electrical Conductivity.—The specific resistance of many electric conductors is known to be temporarily changed by the action of a magnetic field, but except in the case of bismuth the effect is very small.

Gray and T. Jones (*Proc. Roy. Soc.* vol. lxvii. (1900), p. 208) found that the resistance of a soft iron wire was increased by about 1/700 in a field of 320 C.G.S. units. The effect appeared to be closely connected with the intensity of magnetization, being approximately proportional to I^4. Barlow (*Proc. Roy. Soc.*, 1902), experimenting with wires of iron, steel, and nickel, showed that the change of resistance was proportional to a function $aI^2+bI^4+cI^6$, where a, b, and c are constants for each specimen. Tomlinson (*Phil. Trans.*, Part I., 1883, p. 153) discovered in 1881 that the resistance of a bismuth rod was slightly increased when the rod was subjected to longitudinal magnetic force, and a year or two later Righi (*Atti R. A. Lincei* [3], vol. xix. p. 545) showed that a more considerable alteration was produced when the magnetic force was applied transversely to the bismuth conductor; he also noticed that the effect was largely dependent upon temperature. (See also Lenard, *Wied. Ann.* vol. xxxix. (1890), p. 619.) The most complete series of experiments yet made on the influence of magnetic force at different temperatures are those of Henderson and of Dewar and Fleming. Henderson (*Phil. Mag.* vol. xxxviii. p. 488) used a little spiral of the pure electrolytic bismuth wire prepared by Hartmann and Braun; this was placed between the pole-pieces of an electromagnet and subjected to fields of various strengths up to nearly 39,000 units. At constant temperature the resistance increased with the field; the changes in the resistance of the spiral when the temperature was 18° C. are indicated in the annexed table, from which it will be seen that in the strongest transverse field reached the resistance was increased more than threefold. Other experiments showed the relation of resistance to temperature (from 0° to about 90°) in different constant fields. It appears that as the temperature rises the resistance decreases to a minimum and then increases, the minimum point occurring at a higher temperature the stronger the field. For $H=11,500$ the temperature of minimum resistance was about 50°; for much lower or higher values of H the actual minimum did not occur within the range of temperature dealt with. Dewar and Fleming (*Proc. Roy. Soc.* vol. lx. p. 425) worked with a similar specimen of bismuth, and their results for a constant temperature of 19° agree well with those of Henderson. They also experimented with constant temperatures of −79°, −185°, and −203°, and found that at these low temperatures the effect of magnetization was enormously increased. The following table gives some of their results, the specific resistance of the bismuth being expressed in C.G.S. units.

H.	R.	H.	R.
0	1·000	27450	2·540
6310	1·253	32730	2·846
12500	1·630	38900	3·334
20450	2·160		

Field Strength.	Temp. 19° C.		Temp. −185° C.	
	Spec. Res.	Comp. Res.	Spec. Res.	Comp. Res.
0	116200	1·000	41000	1·00
1375	118200	1·017	103300	2·52
2750	123000	1·059	191500	4·67
8800	149200	1·284	738000	18·0
14150	186200	1·602	1730000	42·2
21800	257000	2·212	6190000	151

At the temperature of liquid air (−185°) the application of a field of 21,800 multiplied the resistance of the bismuth no less than 150 times. Fig. 24 shows the variations of resistance in relation to temperature for fields of different constant values. It will be seen that for $H=2450$ and $H=5500$ the minimum resistance occurs at temperatures of about −80° and −7° respectively.

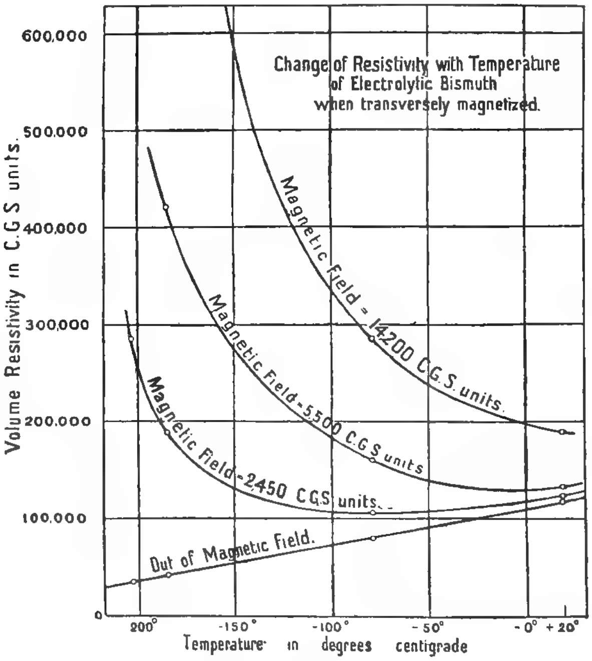

Fig. 24.

Hall Effect.—If an electric current is passed along a strip of thin metal, and the two points at opposite ends of an equipotential line are connected with a galvanometer, its needle will of course not be deflected. But the application of a magnetic field at right angles to the plane of the metal causes the equipotential lines to rotate through a small angle, and the points at which the galvanometer is connected being no longer at the same potential, a current is indicated by the galvanometer. (See *Ency. Brit.* vol. xv. p. 273.) The transverse electromotive force is equal to KCH/D, where C is the current, H the strength of the field, D the thickness of the metal, and K a constant which has been termed the *rotatory power* or *rotational coefficient.* (See Hopkinson, *Phil. Mag.* vol. x. (1880), p. 430.) The following values of K for different metals are given by Hall (*Phil. Mag.* vol. xix. (1885), p. 419), the positive sign indicating that the electromotive force is in the same direction as the mechanical force acting upon the conductor. Ettinghausen and Nernst (*Wien. Ber.* vol. xciv. [2] (1886), p. 560) have found that the rotational coefficient of tellurium is more than fifty times greater than that of bismuth, its sign being positive. Several experimenters have endeavoured to find a Hall effect in liquids, but such results as have been hitherto obtained are by no means free from doubt. Marx (*Ann. d. Phys.* vol. ii. (1900), p. 798) observed a well-defined Hall effect in incandescent gases.

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[1] The marked effect of silicon in increasing the permeability of cast iron has also been noticed by Caldwell, *Elect. World*, vol. xxxii. (1898), p. 619.

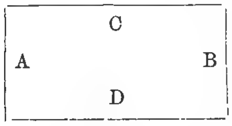
[2] TROWBRIDGE and SHELDON, *Phil. Mag.* vol. xxix. (1890), p. 136.—PREECE, *Journ. Inst. Elect. Eng.* (1890), p. 62; also *Electrician*, vol. xxv. (1890), p. 546.—KLEMENCIC, *Wien. Ber.* vol. cv. IIa. (1896), p. 635.—PEIRCE, *Am. Journ. Sci.* vol. ii. (1896), p. 347.—ABT, *Wied. Ann.* vol. lxvi. (1898), p. 116.—OSMOND, *C. R.* vol. cxxviii. (1899), p. 1513.

Metal.	$K \times 10^{15}$.	Metal.	$K \times 10^{15}$.
Antimony	+114000	Copper	−520
Steel	+12060	Gold	−660
Iron	+7850	Nickel	−14740
Cobalt	+2460	Bismuth[1]	−8580000
Zinc	+820		

Electro-Thermal Relations.—The Hall electromotive force is only one of several so-called "galvano-magnetic effects" which are observed when a magnetic field acts normally upon a thin plate of metal traversed by an electric current. It is remarkable that if a flow of heat be substituted for a current of electricity, a closely allied group of "thermo-magnetic effects" is presented. The two classes of phenomena have been collated by Lloyd (*Am. Journ. Sci.* vol. xii. (1901), p. 57) as follows:—

Galvano-Magnetic Effects.	*Thermo-Magnetic Effects.*
(1) A transverse difference of electric potential (Hall effect).	(i.) A transverse difference of electric potential (Nernst effect).
(2) A transverse difference of temperature (Ettinghausen effect).	(ii.) A transverse difference of temperature (Leduc effect).
(3) Longitudinal change of electric conductivity.	(iii.) Longitudinal change of thermal conductivity.
(4) Longitudinal difference of temperature.	(iv.) Longitudinal difference of electric potential.[2]

If in the annexed diagram ABCD represents the metallic plate through which the current of electricity or heat flows in the direction AB, then effects (1), (2), (i.), and (ii.) are exhibited at C and D, effects (4) and (iv.) at A and B, and effects (3) and (iii.) along AB. The transverse effects are reversed in direction when either the magnetic field or the primary current (electric or thermal) is reversed, but the longitudinal effects are independent of the direction of the field. Bismuth is the only metal in which all the phenomena of both classes have yet been observed. It has been shown by Moreau (*C. R.* vol. cxxx. (1900), pp. 122, 412, 562) that if K is the coefficient of the Hall effect (1) and K' the analogous coefficient of the Nernst effect (i.) (which is constant for small values of H), then $K' = K\sigma/\rho$, σ being the coefficient of the Thomson effect for the metal and ρ its specific resistance. He considers that Hall's is the fundamental phenomenon, and that the Nernst effect is essentially identical with it, the primary electromotive force in the case of the latter being that of the Thomson effect in the unequally heated metal (*Ency. Brit.* vol. viii. p. 97), while in the Hall experiment it is derived from an external source.



Thermo-electric Quality.—According to Kelvin (Thomson) the thermo-electric quality of iron is affected by longitudinal magnetization in such a manner that the thermo-electric current flows from the unmagnetized to the magnetized metal through the hot junction; or, in other words, longitudinal magnetization renders iron less positive (*Ency. Brit.* vol. xv. p. 273). It has been found that when the magnetizing force is increased, this effect passes a maximum, and in a sufficiently strong field would probably even be reversed.[3] Ewing (*Phil. Trans.* vol. clxxvii. p. 373) has shown that tensile stress diminishes the thermo-electric effect of magnetization and reverses it when the load is great; nickel always becomes more positive when magnetized; Tomlinson (*Proc. Roy. Soc.* vol. xxxix. (1885), p. 513) found that cobalt in a magnetic field of 44 units was negative to unmagnetized cobalt. If it should turn out that the effect upon cobalt is reversed in a weak field, the interesting fact would be established that the changes produced by magnetization in the thermo-electric qualities of the ferromagnetic metals are exactly parallel to those which it causes in their dimensions. A comprehensive series of experiments by Lownds (*Ann. d. Phys.* vol. iv. (1901), p. 776) shows conclusively, in opposition to the view long held, that the thermo-electric quality of bismuth is entirely unaffected by a magnetic field.

Elasticity.—The results of experiments as to the effect of magnetization upon elasticity were until quite lately discordant and inconclusive, sufficient care not having generally been taken to protect the specimen under test from the heat radiated by the magnetizing coil. Recent researches, however, indicate pretty clearly that for iron and nickel both Young's modulus and the rigidity are materially increased when the metals are subjected to a magnetic field.[4] Day, finding that in very strong fields the rigidity continued to increase long after magnetic saturation had been reached, concludes that the phenomena of magnetic intensity and of magnetic rigidity are quite distinct, a practical limit to the former being reached in comparatively weak fields. This observation is of interest in relation to the changes of length produced by magnetism, though, as Barus remarks, the rigidity, unlike the length, never passes a maximum. Tangl's delicate experiments show that Young's modulus for a magnetized wire depends not only upon the magnetizing force, but also upon the tensile stress. The effects are very complex, and require further investigation.

Chemical and Voltaic Effects.—If two iron plates, one of which is magnetized, are immersed in an electrolyte, a current will generally be indicated by a galvanometer connected with the plates.

As to whether the magnetized plate becomes positive or negative to the other, different experimenters are not in agreement. It has, however, been shown by Hurmuzescu (*Rap. du Congrès Int. de Phys.*, Paris, 1900, p. 561) that the true effect of magnetization is liable to be disguised by secondary or parasitic phenomena, arising chiefly from polarization of the electrodes and from local variations in the concentration and magnetic condition of the electrolyte; these may be avoided by working with weak solutions, exposing only a small surface in a non-polar region of the metal, and substituting a capillary electrometer for the galvanometer generally used. When such precautions are adopted it is found that the "electromotive force of magnetization" is, for a given specimen, perfectly definite both in direction and in magnitude; it is independent of the nature of the corrosive solution, and is a function of the field-strength alone, the curves showing the relation of electromotive force to field-intensity bearing a rough resemblance to the familiar I-H curves. The value of the E.M.F. when $H=2000$ is of the order of 1/100 volt for iron, 1/1000 volt for nickel, and 1/10,000 for bismuth. When the two electrodes are ferromagnetic, the direction of the current through the liquid is from the unmagnetized to the magnetized electrode, the latter being least attacked; with diamagnetic electrodes the reverse is the case. Hurmuzescu shows that these results are in accord with theory. Applying the principle of the conservation of internal energy, he demonstrates that for iron in a field of 1000 units and upwards the E.M.F. of magnetization is

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[1] The large Hall effect in bismuth was discovered by Righi (*Journ. de Phys.* [2], vol. iii. (1884), p. 127).

[2] REFERENCES.—(2) ETTINGHAUSEN, *Wied. Ann.* vol. xxxi. (1887), p. 737.—(4) NERNST, *ibid.* p. 784.—(i.) and (iv.) ETTINGHAUSEN and NERNST, *Wied. Ann.* vol. xxix. (1886), p. 343.—(ii.) and (iii.) RIGHI, *Rend. Acc. Linc.* vol. iii., part ii. (1887), p. 6, and part i. p. 481; and LEDUC, *Journ. de Phys.* vol. vi. (1887), p. 78. Additional authorities are quoted by Lloyd, *loc. cit.*

[3] CHASSAGNY, *C. R.* vol. cxvi. (1893), p. 977.—LALA and FOURNIER, *C. R.* vol. cxxiii. (1896), p. 801.—HOULEVIGNE, *Journ. de Phys.* vol. v. (1896), p. 53.

[4] DAY, *Am. Journ. Sci.* vol. iii. (1897), p. 449.—STEVENS and DORSAY, *Phys. Rev.* vol. ix. (1899), p. 116, and vol. x. (1900), p. 161.—BARUS, *Am. Journ. Sci.* vol. x. (1900), p. 407.—TANGL, *Ann. d. Phys.* vol. vi. (1901), p. 34.

$$E=\frac{l}{\delta}\cdot\frac{I^2}{2\kappa} \qquad \text{approximately,}$$

l being the electrochemical equivalent and δ the density of the metal. Owing to the difficulty of determining the magnetization I and the susceptibility κ with accuracy, it has not yet been possible to submit this formula to a quantitative test, but it is said to afford an indication of the results given by actual experiment. It has been discovered by Nichols and Franklin (*Am. Journ. Sci.* vol. xxxiv. (1887), p. 419; vol. xxxv. p. 290) that the transition from the "passive" to the active state (see *Ency. Brit.* vol. xiii. p. 279) of iron immersed in strong nitric acid is facilitated by magnetization, the temperature of transition being lowered. This is attributed to the action of local currents set up between unequally magnetized portions of the iron. Similar results have been obtained by Andrews (*Proc. Roy. Soc.* vol. xlviii. (1890), p. 116).

FEEBLY SUSCEPTIBLE SUBSTANCES.

Water.—The following are recent determinations of the magnetic susceptibility of water:—

Observer.	$\kappa\times10^6$.	Publication.
Quincke	$-0\cdot797$ at 18° C.	*Wied. Ann.* vol. xxiv. p. 387, 1885.
Du Bois	$-0\cdot837\,(1-0\cdot0025\,\overline{t-15^\circ})$	*Wied. Ann.* vol. xxxv. p. 137, 1888.
Curie	$-0\cdot790$ at 4° C.	*C. R.* vol. cxvi. p. 136, 1893.
Townsend	$-0\cdot77$	*Phil. Trans.* vol. clxxxvii. p. 544, 1896.
Fleming and Dewar	$-0\cdot74$	*Proc. Roy. Soc.* vol. lxiii. p. 311, 1898.
Koenigsberger	$-0\cdot803$ at 21° C.	*Wied. Ann.* vol. lxvi. p. 698, 1898.
Jäger and Meyer	$-0\cdot689\,(1-0\cdot0016t)$	*Wied. Ann.* vol. lxvii. p. 707, 1899.

Oxygen and Air.—The best modern determinations of the value of κ for gaseous oxygen agree very fairly well with that given by Faraday in 1853. (See *Ency. Brit.* vol. xv. p. 267.) Assuming that for water $\kappa=-0\cdot8\times10^{-6}$, his value of κ for oxygen at 15° C. reduces to $0\cdot15\times10^{-6}$. Important experiments on the susceptibility of oxygen at different pressures and temperatures have been carried out by P. Curie (*C. R.* vol. cxv. p. 805; vol. cxvi. p. 136; *Journ. de Phys.* [3], vol. iv. p. 204). He found that the susceptibility for unit of mass, K, was independent of both pressure and magnetizing force, but varied inversely as the absolute temperature, θ, so that $10^6K=33700/\theta$. Since the mass of 1 cub. cm. of oxygen at 0° C. and 760 mm. pressure is $0\cdot00141$ grm., the mass at any absolute temperature θ is by Charles's law $0\cdot00141\times273/\theta=0\cdot3849/\theta$ grm.; hence the susceptibility per unit of volume at 760 mm. will be

$$\begin{aligned}\kappa&=10^{-6}\times0\cdot3849\times33700/\theta^2\\&=10^{-6}\times12970/\theta^2.\end{aligned}$$

At 15° C. $\theta=273+15=288$, and therefore $\kappa=0\cdot156\times10^{-6}$, nearly the same as the value found by Faraday. At 0° C., $\kappa=0\cdot174\times10^{-6}$. For air Curie calculated that the susceptibility per unit mass was $10^6K=7830/\theta$; or, taking the mass of 1 c.c. of air at 0° C. and 760 mm. as $0\cdot001291$ grm., $\kappa=10^{-6}\times2760/\theta^2$ for air at standard atmospheric pressure. It is pointed out that this formula may be used as a temperature correction in magnetic determinations carried out in air.

Fleming and Dewar determined the susceptibility of liquid oxygen (*Proc. Roy. Soc.* vol. lx. (1896), p. 283; vol. lxiii. p. 311) by two different methods. In the first experiments it was calculated from observations of the mutual induction of two conducting circuits in air and in the liquid; the results for oxygen at −182° C. were

$$\mu=1\cdot00287,\ \kappa=228\times10^{-6}.$$

In the second series, to which greater importance is attached, measurements were made of the force exerted in a divergent field upon small balls of copper, silver, and other substances, first when the balls were in air and afterwards when they were immersed in liquid oxygen. If V is the volume of a ball, H the strength of the field at its centre, and κ' its apparent susceptibility, the force in the direction x is $f=\kappa'VH\times dH/dx$; and if κ'_a and κ'_o are the apparent susceptibilities of the same ball in air and in liquid oxygen, $\kappa'_a-\kappa'_o$ is equal to the difference between the susceptibilities of the two media. The susceptibility of air being known—practically it was negligible in these experiments—that of liquid oxygen can at once be found. The mean of 36 experiments with 7 balls gave

$$\mu=1\cdot00407,\ \kappa=324\times10^{-6}.$$

A small but decided tendency to a decrease of susceptibility in very strong fields was observed. It appears, therefore, that liquid oxygen is by far the most strongly paramagnetic liquid known, its susceptibility being more than four times greater than that of a saturated solution of ferric chloride. On the other hand, its susceptibility is about 50 times less than that of Hadfield's 12 per cent. manganese steel, which is commonly spoken of as non-magnetizable.

Bismuth.—Bismuth is of special interest, as being the most strongly diamagnetic substance known, the mean value of the seven determinations of its susceptibility given in *Ency. Brit.* vol. xv. p. 268, being $-14\cdot6\times10^{-6}$. The magnetic properties of the metal at different temperatures and in fields up to 1350 units have been studied by P. Curie (*loc. cit.*), who found that its "specific susceptibility" (K) was independent of the strength of the field, but decreased with rise of temperature up to the melting-point, 273° C. His results appear to show the relation

$$-K\times10^6=1\cdot381-0\cdot00155t^\circ.$$

Assuming the density of Bi to be $9\cdot8$, and neglecting corrections for heat dilatation, his value for the susceptibility at 20° C. is equivalent to $\kappa=-13\cdot23\times10^{-6}$. As the temperature was raised up to 273°, κ gradually fell to $-9\cdot38\times10^{-6}$, rising suddenly when fusion occurred to $-0\cdot37\times10^{-6}$, at which value it remained constant when the fluid metal was further heated. Fleming and Dewar give for the susceptibility the values $-13\cdot7\times10^{-6}$ at 15° C. and $-15\cdot9\times10^{-6}$ at −182°, the latter being approximately equivalent to $K\times10^6=-1\cdot62$. Putting $t^\circ=-182$ in the equation given above for Curie's results, we get $K\times10^6=-1\cdot66$, a value sufficiently near that obtained by Fleming and Dewar to suggest the probability that the diamagnetic susceptibility varies inversely as the temperature between −182° and the melting-point.

Other Diamagnetics.—The following table gives Curie's determinations (*Journ. de Phys.* vol. iv. (1895), p. 204) of the specific susceptibility K of other diamagnetic substances at different temperatures. It should be noted that $K=\kappa/\text{density}$.

Substance.	Temp. ° C.	$-K \times 10^6$.
Water	15 – 189	0·790
Rock salt	16 – 455	0·580
Potassium chloride	18 – 465	0·550
,, sulphate	17 – 460	0·430
,, nitrate (fusion 350°)	18 – 420	0·330
Quartz	18 – 430	0·441
Sulphur, solid or fused	18 – 225	0·510
Selenium, solid or fused	20 – 200	0·320
,, fused	240 – 415	0·307
Tellurium	20 – 305	0·311
Bromine	20	0·410
Iodine, solid or fused	18 – 164	0·385
Phosphorus, solid or fused	19 – 71	0·920
,, amorphous	20 – 275	0·730
Antimony, electrolytic	20	0·680
,,	540	0·470
Bismuth, solid	20	1·350
,, ,,	273	0·957
,, fused	273 – 405	0·038

For all diamagnetic substances, except antimony and bismuth, the value of K was found to be independent of the temperature.

Paramagnetic Substances.—Experiments by Henderson (*Phil. Trans.* vol. clxxxvii. (1896), p. 533) show that the susceptibility of solutions of salts of iron is independent of the magnetizing force, and depends only on the quantity of iron contained in unit volume of the liquid. If W is the weight of iron present per c.c. at about 10° C., then for ferric salts

$$10^6\kappa = 266W - 0{\cdot}77$$

and for ferrous salts

$$10^6\kappa = 206W - 0{\cdot}77,$$

the quantity $-0{\cdot}77$ arising from the diamagnetism of the water of solution. Annexed are values of $10^6\kappa$ for the different salts examined, w being the weight of the salt

Salt.	$10^6\kappa + 0{\cdot}77$.	Salt.	$10^6\kappa + 0{\cdot}77$.
Fe_2Cl_6	$91{\cdot}6w$	$FeCl_2$	$90{\cdot}8w$
$Fe_2(SO_4)_3$	$74{\cdot}5w$	$FeSO_4$	$74{\cdot}9w$
$Fe_2(NO_3)_6$	$61{\cdot}5w$		

per c.c. of the solution. Susceptibility was found to diminish greatly with rise of temperature. According to Jäger and Meyer (*Wien. Akad. Sitz.* vol. cvi. II.*a*, p. 623, and vol. cvii. II.*a*, p. 5) the atomic susceptibilities k of the metals nickel, chromium, iron, cobalt, and manganese in solutions of their salts are as follows:—

Metal.	$k \times 10^6$.	Metal.	$k \times 10^6$.
Ni	$4{\cdot}95 = 2{\cdot}5 \times 2$	Co	$10{\cdot}0 = 2{\cdot}5 \times 4$
Cr	$6{\cdot}25 = 2{\cdot}5 \times 2{\cdot}5$	Fe(2)	$12{\cdot}5 = 2{\cdot}5 \times 5$
Fe(1)	$7{\cdot}5 = 2{\cdot}5 \times 3$	Mn	$15{\cdot}0 = 2{\cdot}5 \times 6$

Fe(1) is iron contained in $FeCl_2$ and Fe(2) iron contained in $FeSO_4$ and $Fe_3(NO_3)_6$.

Curie has shown, for many paramagnetic bodies, that the specific susceptibility K is inversely proportional to the absolute temperature θ. Du Bois believes this to be an important general law, applicable to the case of every paramagnetic substance, and suggests that the product $K\theta$ should be known as "Curie's constant" for the substance.

Elementary Bodies and Atomic Susceptibility.—Among a large number of substances the susceptibilities of which have been determined by Koenigsberger (*Wied. Ann.* vol. lxvi. (1898), p. 698) are the following elements:—

Element.	$\kappa \times 10^6$.	Element.	$\kappa \times 10^6$.
Copper	− 0·82	Tellurium	− 2·10
Silver	− 1·51	Graphite	+ 2
Gold	− 3·07	Aluminium	+ 1·80
Zinc	− 0·96	Platinum	+ 22
Tin	+ 0·46	Palladium	+ 50 to 60
Lead	− 1·10	Tungsten	+ 14
Thallium	− 4·61	Magnesium	+ 4
Sulphur	− 0·86	Sodium	+ 2·2
Selenium (red)	− 0·50	Potassium	+ 3·6

In a table accompanying Koenigsberger's paper the elements are arranged upon the periodic system and the atomic susceptibility (product of specific susceptibility into atomic weight) is given for each. It appears that the elements at about the middle of each row are the most strongly paramagnetic; towards the ends of a row the susceptibility decreases, and ultimately becomes negative. Thus a relation between susceptibility and atomic weight is clearly indicated. Tables similarly arranged, but much more complete, have been published by Meyer (*Wied. Ann.* vol. lxviii. (1899), p. 325, and vol. lxix., p. 236), whose researches have filled up many previously existing gaps. The values assigned to the atomic susceptibilities of most of the known elements are appended. According to the notation adopted by Meyer the atomic susceptibility $k = \kappa \times$ atomic-weight/(density × 1000).

El	10^6k	*El*	10^6k	*El*	10^6k
Be	+ 0·72	Cu	− 0·006	Cs	− 0·03[1]
B	+ 0·05	Zn	− 0·010	Ba	− 0·02[1]
C	− 0·05	Ga	−	La	+ 13·0
N	?	Ge		Ce	+ 34·0
O	+	As	?	Pr	+ Strong
Fl	− 0·01[1]	Se	− 0·025	Nd	+
		Br	− 0·033	Sa	+
Na	− 0·005[1]			Gd	+
Mg	+ 0·014	Rb	− 0·02[1]		
Al	+	Sr	− 0·02[1]	Er	+ 41·8(?)
Si	+ 0·002	Y	+ 3·2(?)		
P	− 0·007	Zr	− 0·014	Yb	+ (?)
S	− 0·011	Nb	+ 0·49(?)	Ta	+ 1·02(?)
Cl	− 0·02[1]	Mo	+ 0·024	W	+ 0·1
		Ru	+	Os	+ 0·074
K	− 0·001[1]	Rh	+	Ir	+
Ca	− 0·003[1]	Pd	+ 0·55	Pt	+ 0·227
Sc	?	Ag	− 0·016	Au	− 0·031
Ti	+ 0·09	Cd	− 0·015	Hg	− 0·030
V	+ 0·17	In	− 0·01[1]	Tl	− 0·93
Cr	+ Strong	Sn	+ 0·004[1]	Pb	− 0·025
Mn	+	Sb	− 0·069	Bi	− 0·023
Fe	+	Te	− 0·039		
Co	+	I	− 0·040	Th	+ 16·0(?)
Ni	+			U	+ 0·21

Meyer thinks that the susceptibilities of the metals praseodidymium, neodidymium, ytterbium, samarium, gadolinium, and erbium, when obtained in a pure form, will be found to equal or even exceed those of the well-known ferromagnetic metals. Many of their compounds are very strongly magnetic, erbium, for example, in Er_2O_3 being four times as strong as iron in the familiar magnetite or lodestone, Fe_2O_3. The susceptibilities of some hundreds of inorganic compounds have also been determined by the same investigator (*loc. cit.*). Among other recently published researches relating to atomic and molecular magnetism are those of Liebknecht and Wills (*Ann. d. Phys.* vol. i. (1900), p. 178), du Bois and Liebknecht (*ibid.* p. 189), and Meyer (*ibid.* p. 668). An excellent summary of the present state of knowledge regarding the magnetic properties of matter, with many tables and references, has been compiled by du Bois (*Report to the Congrès Int. de Phys.*, Paris, 1900, vol. ii. p. 460).

Molecular Theory of Magnetism.

According to Weber's theory, the molecules of a ferromagnetic metal are small permanent magnets, the axes of which under ordinary conditions are turned indifferently in every direction, so that no magnetic polarity is exhibited by the metal as a whole; a magnetic force acting upon the metal tends to turn the axes of the little magnets in one direction, and thus the entire piece acquires the properties of a magnet. If, however, the molecules could turn with perfect freedom, it is clear that the smallest magnetizing force would be sufficient to develop the highest possible degree of magnetization, which is of course not the case. Weber therefore supposed each molecule to be acted on by a force tending to preserve it in its original direction, the position actually assumed by the axis being in the direction of the resultant of this hypothetical force and the applied magnetizing force. Maxwell (*Electricity and Magnetism*, § 444), recognizing that the theory in this form gave no account of residual magnetization, made the further assumption that if the deflection of the axis of the molecule exceeded a certain angle, the axis would not return to its original position when the deflecting force was removed, but would retain a permanent set. Although the amended theory as worked out by Maxwell is in rough agreement with certain leading phenomena of magnetization, it fails to account for many others, and is in some cases at variance with observed facts.

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[1] Calculated.

Ewing (*Proc. Roy. Soc.* vol. xlviii. (1890), p. 342) has demonstrated that it is quite unnecessary to assume either the directive force of Weber, the permanent set of Maxwell, or any kind of frictional resistance, the forces by which the molecular magnets are constrained being simply those due to their own mutual attractions and repulsions. The effect of these is beautifully illustrated by a model consisting of a number of little compass needles pivoted on sharp points and grouped near to one another upon a board, which is placed inside a large magnetizing coil. When no current is passing through the coil and the magnetic field is of zero strength, the needles arrange themselves in positions of stable equilibrium under their mutual forces, pointing in many different directions, so that there is no resultant magnetic moment. This represents the condition of the molecules in unmagnetized iron. If now a gradually increasing magnetizing force is applied, the needles at first undergo a stable deflection, giving to the group a small resultant moment which increases uniformly with the force; and if the current is interrupted while the force is still weak, the needles merely return to their initial positions. This illustrates the first stage in the process of magnetization, when the moment is proportional to the field and there is no hysteresis or residual magnetism (see *ante*, p. 436). A somewhat stronger field will deflect many of the needles beyond the limits of stability, causing them to turn round and form new stable combinations, in which the direction assumed by most of them approximates to that of the field. The rearrangement is completed within a comparatively small range of magnetizing force, a rapid increase of the resultant moment being thus brought about. When the field is removed, many of the newly formed combinations are but slightly disturbed, and the group may consequently retain a considerable resultant moment. This corresponds to the second stage of magnetization, in which the susceptibility is large and permanent magnetization is set up. A still stronger magnetizing force has little effect except in causing the direction of the needles to approach still more nearly to that of the field; if the force were infinite, every member of the group would have exactly the same direction, and the greatest possible resultant moment would be reached; this illustrates "magnetic saturation"—the condition approached in the third stage of magnetization. When the strong magnetizing field is gradually diminished to zero and then reversed, the needles pass from one stable position of rest to another through a condition of instability; and if the field is once more reversed, so that the cycle is completed, the needles again pass through a condition of instability before a position of stable equilibrium is regained. Now the unstable movements of the needles are of a mechanically irreversible character; the energy expended in dissociating the members of a combination and placing them in unstable positions assumes the kinetic form when the needles turn over, and is ultimately frittered down into heat. Hence in performing a cycle there is a waste of energy corresponding to what has been termed hysteresis-loss.

Supposing Ewing's hypothesis to be correct, it is clear that if the magnetization of a piece of iron were reversed by a strong rotating field instead of by a field alternating through zero, the loss of energy by hysteresis should be little or nothing, for the molecules would rotate with the field and no unstable movements would be possible.[1] Some experiments by F. G. Baily (*Phil. Trans.* vol. clxxxvii. (1896), p. 715) show that this is actually the case. With small magnetizing forces the hysteresis was indeed somewhat larger than that obtained in an alternating field, probably on account of the molecular changes being forced to take place in one direction only; but at an induction of about 16,000 units in soft iron and 15,000 in hard steel the hysteresis reached a maximum and afterwards rapidly diminished. In one case the hysteresis loss per cubic centimetre per cycle was 16,100 ergs for $B=15,900$, and only 1200 ergs for $B=20,200$, the highest induction obtained in the experiment; possibly it would have vanished before B had reached 21,000.[2] These experiments prove that actual friction must be almost entirely absent, and, as Baily remarks, the agreement of the results with the previously suggested deduction affords a strong verification of Ewing's form of the molecular theory. Ewing has himself also shown how satisfactorily this theory accords with many other obscure and complicated phenomena, such as those presented by coercive force, differences of magnetic quality, and the effects of vibration, temperature, and stress; while as regards simplicity and freedom from arbitrary assumptions it leaves little to be desired.

The next problem which awaits solution concerns the origin of molecular magnetism. Why is it that the molecules or atoms of iron, nickel, cobalt, and perhaps one or two of the rarer metals, have the properties of little magnets, while those of other substances are magnetic only in an immensely inferior degree, or not at all? Ampère's hypothesis that an electric current constantly circulates around each magnetic molecule (*Encyclopædia Britannica*, vol. viii. p. 76) still holds its ground, though in a somewhat modified form. Rowland, carrying out in 1876 an experiment which had been proposed by Maxwell a few years earlier, showed that a revolving electric charge produced the same magnetic effects as a current, and it has been supposed that molecular magnetism may be due, not to currents in the sense contemplated by Ampère, but to the rapid revolution of electrostatic charges. Such a hypothesis has acquired additional probability from the researches of J. J. Thomson and others. Thomson has demonstrated the existence, under many different conditions, of particles more minute than anything previously known to science. The mass of each is about a thousandth part of that of a hydrogen atom, and with each is indissolubly associated a charge of negative electricity equal in quantity to about 6×10^{-10} C.G.S. electrostatic unit. These particles, which were termed by their discoverer *corpuscles*, are more commonly spoken of as *electrons*,[3] the particle thus being identified with the charge which it carries. With every material atom in a neutral condition there is linked, as Thomson believes, one or more detachable corpuscles, the number depending upon the valency of the atom: if the atom loses a corpuscle, it becomes positively electrified; if it receives additional corpuscles, it is negatively electrified. The process of electric conduction in metals consists in the movement of detached corpuscles, and many other phenomena, both electrical and thermal, can be more or less completely explained by their agency. Attempts have been made to account quantitatively for the magnetic properties of iron and other substances on the supposition that the corpuscles or electrons revolve like satellites in orbits around the atoms with which they are associated. The period of revolution would necessarily be almost evanescent. It has been calculated by Lang (*Ann. d. Phys.* vol. ii. (1900), p. 483) that if the iron atom is regarded as divalent, the electrons must travel at a speed comparable with that of light, completing at the lowest estimate more than a trillion revolutions in a second. Such methods of explaining magnetic phenomena are not free from difficulties, and so far they have failed to give any clear indication of a physical cause for the sharply defined difference which exists between ferromagnetic and other bodies. But though at the time of writing no detailed hypothesis has met with general acceptance, it can hardly be doubted that by further researches upon the lines of those to which reference has been made, much new light will in the near future be thrown upon some of the most obscure problems of magnetism.

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[1] This deduction from Ewing's theory appears to have been first suggested by J. Swinburne. See *Industries*, 1890, p. 289.

[2] Beattie (*Phil. Mag.* vol. i. (1901), p. 642) has found similar effects in nickel and cobalt.

[3] The charge associated with a corpuscle is the same as that carried by a hydrogen atom. Stoney in 1881 (*Phil. Mag.* vol. xi. p. 387) pointed out that this latter constituted the indivisible "atom of electricity," or natural unit charge; later he proposed (*Trans. Roy. Dub. Soc.* vol. iv. (1891), p. 583) that such unit charge should be called an "electron." The application of this term to Thomson's corpuscle implies, rightly or wrongly, that, notwithstanding its apparent mass, the corpuscle is in fact nothing more than an atom of electricity. The question whether a corpuscle actually has a material gravitating nucleus is undecided.

AUTHORITIES.—In addition to the works already cited in text and footnotes, the following may be mentioned:—MASCART and JOUBERT. *Electricity and Magnetism.* Trans. by ATKINSON. London, 1883.—J. C. MAXWELL. *Electricity and Magnetism.* 3rd edit. Oxford, 1892.—J. A. EWING. *Magnetic Induction in Iron and other Metals.* 3rd edit. London, 1900.—J. J. THOMSON. *Recent Researches in Electricity and Magnetism.* Oxford, 1893.—H. DU BOIS. *The Magnetic Circuit.* Trans. by ATKINSON. London, 1896.—A. GRAY. *Treatise on Magnetism and Electricity.* London, 1898.—J. A. FLEMING. *Magnets and Electric Currents.* London, 1898.—C. MAURAIN. *Le Magnetisme du Fer.* Paris [1899].—E. SCHMIDT. *Die Magnetische Untersuchung des Eisens und verwandter Metalle,* Halle a. S., 1900.—*Rapports du Congrès International de Physique*, vol. ii. Paris, 1900. (S. BI.)

Magnetism, Terrestrial.—§ 1. In the earlier volumes of the *Encyclopædia Britannica* Dr Balfour Stewart treated terrestrial magnetism as part of the subject of Meteorology (ninth edition, vol. xvi. p. 159). For brevity his article is distinguished here by the letter S. For the same reason the letters R and T are employed to denote respectively the *Repertorium für Meteorologie*, and the journal *Terrestrial Magnetism*, edited by Dr Bauer.

Instruments.

§ 2. The instruments mentioned in S are still those in most general use, but a variety of new forms have been employed during recent years. Amongst these may be mentioned "earth-inductors," or rotating coils, for determining the inclination by induction methods, magnetometers and magnetographs with small magnets (*Ann. du Bureau Central Météorologique de France*, vol. i. 1884, p. B_{57}, &c.; *Wied. Ann.* vol. xix. p. 130, vol. xxix. p. 47, vol. xl. p. 489, vol. lxiv. p. 735, &c.), and very open scale instruments employed by, amongst others, Kohlrausch (*Wied. Ann.* vol. lx. p. 336, &c.) and Eschenhagen (T, vol. i. 1896, p. 55; *Sitz der k. Preuss. Akad. der Wiss.* 30th July 1896 and 24th June 1897; *Verhand. der Deutschen Physik. Gesellsch.* 1899, p. 147, &c.). Under Wild's auspices a variety of forms of magnetometers and earth-inductors have been used by the Russian magnetic service in field and observatory work, in Arctic regions as well as in temperate climates. A summary of modern magnetic instruments, including earth-inductors, with illustrations of Wild's chief forms, was communicated by Edelmann to the Chicago Meteorological Congress (*Bull. No. 11, Part II., U.S. Dept. of Agriculture*, 1895). The degree of accuracy obtainable with these instruments as well as with English inclinometers, and many questions relating to the determination of constants, have been discussed by Wild himself (R, vol. viii. No. 7; vol. xvi. No. 2; vol. xvii. No. 6; *Mém. de l'Acad. des Sciences de St Pétersbourg*, vol. xxxiv. No. 11; vol. xxxvi. No. 1; vol. xxxvii. No. 4 and No. 6; vol. xxxviii. No. 3, &c.). Investigations on these and cognate matters have also been published by Kohlrausch (*Wied. Ann.* vol. xv. p. 545; vol. xxii. p. 411; vol. xxxi. p. 609, &c.), Mielberg (R, vol. x. No. 1), Leyst (R, vol. x. Nos. 5 and 11), Mascart (*Ann. du Bureau Central Météorologique*, vol. i. 1890, p. B_{113}; *Brit. Assoc. Report* for 1898, p. 741, &c.), Borgen (*Archiv der Deutschen Seewarte*, 1891, No. 2, 1895, No. 5, T. vol. i. p. 176; *Beob. aus dem Mag. Obs. in Wilhelmshaven*, 1899, &c.), Palazzo (*Ann. dell' Ufficio Cent. Met. e Geod. Ital.* vol. xvi. Parte 1, 1894), Chree (*Proc. Roy. Soc.* vol. lxv. p. 375), and others.

Observatories.

§ 3. At a magnetic observatory provision must be made for accommodating both absolute and self-recording instruments. In the case of the former there must be no artificial disturbance, whether due to magnets or to electric currents. In the case of the latter a *constant* source of disturbance, such as the proximity of a fixed magnet of unvarying strength, though objectionable, is not fatal, but it is essential that all variable disturbances should be excluded. As changes of temperature influence magnets, and temperature corrections are difficult to determine accurately, uniformity of temperature greatly facilitates magnetic work. In recently-constructed magnetic chambers, at first-class observatories, every precaution is taken to exclude magnetic materials and to secure uniformity of temperature, and the moments and relative positions of the different magnets are carefully arranged so as to avoid mutual interference. For particulars the reader is referred to descriptions of the magnetic chambers at Pavlovsk, Washington, Potsdam, and Parc St Maur (see report by Ensign Marsh, U.S. Navy; Appendix I. to *Washington Observations for 1887*, U.S. Naval Observatory; T, vol. i. 1896, p. 96, and vol. iii. 1898, p. 1), and to an elaborate description of an ideal building by Wild (T, vol. iv. p. 169, see also p. 153). Of late years the development of electric railways and tramways has complicated the question. With the arrangements customary in electric traction, when the cars are running the effects on delicate magnetic instruments are visible at a distance of several miles. By having properly insulated returns, and taking other precautions, these disturbing effects can probably be so much reduced as to safeguard the usefulness of many existing observatories. These precautionary measures entail, however, some additional expense, and the pecuniary interests concerned are so powerful that the rapid development of an enlightened public opinion is much to be desired. In the meantime several magnetic observatories—*e.g.*, those at Washington, Toronto, Batavia, and Vienna—have been completely upset, and most of those situated near large cities are in imminent danger (T, vol. ii. 1897, p. 125, and vol. iii. 1898, p. 145; *Brit. Assoc. Report* for 1898, p. 758; Edler, *Verhandl. der Deutschen Phys. Gesell.* Jahr. 1899, p. 174, &c.).

Records.

§ 4. Magnetic changes are often very abrupt; in half an hour the needle may execute a to-and-fro movement much larger than the mean amplitude of its movement during the day. It is usual to confine measurements of the records from magnetographs to exact hours (whether local, Göttingen, or Greenwich time). Consequently a good deal may depend on the precise time of occurrence of large erratic movements. The mean curve of the diurnal variation, for so long a period as a month even, might at certain seasons be considerably affected by accidents of this kind. In extreme cases the trace may go off the photographic sheet, leaving the observer nothing to draw on but his imagination. It has thus long been customary to exclude conspicuously large movements in considering many species of magnetic phenomena, and many authorities have sought to exclude even comparatively small irregular movements. Sabine (S, § 48) proposed to exclude any observed value which differed by more than a certain specified amount from the monthly mean of the element in question for that particular hour. The observations so excluded were pretty numerous, as the limits were usually narrow; they were regarded as disturbed. The so-called *disturbances* were found by Sabine (S, §§ 53–59) and other investigators to occur more frequently at certain seasons of the year and at certain hours of the day than at others; thus their exclusion modified the diurnal inequality curves. In view of the great variation in the number and amplitude of magnetic disturbances from year to year, and from station to station, Sabine's method of treatment is unquestionably arbitrary, as will be obvious from the following facts. In England in the course of a day it is extremely rare to have a range of 1½° in the declination, or of ·005 C.G.S. units in the horizontal or vertical components. But in polar regions, as was very fully demonstrated by the international work done during the years 1882–83, larger disturbances are frequent. At the British station, Fort Rae, a range of 11¼° was observed one day in the declination, and on ten days in the year the range exceeded 5°. At the German station, Kingua Fjord, the range exceeded 5° on each of seven consecutive days in November, and also on twelve other occasions. At the Finnish station, Sodankylä, the declination range never reached 5°; but on the other hand the horizontal force range exceeded ·01 C.G.S. on fifteen occasions, as against thirteen such occasions at Fort Rae and three at Kingua Fjord. At the Russian station, Ssagyster, on the Lena, the declination range exceeded 5° on only five occasions, and the horizontal force range only once reached ·01 C.G.S.; but on the other hand the vertical force range exceeded 0·1 on about four days on the average out of five, and on one occasion it attained the enormous value of ·268 C.G.S. units.

“Quiet” days.

§ 5. During recent years Sabine's method has been largely abandoned in favour of a suggestion of Wild's to select for each month a few specially *quiet* or *normal* days, and to employ these alone for many purposes. Where the time and staff available for reducing the records is limited, this plan has obvious economic advantages. Largely for this reason, two British observatories, Kew and Falmouth, during the decade 1890–1900 confined their attention to quiet days alone. To secure uniformity, the quiet days employed—five a month—were selected at the end of each year by the Astronomer Royal. At some seasons it is exceptional to meet with a day's curve entirely free from sinuosities. At the English observatories, when sinuosities occur on a selected quiet day, the portion of the curve affected is replaced by a pencil line of continuous curvature drawn freehand. At St Petersburg the smoothing process appears to be much more elaborate. This is not the only side on which the quiet-day system is open to criticism. A comparison of the results from normal (quiet) days and all days (exceptionally large movements alone excluded) between 1873 and 1885 at St Petersburg and Pavlovsk, by Muller (R, vol. xii., No. 8, 1889), showed a systematic difference between the mean annual values of certain of the magnetic elements as calculated from the two sets of data. An examination by Ellis (*Brit. Assoc. Report* for 1898, p. 80) of the Greenwich data for the years 1889 to 1896 presented similar features. Table I. gives the average excesses found in these two researches for the quiet day over the *all*-day means, taken algebraically.

TABLE I.—*Differences,* Quiet *less* All-*day Means.*

Station.	Declination + to West.	Horl. Force. Unit = 1×10^{-6} C.G.S.	Vertical Force. Unit = 1×10^{-6} C.G.S.	Inclination.
St Petersburg	+ 0′·24	+ 32	− 8	·23
Greenwich .	+ 0′·08	+ 33	− 9	

In the case of the declination, horizontal force, and inclination, the sign of the difference was the same for every year examined by Muller. The magnitude, however, varied, with a tendency apparently to be largest numerically in years of maximum magnetic disturbance (or sunspot maxima). Thus the secular changes from year to year, or the mean change for a short period of years, deduced from quiet days only, may differ slightly from those deduced from all days.

§ 6. A second unexpected feature of quiet days was discovered by Chree, viz., that the diurnal variation of certain of the elements as deduced from them is conspicuously

TABLE II.—(*Non-cyclic Increment*).

Station.	Epoch.	Declination.	Horl. Force.	Vertical Force.	Inclination.
Kew . .	1890-95	+ 0′·07	+ 36	− 8	− 0′·26
Greenwich .	,,	+ 0′·03	+ 43	− 19	
Colaba . .	1894-97	+ 0′·10	+ 53		

TABLE III.—*Mean Diurnal Inequality of* Westerly *Declination* (+ *Movement to West*).

Station .	Jan Mayen.		St Petersburg and Pavlovsk.		Greenwich		Kew.	Parc St Maur (Paris).	Tiflis.	Colaba.	Batavia.	Mauritius.
Latitude .	71° 0′ N.		59° 41′ N.		51° 28′ N.		51° 28′	48° 49′ N.	41° 43′ N.	18° 54′ N.	6° 11′ S.	20° 6′ S.
Longitude	8° 28′ W.		30° 29′ E.		0° 0′		0° 19′ W.	2° 29′ E.	44° 48′ E.	72° 49′ E.	106° 49′ E.	57° 33′ E.
Epoch .	1882–83.		1873–85.		1890–94.		1890–94.	1883–97.	1893–96.	1894–97.	1883–94.	1876–90.
Hour.	*a.*	*q.*	*a.*	*q.*	*a.*	*q.*	*q.*	*a.*	*a.*	*q.*	*a.*	*a.*
	′	′	′	′	′	′	′	′	′	′	′	′
1	− 6·6	− 4·2	− 1·3	− 0·7	− 1·6	− 1·0	− 1·0	− 1·4	− 0·8	− 0·2	+ 0·1	+ 0·1
2	− 10·5	− 6·4	− 1·2	− 0·8	− 1·5	− 1·0	− 1·0	− 1·2	− 0·7	− 0·2	− 0·1	+ 0·1
3	− 15·2	− 7·8	− 1·2	− 1·0	− 1·4	− 1·1	− 1·1	− 1·2	− 0·7	− 0·1	− 0·1	+ 0·1
4	− 16·9	− 8·4	− 1·4	− 1·3	− 1·[illegible]	− 1·4	− 1·5	− 1·2	− 0·6	− 0·1	0·0	+ 0·2
5	− 17·0	− 8·1	− 1·7	− 1·8	− 1·[illegible]	− 1·8	− 2·0	− 1·6	− 0·8	− 0·2	0·0	+ 0·3
6	− 13·7	− 7·0	− 1·9	− 2·3	− 2·3	− 2·4	− 2·5	− 1·9	− 1·4	− 0·7	+ 0·1	+ 0·4
7	− 9·3	− 5·1	− 2·2	− 2·8	− 2·7	− 3·0	− 3·1	− 2·4	− 2·1	− 1·1	+ 0·5	+ 0·6
8	− 6·8	− 3·2	− 2·5	− 3·2	− 2·8	− 3·3	− 3·4	− 2·7	− 2·8	− 1·3	+ 1·3	+ 1·1
9	− 3·7	− 0·6	− 2·3	− 3·0	− 2·2	− 2·7	− 2·8	− 2·3	− 2·6	− 0·8	+ 1·7	+ 1·8
10	− 2·4	+ 2·1	− 1·0	− 1·7	− 0·4	− 0·9	− 0·8	− 0·5	− 1·1	0·0	+ 1·5	+ 1·9
11	− 0·5	+ 4·6	+ 1·0	+ 0·4	+ 2·2	+ 1·7	+ 1·8	+ 2·0	+ 0·9	+ 1·0	+ 0·9	+ 1·3
Noon	+ 2·5	+ 6·5	+ 3·1	+ 2·7	+ 4·5	+ 4·1	+ 4·3	+ 4·2	+ 2·7	+ 1·4	+ 0·1	0·0
1	+ 3·7	+ 7·3	+ 4·6	+ 4·3	+ 5·5	+ 5·1	+ 5·3	+ 5·3	+ 3·6	+ 1·2	− 0·6	− 1·1
2	+ 6·4	+ 7·1	+ 4·9	+ 4·5	+ 5·2	+ 4·7	+ 4·9	+ 4·9	+ 3·5	+ 0·8	− 1·1	− 2·0
3	+ 7·4	+ 5·9	+ 4·1	+ 3·6	+ 3·9	+ 3·4	+ 3·6	+ 3·7	+ 2·7	+ 0·2	− 1·3	− 2·3
4	+ 8·5	+ 4·3	+ 2·7	+ 2·3	+ 2·5	+ 2·0	+ 2·0	+ 2·3	+ 1·7	− 0·2	− 1·2	− 1·8
5	+ 10·[illegible]	+ 3·0	+ 1·5	+ 1·3	+ 1·2	+ 0·9	+ 0·8	+ 1·1	+ 0·8	− 0·1	− 0·9	− 0·9
6	+ 14·2	+ 2·3	+ 0·6	+ 0·7	+ 0·3	+ 0·3	+ 0·2	+ 0·2	+ 0·3	+ 0·1	− 0·6	0·1
7	+ 15·2	+ 2·2	0·0	+ 0·4	− 0·3	0·0	− 0·1	− 0·4	+ 0·1	+ 0·2	− 0·4	+ 0·1
[illegible]	+ 15·8	+ 2·6	− 0·4	+ 0·2	− 0·8	− 0·3	− 0·4	− 0·9	− 0·1	+ 0·2	− 0·2	+ 0·1
9	+ 13·2	+ 2·6	− 1·0	0·0	− 1·2	− 0·5	− 0·6	− 1·3	− 0·4	+ 0·2	0·0	+ 0·1
10	+ 7·4	+ 2·0	− 1·4	− 0·2	− 1·4	− 0·7	− 0·7	− 1·5	− 0·7	+ 0·1	+ 0·1	+ 0·1
11	+ 1·1	+ 0·5	− 1·6	− 0·4	− 1·6	− 0·9	− 0·9	− 1·6	− 0·8	0·0	+ 0·1	+ 0·1
12	− 3·6	− 1·8	− 1·5	− 0·6	− 1·7	− 1·1	− 1·1	− 1·6	− 0·8	− 0·1	+ 0·1	+ 0·1

TABLE IV.—*Mean Diurnal Inequality of Horizontal Force* (*unit* = 1×10^{-5} *C.G.S.*).

Station .	Jan Mayen.		St Petersburg and Pavlovsk.		Greenwich.		Kew.	Parc St Maur.	Tiflis.	Colaba.	Batavia.	Mauritius.
Epoch .	1882–83.		1873–85.		1890–94.		1890–94.	1883–97.	1893–96.	1894–97.	1883–94.	1883–90.
Hour.	*a.*	*q.*	*a.*	*q.*	*a.*	*q.*	*q.*	*a.*	*a.*	*q.*	*a.*	*a.*
	′	′	′	′	′	′	′	′	′	′	′	′
1	-57	-22	+4	+5	+5	+5	+5	+5	+4	-12	-11	-3
2	-64	-24	+4	+4	+4	+4	+4	+5	+4	-12	-10	-1
3	-74	-25	+4	+4	+3	+3	+4	+5	+4	-12	-8	+1
4	-69	-24	+4	+4	+3	+3	+5	+5	+5	-11	-7	+2
5	-60	-22	+5	+4	+3	+3	+5	+6	+5	-11	-5	+3
6	-37	-19	+4	+4	+1	+1	+3	+4	+5	-8	-1	+4
7	-15	-15	+2	+2	-3	-3	-1	+1	+2	-3	+5	+7
8	-1	-13	-3	-4	-10	-10	-7	-5	-3	+8	+14	+9
9	+8	-12	-10	-10	-18	-17	-15	-12	-9	+20	+24	+9
10	+17	-12	-16	-16	-22	-22	-20	-17	-11	+30	+31	+9
11	+32	-10	-19	-20	-21	-21	-20	-16	-7	+35	+35	+9
Noon.	+49	-4	-17	-18	-15	-15	-15	-12	-1	+31	+31	+8
1	+65	+8	-12	-13	-7	-8	-8	-7	+4	+23	+22	+7
2	+78	+22	-6	-6	-1	-1	-3	-4	+5	+13	+10	+2
3	+89	+37	0	0	+3	+3	+1	-1	+3	+4	-1	-2
4	+83	+43	+3	+3	+6	+5	+3	0	-2	-3	-9	-6
5	+68	+49	+5	+5	+8	+8	+6	+2	-5	-7	-13	-7
6	+37	+43	+6	+6	+10	+10	+8	+4	-6	-9	-14	-7
7	+13	+30	+7	+7	+11	+11	+10	+6	-5	-10	-15	-7
8	-11	+15	+8	+8	+10	+10	+9	+7	-2	-12	-16	-8
9	-33	+1	+9	+9	+9	+9	+8	+7	+1	-12	-16	-8
10	-36	-10	+8	+9	+8	+7	+7	+6	+3	-12	-16	-8
11	-40	-16	+7	+8	+7	+7	+6	+6	+4	-12	-15	-7
12	-51	-20	+6	+6	+6	+6	+5	+6	+4	-12	-13	-5

non-cyclic (*Brit. Assoc. Reports*, 1895, p. 209; and 1896, p. 231). On the average, from 1890 to 1895, the horizontal force at Kew increased 21×10^{-5} C.G.S. units a year, so that its value at the second midnight of an average day exceeded its value at the first midnight by approximately 6×10^{-7} C.G.S. On the average quiet day, however, the horizontal force increased 36×10^{-6} C.G.S. Similar phenomena at Greenwich were discussed by Ellis (*Brit. Assoc. Reports*, 1896, p. 238; and 1898, p. 80), and they are apparent in the records of other observatories, *e.g.*, Falmouth, Parc St Maur (Paris), and Colaba (Bombay), where the Astronomer Royal's quiet days have been tabulated. Table II. gives mean values for the non-cyclic increment during twenty-four hours from midnight to midnight. Declination is taken + to the west, and the unit of force is 1×10^{-6} C.G.S. The data for Kew and Greenwich were given by Chree and Ellis (*l.c.*); those for Colaba are deduced from *Mag. and Met. Observations made at the Govt. Obs., Bombay* (Appendices to years 1896–97).

As magnetic force is usually measured to 1×10^{-5} C.G.S. unit, and angular movement to 0′·1, non-cyclic changes such as appear in Table II. are far from negligible. The non-cyclic effect would introduce a fictitious element into the diurnal inequality. Chree and Ellis eliminate it on the provisional hypothesis that it takes place uniformly throughout the twenty-four hours. Phenomena closely analogous to, if not identical with, the non-cyclic effect have been detected by van Bemmelen in the case of days near times of large magnetic disturbances (*Meteorologische Zeitschrift*, September 1895).

§ 7. The values of the magnetic elements at any given station are in a state of constant change. Part of the change arises from causes of a periodic character, and of

TABLE V.—*Diurnal Inequality of Vertical Force* (unit = 1×10^{-5} *C.G.S.*).

Station .	Jan Mayen.		St Petersburg and Pavlovsk.		Greenwich.		Parc St Maur (Paris).	Tiflis.	Batavia.	Mauritius.
Epoch .	1882–83.		1873–85.		1890–94.		1883–97.	1893–96.	1883–94.	1884–90.
Hour.	*a.*	*q.*	*a.*	*q.*	*a.*	*q.*	*a.*	*a.*	*a.*	*a.*
	′	′	′	′	′	′	′	′	′	′
1	+65	+3	-7	-1	-3	-1	0	+3	+7	+2
2	+65	+2	-7	-1	-4	-1	0	+2	+5	+2
3	+56	-1	-7	-1	-4	0	-1	+2	+4	+2
4	+37	-5	-6	0	-3	+1	0	+2	+3	+2
5	+16	-7	-5	0	-2	+2	0	+3	+2	+2
6	-7	-8	-4	0	-1	+2	+1	+4	+1	+2
7	-17	-6	-3	0	0	+3	+1	+4	0	+3
8	-14	-4	-2	0	0	+2	0	+3	-3	+4
9	-9	-0	-3	-1	-3	-2	-4	-1	-11	+5
10	-6	+5	-2	-2	-7	-6	-8	-7	-20	+3
11	-6	+10	-3	-4	-10	-10	-12	-12	-26	0
Noon	-10	+16	-3	-5	-10	-11	-12	-13	-27	-4
1	-13	+21	-1	-4	-6	-8	-9	-11	-21	-7
2	-24	+23	+2	-1	-1	-3	-3	-7	-13	-9
3	-31	+20	+8	+2	+4	+2	+2	-3	-4	-8
4	-40	+13	+9	+3	+8	+4	+6	+1	+4	-5
5	-48	+2	+10	+3	+10	+6	+7	+3	+10	-3
6	-53	-9	+10	+3	+10	+6	+8	+4	+13	0
7	-47	-18	+9	+3	+9	+5	+7	+4	+14	0
8	-36	-20	+8	+3	+7	+4	+6	+4	+14	+1
9	-7	-19	+6	+2	+5	+3	+5	+4	+14	+2
10	+18	-13	+3	+2	+2	+2	+3	+4	+13	+2
11	+42	-5	-2	0	0	+1	+2	+4	+11	+2
12	+54	0	-5	-1	-2	0	+1	+3	+9	+2

TABLE VI.—*Diurnal Inequality of Inclination.*

Station . . . End Dipping . Epoch . . . Hour.	Jan Mayen. North. 1882–83. *a.*	 *q.*	St Petersburg. North. 1873–85. *a.*	 *q.*	Kew. North. 1891–95. *q.*	Parc St Maur (Paris). North. 1883–97. *a.*	Tiflis. North. 1893–96. *a.*	Batavia. South. 1883–94. *a.*	Mauritius.[1] South. 1884–90. *a.*
	′	′	′	′	′	′	′	′	′
1	+4·6	+1·5	−0·5	−0·3	−0·3	−0·3	−0·1	+0·9	+0·3
2	+5·0	+1·6	−0·5	−0·3	−0·3	−0·3	−0·1	+0·8	+0·2
3	+5·6	+1·6	−0·5	−0·3	−0·3	−0·3	−0·2	+0·6	0·0
4	+5·0	+1·5	−0·4	−0·3	−0·2	−0·4	−0·2	+0·5	0·0
5	+4·2	+1·4	−0·5	−0·3	−0·2	−0·4	−0·2	+0·3	−0·1
6	+2·4	+1·2	−0·4	−0·3	−0·1	−0·3	−0·1	+0·1	−0·2
7	+0·7	+0·9	−0·2	−0·1	+0·2	0·0	0·0	−0·2	−0·3
8	−0·1	+0·8	+0·1	+0·3	+0·6	+0·4	+0·3	−0·8	−0·4
9	−0·7	+0·8	+0·6	+0·6	+1·0	+0·7	+0·5	−1·7	−0·4
10	−1·2	+0·9	+1·0	+1·0	+1·3	+0·[illegible]	+0·4	−2·7	−0·5
11	−2·2	+0·8	+1·2	+1·2	+1·2	+0·7	−0·1	−3·3	−0·6
Noon	−3·4	+0·4	+1·1	+1·1	+0·8	+0·4	−0·5	−3·1	−0·7
1	−4·5	−0·2	+0·7	+0·7	+0·4	+0·2	−0·7	−2·4	−0·8
2	−5·6	−1·2	+0·4	+0·4	+0·2	+0·2	−0·6	−1·3	−0·6
3	−6·3	−2·2	+0·2	+0·1	0·0	+0·2	−0·3	−0·2	−0·3
4	−6·1	−2·9	0·0	−0·1	−0·1	+0·2	+0·1	+0·7	+0·1
5	−5·1	−3·2	−0·1	−0·3	−0·3	+0·1	+0·4	+1·3	+0·4
6	−3·1	−2·9	−0·2	−0·3	−0·4	0·0	+0·6	+1·5	+0·5
7	−1·7	−2·2	−0·3	−0·4	−0·6	−0·2	+0·5	+1·6	+0·5
8	+0·3	−1·3	−0·3	−0·5	−0·[illegible]	−0·3	+0·3	+1·6	+0·6
9	+2·0	−0·3	−0·4	−0·6	−0·6	−0·3	+0·1	+1·6	+0·6
10	+2·5	+0·5	−0·5	−0·6	−0·5	−0·3	0·0	+1·5	+0·6
11	+3·0	+1·0	−0·5	−0·6	−0·5	−0·3	0·0	+1·4	+0·5
12	+4·0	+1·3	−0·5	−0·4	−0·4	−0·3	−0·1	+1·2	+0·4

[1] Calculated from results for horizontal and vertical components in Tables IV. and V.

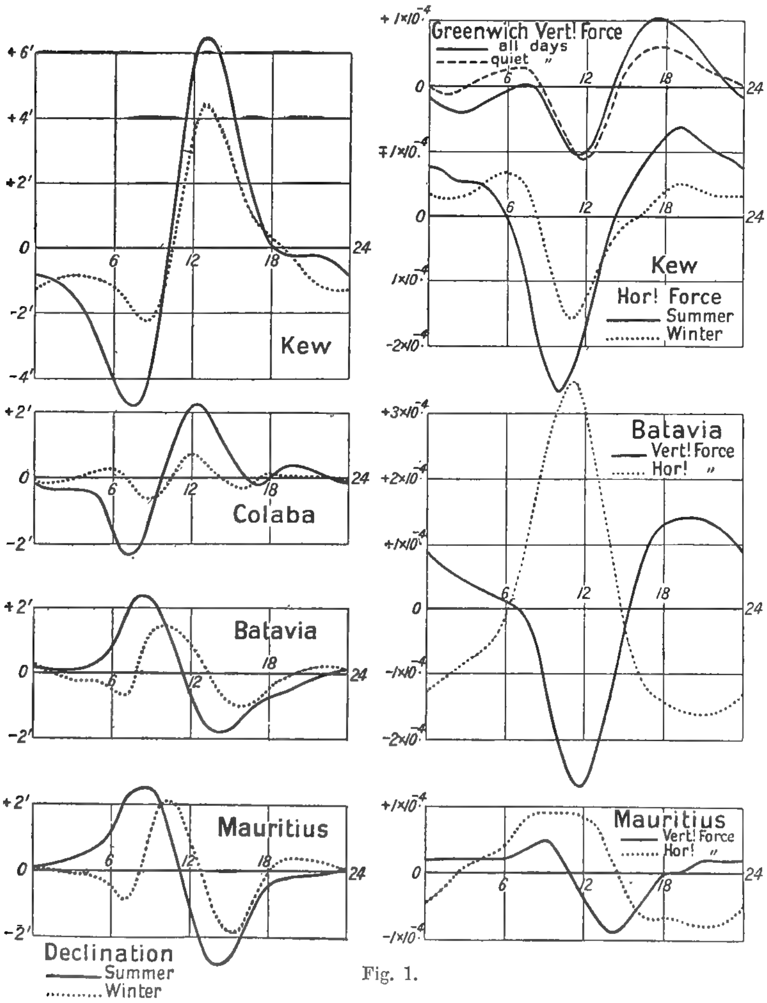

Fig. 1.

the periods the solar day is the most conspicuous (cf. S, §§ 36–45, 68, &c.). The amplitude of the diurnal inequality of any magnetic element varies with the season of the year and the position of the year in the sun-spot cycle, and is probably modified by other causes; while the hours at which the maxima and minima occur, though less variable, are by no means constant. It is thus impossible to give more than a general idea of the phenomena as observed at a few representative stations.

Diurnal inequalities.

Tables III. to VI. give the mean diurnal inequalities of the declination, horizontal and vertical force components, and inclination for one or a series of specified years. Of the stations selected, Jan Mayen was the Austrian polar station. Pavlovsk is close to St Petersburg, and succeeded it as the central Russian magnetic observatory. The data are derived from the official publications of the respective stations, or from special papers as follows:—Jan Mayen ("Die Internationale Polarforschung, 1882–83; Die Oesterreichische Polar Station. . . ." *k. Akad. der Wiss.* II. Bd., II. Abth.); St Petersburg-Pavlovsk (Muller, R, vol. xii., No. 8, 1889); Greenwich (Ellis, *Brit. Assoc. Report*, 1898, p. 80); Kew (*Brit. Assoc. Report*, 1895, p. 209, and *Reports of Kew Observatory Cttee.*); Parc St Maur (Moureaux, *Ann. du Bureau Central Météorologique de France* for 1897, p. B_{65}); Tiflis (*Beob. des Tiflisser Physik. Observatoriums* for years 1893 to 1896); Colaba (*Mag. and Met. Observations, Bombay*, years 1896 and 1897); Batavia (*Observations made at the Mag. and Met. Observatory at Batavia*, App. vol. xvi., for 1893); Mauritius (Meldrum and Claxton, *Magnetical Reductions*, Mauritius, 1899). Data from *quiet* days only are distinguished by the letter *q*; those from *all* days (except those of exceptional disturbance) by the letter *a*.

§ 8. The difference between all and quiet days' results, so conspicuous at Jan Mayen in all the elements, is considerable even at Pavlovsk and Greenwich in the case of the vertical force. At some stations the times of occurrence of the maxima, minima, and mean values vary considerably throughout the year. This is more especially true of the declination in tropical stations. In fact, according to Sabine (see S, §§ 42, 43), at a station near the magnetic equator, while the declination diurnal inequality during summer resembles that of temperate stations in its own hemisphere, the inequality during winter is of the type characteristic of the opposite hemisphere. This is perhaps rather an extreme way of stating the facts. It is true, however, that the contributions to the hourly means from different months may to a considerable extent neutralize one another, and that a more correct idea of the phenomena is obtained by considering the winter and summer months separately. For this reason, winter and summer curves of declination are shown side by side on the left-hand side of Fig. 1. They are based on the results for the years specified in Tables III. to V. The uppermost of the right-hand curves shows the inequality of vertical force at Greenwich from *all* and from *quiet* days. The next curves on the same side show the horizontal force inequalities at Kew during summer and winter, while the remaining curves show the mean annual inequalities of horizontal and vertical force at Batavia and Mauritius. The curves relating to the same element are all drawn to the same scale, and the scales for the horizontal and vertical force inequalities are identical. The hours are counted from midnight, which answers to 0 or 24.

Graphic methods.

§ 9. Two other methods of illustrating diurnal inequalities may be mentioned. The first, which has been employed by Airy, Lloyd, and others, consists in drawing curves to represent disturbing forces to which the inequalities of declination and horizontal force may be ascribed. Such curves are sometimes termed *vector diagrams.* The radius vector, from the origin O, represents the forces in question both in magnitude and direction. The hours to which individual radii refer are marked on the curve. It is immaterial what we take as our initial line, or our rectangular axes, so long as the directions are known. It is desirable to show the geographical meridian as well as the mean magnetic meridian of the station for the epoch dealt with.

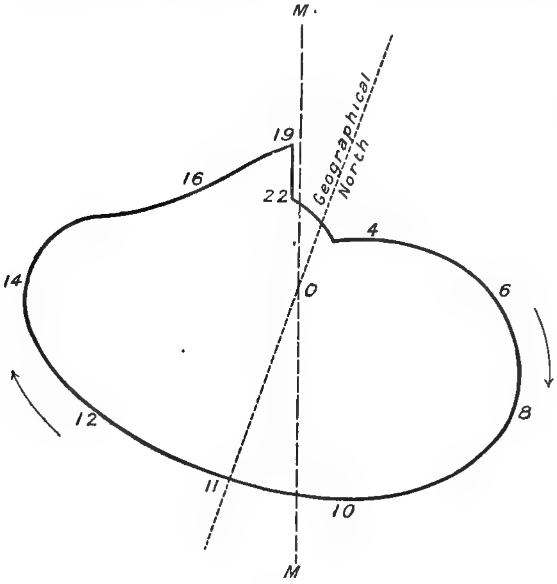

Fig. 2.

Fig. 2 is the vector diagram for Kew at midsummer (June and July) for quiet days during 1890–94 (*Brit. Assoc. Report* for 1895). Fig. 3 refers to all, Fig. 4 to quiet days in May to July of 1883 at Jan Mayen, the Austrian polar station. The data on which they are based are given by Lüdeling (*Sitz. der k. Preuss. Akad. der Wiss.* 1898, p. 524; and 1899, p. 236). In the diagrams MM represents the magnetic meridian. As shown by the arrows, Fig. 2 is described in the direction of the hands of a watch—the normal direction in temperate latitudes, both for all and for quiet days. The quiet-day diagram at Jan Mayen is also mainly described clockwise (Fig. 4), but the all-day diagram is described anti-clockwise (Fig. 3). Lüdeling found this peculiar difference between all and quiet days to be common to the other polar stations excepting Kingua Fjord, where both diagrams were described clockwise. Lüdeling has also employed vector diagrams to represent the *difference* between the diurnal variations in all and in quiet days at the polar stations; here again the diagrams are described anti-clockwise, except that for Kingua Fjord.

The other graphical method is closely analogous to Bauer's method of showing secular change, illustrated by Fig. 5. Starting with an imaginary needle freely suspended by its centre of gravity, it combines the diurnal changes of declination and inclination in a curve traced on the plane perpendicular to the mean position of the needle. This method has been employed by Rücker ("Rede Lecture," *Nature*, vol. lvii. pp. 160 and 180), and by Capello (*Brit. Assoc. Report* for 1898, p. 750). Capello gives curves for St Petersburg, Kew, Paris, Perpignan, and Lisbon. In the case of the first three mentioned stations the motion is wholly clockwise. The Perpignan and Lisbon curves illustrate a transition, the anti-clockwise movement being very decidedly predominant at Lisbon.

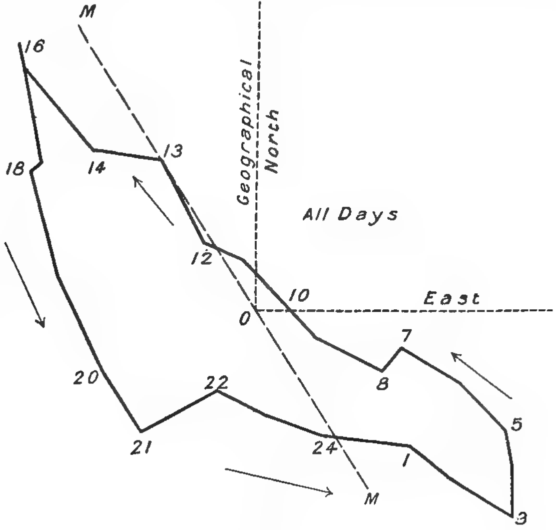

Fig. 3.

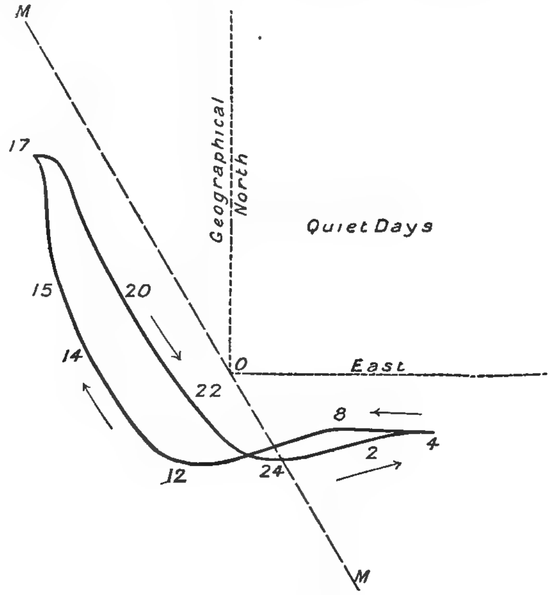

Fig. 4.

§ 10. Owing to the influence of the season on the type of the inequalities, the mean amplitude obtained by combining hourly values from the whole year is necessarily less than the arithmetic mean of the amplitudes found for any series of equal subdivisions of the year. At some observatories it is customary to measure the difference between the greatest and least of the hourly values, or even between the greatest and least values met with anywhere in the twenty-four hours, tabulating the result under some such heading as *diurnal range.* Diurnal ranges so calculated are, it should be noticed, entirely different—especially in disturbed times—from the amplitudes of ordinary diurnal inequalities. Even in the case of monthly means, variability in the times of occurrence of undisturbed maxima and minima should not be lost sight of. Again, it should be noticed that as the mean times of occurrence of maxima and minima seldom coincide with exact hours, the amplitudes of inequalities deduced directly from hourly measurements may be sensibly too small. At some stations attempts are made to rectify this, the hourly measurements being either made the basis of continuous curves, or employed in the calculation of Fourier's series with periods of twenty-four hours or their submultiples. The maxima and minima and their exact times of occurrence can then be determined very accurately. This procedure is, however, exceptional, so the amplitudes dealt with in Table VII. are simply the differences between the greatest and least of the mean hourly values. The mean of the twelve monthly amplitudes is taken as unity.

TABLE VII.—*Relative Values of Amplitudes of Diurnal Inequalities throughout the Year.*

Station.	Epoch.	Element.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
Kew . .	1890–94	Declination	·56	·63	1·09	1·26	1·34	1·26	1·26	1·37	1·17	·95	·66	·45
,, . .	,,	Hor. force	·57	·64	·88	1·19	1·29	1·34	1·37	1·35	1·17	·99	·76	·45
,, . .	1891–95	Inclination	·61	·65	·87	1·13	1·24	1·31	1·35	1·38	1·20	·95	·86	·46
Tiflis . .	1880–90	Declination	·41	·57	1·07	1·42	1·36	1·38	1·33	1·38	1·27	·93	·51	·36
,, . .	1893–96	Hor. force	·67	·79	·73	1·06	1·24	1·09	1·36	1·48	1·34	·75	·78	·71
,, . .	,,	Vert. force	·58	·76	·97	1·36	1·35	1·21	1·36	1·30	1·06	·86	·70	·50
Batavia .	1883–94	Declination	1·15	1·35	1·02	·84	·69	·60	·66	·88	1·06	1·27	1·28	1·21
,, . .	,,	Hor. force	·96	·92	1·07	1·20	1·00	·96	·99	1·05	1·17	1·04	·85	·79
,, . .	,,	Vert. force	1·05	1·21	1·23	1·19	·77	·80	·83	·70	1·04	1·30	1·03	·85
,, . .	,,	Inclination	1·01	1·10	1·18	1·20	·87	·86	·88	·85	1·09	1·19	·96	·81
Mauritius .	1876–90	Declination	1·07	1·26	1·30	·97	·85	·60	·70	1·01	1·03	1·14	1·01	1·05
,, .	1883–90	Hor. force	1·02	·76	1·01	1·11	·97	1·02	·99	1·10	·99	1·02	1·04	·98
,, .	1884–90	Vert. force	·75	1·04	1·20	1·00	·94	·82	·97	1·36	1·31	1·05	·86	·71

Generally speaking, there is a distinct minimum amplitude in December in the northern and in June in the southern hemisphere. There are usually two approximately equal maxima in summer, with an intermediate badly defined minimum. At Kew the mode of variation of the amplitude throughout the year is fairly similar in all the elements, but this is exceptional. For instance, at Batavia and Mauritius the diurnal variation of the horizontal force is much less variable than that of the declination or vertical force.

Lunar diurnal inequality. § 11. There seems little doubt that a small lunar diurnal inequality really exists, though some of the data in S, §§ 95–99, seem contradictory. Figee has analysed the Batavia all-day observations between April 1883 and March 1894, and has found a lunar diurnal inequality in all the elements, showing two maxima and two minima. The mean values found for the amplitudes are: declination, 0′·17; inclination, 0′·06; horizontal force, 17×10^{-6} C.G.S. units; vertical force, 9×10^{-6} C.G.S. According to Figee, the lunar influence on disturbances is relatively large. (See Appendix, *Observations . . . at the Mag. and Met. Observatory at Batavia*, vol. xvii. 1894.) Utilizing observations at Bombay and Trevandrum, C. Chambers (*Phil. Trans.* vol. clxxviii. A (1887), p. 1) calculated lunar diurnal inequalities answering to different phases of the moon at different seasons of the year, and concluded "that the bulk of the phenomenon dealt with is, properly speaking, . . . a solar diurnal variation that depends on the relative positions of the sun and moon." The correct way of regarding such data is open to some doubt (see § 14).

Annual inequality. § 12. The secular changes in the magnetic elements seem to proceed at slightly different rates at different seasons of the year (see S, §§ 64–67). The term *annual inequality* is here applied to that part of the annual change in the absolute values that remains unaccounted for by a secular change taking place at a uniform rate throughout the year. Table VIII. gives some recent results. The letters *a* and *q* distinguish results based on all and on quiet days.

TABLE VIII.—*Annual Inequality.*

	Declination (+to West).						Horizontal Force (+above the mean) unit 1×10^{-5} C.G.S.				
	Kew, 1890–94. *q.*	St Petersburg and Pavlovsk, 1873–85. *a.*	St Petersburg and Pavlovsk, 1873–85. *q.*	Tiflis, 1879–87. *a.*	Batavia, 1884–93. *a.*	Mauritius, 1880–97. *q.*	Kew, 1890–94. *q.*	St Petersburg, Pawlowsk, 1873–85. *a.*	St Petersburg, Pawlowsk, 1873–85. *q.*	Batavia, 1884–93. *a.*	Mauritius, 1883–97. *q.*
January .	+0′·4	−0′·2	0′·0	−0′·1	+0′·2	+0′·1	−1	−1	−1	+5	+3
February .	+·2	−·2	−·1	−·2	+·2	+·3	−1	−2	−2	+2	+4
March .	−·2	−·1	·0	−·1	−·1	+·3	−1	+1	+2	0	−4
April .	−·5	+·1	·0	+·1	−·1	+·3	+2	−1	−1	−4	−4
May . .	−·6	+·3	+·2	+·1	−·3	+·1	+6	+3	+1	−7	−5
June . .	−·6	+·4	·0	+·2	−·1	−·2	+6	+4	+2	−1	+3
July . .	−·3	+·1	+·1	+·2	−·1	−·4	+4	+5	+3	0	−3
August .	+·1	+·2	+·1	+·3	−·2	−·4	0	+1	0	+3	−2
September .	+·3	+·2	+·1	+·2	+·1	−·1	−4	−2	−3	−2	−2
October .	+·2	−·2	·0	−·1	·0	·0	−5	−4	−4	−2	0
November .	+·4	−·5	−·2	−·3	+·1	·0	−4	−2	−1	0	+2
December .	+·5	−·4	−·2	−·2	+·3	+·1	−2	+1	+1	+7	+5

The data are from the following sources: Kew (*Brit. Assoc. Report*, 1895); St Petersburg (Muller, R, vol. xii. No. 8, 1889; see also Leyst, R, vol. xvii. No. 1, 1894); Tiflis (Rykatchew, R, vol. xiv. No. 1, 1890; see also Mielberg, R, vol. xvii. No. 11, 1894); Batavia (Appendix to *Observations made at the . . Observatory at Batavia*, vol. xvi. for 1893); Mauritius (*Mauritius Magnetical Reductions*, edited by T. F. Claxton, Mauritius, 1899). The data in Table VIII. have been smoothed, except in the case of Batavia and Mauritius. As Batavia and Mauritius are south of the equator, we see that, when allowance is made for a uniform secular change, the horizontal force is above its mean value in summer at all the stations. Schwalbe has observed this phenomenon in the data for South Georgia. As regards the declination, it is doubtful whether the figures prove more than that the secular change takes place at a nearly uniform rate throughout the year. *All*-day results for Pavlovsk, Tiflis and Moscow agree fairly in character, but differ somewhat markedly from the results at Kew. Not unlikely a good deal may depend on the epoch chosen, and according to the Pavlovsk data there is a difference between all and quiet days. (See Walker's *Terrestrial and Cosmical Magnetism*, pp. 72–79; S, §§ 65, 67; and Schwalbe, *Met. Zeit.*, December 1898, p. 449.) Muller gives also annual inequality results in vertical force and inclination at St Petersburg and Pavlovsk, but the vertical force data for different epochs differ widely.

Longer periods. § 13. Of longer periods the sun-spot, or as it is often termed eleven-years' period, is much the most certain and most important (see S, §§ 46–50). Of late years various researches have thrown further light on the subject. W. Ellis (*Proc. Roy. Soc.* vol. lxiii. 1898, p. 64) has extended his earlier investigations so as to include Greenwich data from 1841 to 1896. After allowing for the variations in amplitude depending on the season of the year, he finds for the times of maximum and minimum amplitude of the diurnal inequality at Greenwich, as compared with the times of maximum and minimum sun-spot frequency (according to Wolf), the figures given in Table IX.

TABLE IX.

Phase.	Magnetic Epochs.			Sun-spot Epoch. 1800+
	Declination. 1800+	Horizontal Force. 1800+	Mean. 1800+	
Minimum .	44·3	42·9	43·60	43·5
Maximum .	48·1	49·0	48·55	48·1
Minimum .	57·2	55·1	56·15	56·0
Maximum .	60·6	60·2	60·40	60·1
Minimum .	67·5	67·6	67·55	67·2
Maximum .	70·8	70·9	70·85	70·6
Minimum .	79·0	78·7	78·85	79·0
Maximum .	84·0	83·8	83·90	84·0
Minimum .	89·5	90·0	89·75	90·2
Maximum .	93·5	94·0	93·75	94·0

In S, the conclusion was drawn from earlier work by Stewart, Ellis, and others that the magnetic maxima and minima lagged behind those of the sun-spots; but, as Ellis remarks, this is not confirmed by the more extensive data embodied in Table IX.

§ 14. Bigelow (*U.S. Weather Bureau Bulletin*, No. 11, Part II. 1895, p. 500, &c.) claims to have established the existence of a magnetic period of 26·68 days, and this period was even employed instead of the calendar month in the magnetic tables published by the U.S. Naval Observatory for 1894. Hayward (T, vol. iv. 1899, p. 7) has examined magnetic data from several stations, with a view to determining whether they show a 428-days period (Chandler's period), but with no definite result. Leyst (R, vol. xvii. No. 1, 1894), from an analysis of seventeen years' data at St Petersburg and Pavlovsk, has concluded that all the principal planets sensibly influence the earth's magnetism. Except in the case of Mercury, Leyst confined his attention to the declination. According to his figures, all the planets except Mercury (whose influence is in the opposite direction to that of the others) when nearest the earth increase both the absolute value of the westerly declination (at St Petersburg) and also the amplitude of the solar diurnal inequality, the latter effect being the more conspicuous. Some relative numerical results will be found in Leyst's tables xxv. and xlviii. Schuster in several papers has considered the question of periodicities from a critical standpoint (T, vol. iii. p. 13; *Nature*, vol. liii. 1896, p. 318, &c.). He shows the difficulty of *proving* the existence of periodicities of small amplitude, unless observations extend over a very large number of periods. He also shows how spurious periodicities may arise. A spurious period of about 26·1 days, for instance, may very likely present itself when we deal with one or two complete years' observations of an element affected by an ordinary lunar period of 29·53 days. Schuster obtains formulæ which he applies to the data advanced by Broun, Hornstein, Liznar and others in favour of a 26 days' period in magnetic phenomena (see S, § 86; also *Wien. Ber.* vol. xci. 1885, p. 474, and vol. xciv. 1887, p. 834). The evidence is, he thinks, in no single case conclusive, but there is a consensus of favourable evidence from so many different sources as to create a presumption that something more than pure chance is concerned. The evidence advanced by Leyst in favour of sensible planetary influence appears to Schuster insufficient.

Secular changes.

§ 15. Various tables of data may be found in S, §§ 30–35. One gives the mean declination in 1882 at Kew Observatory as 18° 44′·8 W. In 1900 it was 16° 52′·7 W. Table X. gives mean annual changes during two periods at Kew, Parc St Maur (Paris), and Pavlovsk (St Petersburg), the latter based on papers by Moureaux (*Mém. du Bureau Central Mét.* for 1897, p. B_{65}) and Wild (*Mém. de l'Acad. de St Pétersbourg*, vol. ix. No. 7, 1900).

TABLE X.—*Mean Annual Changes of Magnetic Elements.*

	Declination.		Inclination.		(Hor. Force)×10⁵ C.G.S.		(Vert. Force)×10⁵ C.G.S.
	1883–90.	1890–97.	1883–90.	1890–97.	1883–90.	1890–97.	1883–97.
Kew	−7′·1	−6′·3	−1′·1	−2′·0	+21	+24	−1
Parc St Maur . .	−6′·0	−5′·7	−1′·2	−1′·6	+18	+25	+1
Pavlovsk . . .	−4′·1	−5′·5	0′·0	−0′·6	+6	+14	+16

The − sign represents diminution in westerly declination. In western Europe generally the changes are very similar to those at Kew and Parc St Maur. The *agonic lines* (or loci where the declination is zero) both in Europe and North America are moving westwards; the European line passed through St Petersburg about 1892. For fuller particulars see van Bemmelen (*k. Akad. van Weten. te Amsterdam*, 30th November 1895, and *Supplement to Batavia Observations*, vol. xxi.) and Schott (T, vol. ii. p. 123). The rate of movement of the needle to the east appears to be diminishing in western Europe, though greater there than in southern or eastern Europe. In some Asiatic stations (*e.g.*, Irkutsk, Bombay, Hong Kong, Batavia) in 1900 the needle was moving to the west. The inclination has been diminishing for some time in western Europe at an apparently increasing rate; in St Petersburg, however, it increased up to about 1886. The horizontal force is increasing all over Europe, but at most European stations the vertical force appears nearly stationary. A table of annual values of the magnetic elements at most magnetic observatories has appeared in the *Proc. Roy. Soc.* as Appendix IA to the annual *Reports* of the Kew Observatory Committee since 1895.

§ 16. The secular changes in the declination D and inclination I at a number of American stations have been represented with considerable accuracy by Schott (*U.S. Coast and Geodetic Survey Report* for 1895, App. I. &c.) by formulæ of the type D or $I = a_0 + a_1 \sin(mt + n)$; where t is the time since a given epoch, while a_0, a_1, m and n are constants for the particular place. When observations extend over only a short term of years it is better to use formulæ of the type D or $I = a + bt + ct^2$. Littlehales (T, vol. i. pp. 62 and 89, vol. ii. p. 68) has calculated secular change formulæ for a variety of stations scattered over the globe. Thus for the Cape of Good Hope he finds:

$$\text{Declination} = \quad 14°\cdot63 + 15°\cdot00 \sin\{0\cdot61(t - 1850) + \ \ 77°\cdot8\},$$
$$\text{(North) Inclination} = -49°\cdot11 + \ \ 8°\cdot75 \sin\{0\cdot8\ \ (t - 1850) + 214°\cdot3\},$$

where t is the date in years.

Bauer has introduced a convenient method of showing secular change graphically. From the centre of a sphere he draws radii parallel to the direction of the freely dipping needle and produces them to intersect the tangent plane drawn at the point which answers to the mean position of the needle during the epoch under consideration. The curve formed by these points of intersection

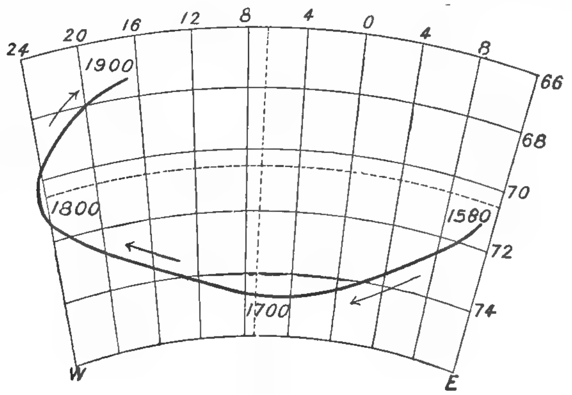

Fig. 5

shows the particulars of the secular change. Fig. 5 is the curve for London (slightly modified from *Nature*, vol. lvii. p. 181). As shown by the arrow, it is being described clockwise. In his original work Bauer found no actual exception to this mode of description, though he observed indications suggestive of exceptions on the Pacific coast. Schott and Littlehales have found a considerable number of cases where the direction of description is open to doubt, while in some stations on both the east and west shores of the Pacific it seems clearly anti-clockwise. Fritsche dealing with the secular changes from 1600 to 1885—as given by his *calculated* values of the magnetic elements—at 204 points of intersection of equidistant lines of latitude and longitude, found only sixty-three cases in which the motion was unmistakably clockwise, as against twenty-one cases in which it was clearly the reverse (*Die Elemente des Erdmagnetismus*, pp. 104–8).

Laws of disturbances.

§ 17. As already mentioned in § 4, disturbances show periodic variations, but the laws followed depend somewhat on the point of view adopted. We may accept Sabine's or some similar definition of a disturbance, distinguish between positive and negative disturbances, and trace the laws observed by the *number* or by the *mean magnitude* of either species; or we may simply take the differences between all- and quiet-day mean values, without going into further details. The conclusions at which Sabine arrived are described in S, §§ 54, &c. The most important of these conclusions, *e.g.*, the existence of times of maximum disturbances at the equinoxes, and the approximate coincidence of years of maximum disturbance with those of sun-spot maxima, are in accord with recent analyses of results from St Petersburg, Parc St Maur, Potsdam, and Greenwich, made respectively by Muller (R, vol. x. No. 3), Moureaux (T, vol. iv. p. 149), Lüdeling (T, vol. i. p. 147), and Ellis (*Monthly Notices of the Royal Astronomical Society*, December 1899, p. 142), in whose papers many further interesting details will be found. If the results of investigations such as Sabine's depend slightly on the definition of a *disturbance*, those of the second point of view described above depend in their turn on the definition of a quiet day, for Sabine's and Wild's quiet days were found by Whipple to show small but decided differences in their mean diurnal inequalities (*Brit. Assoc. Report* for 1886, p. 71). The second point of view is, however, probably the simpler, and it lends itself readily to graphical treatment; thus we can exhibit diurnal inequalities of disturbances in the form of curves of the types 1 or 2. Fig. 6, which is a slight modification of curves given by Ellis (*Brit. Assoc. Report* for 1898, p. 83), shows the algebraical excess of the mean all-day over the mean quiet-day hourly values of the magnetic elements at Greenwich for the epoch 1890–94, thus representing the diurnal inequalities of the disturbances from the second point of view. It will be noticed that the disturbance inequalities in the declination and vertical force are well marked, while that in the horizontal force is insignificant. This latter fact is not inconsistent with the result observed by, for instance, Moureaux at Parc St Maur, that positive and negative horizontal force disturbances, when treated separately after Sabine's method, show well-marked diurnal inequalities.

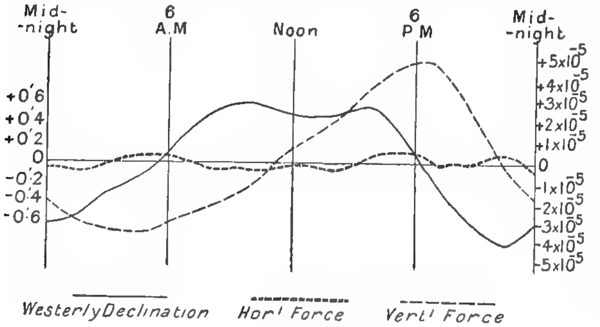

Fig. 6.

Simultaneity of disturbances.

§ 18. That large magnetic disturbances occur simultaneously, or nearly so, over large European areas, was known in the time of Gauss, on whose initiative observations were taken at 5-minutes' intervals at a number of stations on certain pre-arranged *term days*. During March 1879 and August 1880 there were some large disturbances, and W. G. Adams took the opportunity of comparing the magnetic curves from a number of observatories fitted with Kew pattern instruments (*B. A. Reports* for 1880, p. 201; and for 1881, p. 463). He found that the more characteristic movements in the case of any element took place, so far as could be judged, simultaneously at all the stations. At comparatively near stations, such as Stonyhurst and Kew, or Coimbra and Lisbon, the curves were in general almost duplicates. At Kew and St Petersburg there was usually considerable difference in detail, and occasionally the movements were in opposite directions. The differences between Toronto, Melbourne, or Zi-ka-wei and the European stations were still more pronounced. In 1896, on the initiative of Eschenhagen, eye observations of declination and horizontal force were made at Washington, Batavia, Manila, Melbourne, and nine European stations, at 5-seconds' intervals during pre-arranged hours. The data from one of these occasions, 28th February, were published by Eschenhagen (*Anhang Ergebnisse der Mag. Beob. in Potsdam*, 1896). The results were similar to those met with by Adams, but the differences in the construction and sensitiveness of the instruments proved a source of trouble. That simultaneity of occurrence is not peculiar to large disturbances was observed by Adams, and any number of examples are afforded by the magnetograms from stations such as Kew and Falmouth, a few hundred miles apart. Probably the most conclusive evidence of practical simultaneity yet afforded is that obtained from observations with bifilar magnetometers of very short period at Potsdam and Wilhelmshaven (see Eschenhagen, T, vol. i. p. 55), taken between 6 and 7 P.M. on six successive days in March 1895. There was no conspicuous disturbance, but a number of small movements, as many as 112 turning-points being observed in the course of an hour. It was found that practically every movement was common to the two stations, and the simultaneity of occurrence was established to within a second or two. A similar inter-comparison of Potsdam, Wilhelmshaven, and Charlottenburg in June 1895 led to similar results.

Waves of magnetism.

§ 19. The records from ordinary Kew pattern magnetographs not infrequently show a repetition of regular or nearly regular small rhythmic movements, lasting sometimes for hours (cf. van Bemmelen, *Kon. Akad. van Wetensch., Amsterdam*, 22nd November 1899). The space from crest to crest usually answers to an interval of from 2 to 5 minutes. In 1882 Kohlrausch detected with a very sensitive instrument wave-like variations of magnetic force at intervals of about 12 seconds (*Wied. Ann.* vol. lx. p. 336). Eschenhagen has observed small wave-like variations of horizontal force with a period of about 30 seconds (*Sitz. der k. Preuss. Akad. der Wiss.*, 24th June 1897, &c.). According to Eschenhagen, these *elementary waves* usually occur at night, and their passage may last several hours. In reply to criticisms by Cleveland Abbe, who ascribes the phenomenon to the apparatus, Eschenhagen says that he has obtained practically identical results when employing magnets of different periods of oscillation.

Magnetic surveys.

§ 20. Since 1880 there have been detailed investigations into the values of the magnetic elements in several countries. Of these we may mention the surveys of Great Britain and Ireland by Rücker and Thorpe (*Phil. Trans.* vol. clxxxi., A, 1890, p. 53; and vol. clxxxviii., A, 1896), of France and Algeria by Moureaux (*Ann. du Bureau Central Mét.*

de France, vol. i., for years 1884, and 1887 to 1895), of Russia by Smirnow, von Tillo, and others (R, vol. viii. No. 2, 1881; and vol. ix., Nos. 4 and 5, 1885), of Japan by Knott and Tanakadate (*Journal Coll. of Science Imp. University, Japan*, vol. ii. p. 163), of Italy by Chistoni and Palazzo (*Ann. dell' Uff. Centrale Met. e Geod.* vol. xiv. part 1, 1892, p. 57), of Switzerland by Batelli (*Ann. dell' Uff. Centr. Met.* vol. xiv. part 1, p. 83), of the Netherlands by van Rÿckevorsel (*A Magnetic Survey of the Netherlands for the Epoch 1st January 1891*, Rotterdam, 1895), of South Sweden by Gyllensköld (*kg. Svenska Vet-Akad. Handlingar*, vol. xxvii. No. 7, 1895; and T, vol. i. p. 200), of Austria by Liznar (*Denkschriften der Math.-Naturwiss. Classe der k. Akad. der Wiss. Wien*, vol. lxii., 1895; and vol. lxvii. 1899), and of Maryland, U.S., by Bauer (*Maryland Geological Survey Special Publication*, vol. i. part 5). The successful accomplishment of a magnetic survey requires that observations in the field be supplemented by records from fixed observatories, the latter being employed to determine the corrections necessary to reduce the field observations to a common epoch. Irregular magnetic changes are usually simultaneous and of similar amplitude over considerable areas, while secular changes and diurnal inequalities (allowing for differences of local time) are also very similar. Thus a comparatively small number of well-distributed magnetic observatories should suffice to supply the data of this character required for a survey. Unfortunately, however, the distribution of magnetic observatories is seldom ideal (see von Bezold and Rykatcheff, *Brit. Assoc. Report*, 1898, p. 743; and Schmidt, T, vol. ii., p. 27). Thus in the United Kingdom, Greenwich, Kew, and Falmouth differ little in latitude, whilst during Rücker and Thorpe's surveys there was no magnetograph in Scotland or Ireland. Apart from observatories, secular changes can be found only by repeating observations at a series of stations after a considerable interval of time. As the instruments employed in a survey are exposed to the vicissitudes of travel, it is desirable to compare them occasionally with standard instruments at a fixed observatory; such comparisons also provide the means of eliminating the peculiarities of different instruments. (For results of recent inter-comparisons by van Rÿckevorsel, Moureaux, and others, see T, vol. ii. p. 133; vol. iii.; pp. 186, 187; and *Brit. Assoc. Report*, 1896, p. 87.)

§ 21. The survey most likely to interest readers of this article is that of Rücker and Thorpe. After reducing their data to a common epoch, they proceeded as follows:—Dividing the United Kingdom into districts, from all the observations in a particular district they calculated a mean value for each element, answering to an imaginary central station, and also mean values for the changes in each element per degree of latitude or longitude throughout the district. From these data they calculated values of the elements for points defined by whole degrees of longitude and half degrees of latitude. Thence they found where isogonals, isoclinals, &c, cut the lines of latitude. The curves obtained by joining these successive points of intersection on a map are called *district* lines or curves. Rücker and Thorpe's next step was to obtain formulæ giving smooth curves of continuous curvature, approximating as closely as possible to the district lines. These smooth curves are called *terrestrial isomagnetics*; they may be supposed to show what the magnetic elements would be in the absence of disturbances peculiar to special parts of the survey area or its immediately coterminous regions. The component magnetic forces answering to the isomagnetics may be regarded as representing the *normal* field, and when we subtract them from the components actually observed, we obtain forces answering to a residual field, which may be ascribed to regional disturbances. When the vertical disturbing force is downwards, *i.e.*, the observed vertical component larger than that answering to the isomagnetics, Rücker and Thorpe regard it as positive, and the lines which are the loci where the largest positive values occur are termed by them *ridge* lines. Almost without exception, the resultant of the horizontal components of the disturbing forces pointed towards these ridge lines throughout a considerable area on both sides. The phenomena are similar to what would occur if ridge lines indicated the position of the summits of underground masses of magnetic material, magnetized so as to attract the N.-seeking pole of a magnet. Rücker and Thorpe are inclined to believe in the real existence of these subterranean mountains, even when there is no directly confirmatory geological evidence. They point out that if subterranean magnetic rocks are the cause of the phenomena, they must be of considerable extent, for theory and experiment alike indicate that thin basaltic sheets or dykes, or limited masses of trap rock, produce no measurable effect except in their immediate vicinity. In support of their conclusion, Rücker and Thorpe dwell on the fact that in the United Kingdom large masses of basalt, such as occur in Skye, Mull, Antrim, North Wales, or the Scottish coal-field, are invariably centres of attraction for the N.-seeking pole of a magnet, while they did not find a single clear case where a large mass of igneous rock acted as a centre of repulsion. One of the smaller anomalies observed by Rücker and Thorpe in the Thames valley, near London, is supposed by Moureaux (*Ann. du Bureau Central Météorologique de France*, 1890, tome i. p. B_{95}) to be probably associated with interesting anomalies which he has detected in the Paris basin.

§ 22. In some instances regional magnetic disturbances are associated with geodetic anomalies. This is the case in an elongated area including Moscow, surveyed magnetically by Fritsche (*Bull. Soc. Imp. des Naturalistes de Moskau*, No. 4, 1893, p. 381; also T, vol. i. p. 50). Again, Eschenhagen has detected magnetic anomalies in an area including the Harz mountains, where deflections of the plumb line from the normal had been observed (*Forsch. zur deutschen Landes. . . .* Elfter Bd., Heft 1, 1898; also T, vol. iii. p. 77). Eschenhagen found a magnetic *ridge line* running approximately parallel to the line of no deflection of the plumb line. In these cases the disturbed areas are considerable, but the disturbances are comparatively small. On the other hand, enormous disturbances have been observed over certain limited areas. One of the most remarkable of these is an area, about 3 miles long by 1¼ miles at its widest, near Port Walcott, off the north-west Australian coast. The results of a survey made here by H.M.S. *Penguin* have been discussed by Captain Creak (*Phil. Trans.* vol. clxxxvii. A, 1896, p. 345). Within the narrow area specified the declination varied from 26° W. to 56° E., and the inclination from 50° to nearly 80°, the observations being taken some 80 feet above sea bottom. Similar extraordinary anomalies in the province of Kursk, Russia, have been examined and discussed by Moureaux (*Ann. du Bureau Central Mét. de France* for 1897, p. B_{36}).

Gaussian constants.

§ 23. If we assume that the magnetic forces on the earth's surface are derivable from a potential V, we can express V in terms of two series of solid spherical harmonics, one containing negative, the other positive, integral powers of r, the radius vector from the earth's centre. Let λ denote east longitude from Greenwich, and let $\mu = \cos(\pi/2 - l)$, where l is latitude. Also let

$$\mathrm{H}_n^m = (1-\mu^2)^{\frac{m}{2}}\left[\mu^{n-m} - \frac{(n-m)(n-m-1)}{2(2n-1)}\mu^{n-m-2} - \ldots\right],$$

where n and m denote any positive integers, m being not greater than n. Then denoting by R the earth's mean radius, we have

$$\mathrm{V/R}=\Sigma(\mathrm{R}/r)^{n+1}\Big[\mathrm{H}_n^m\big(g_n^m\cos m\lambda+h_n^m\sin m\lambda\big)\Big]$$
$$+\Sigma(r/\mathrm{R})^n\Big[\mathrm{H}_n^m\big(g_{-n}^{\ m}\cos m\lambda+h_{-n}\sin m\lambda\big)\Big];$$

where Σ denotes summation of m from o to n inclusive, and then summation of n from o to ∞. In this equation $g_n^m, h_n^m, g_{-n}^{\ m}, h_{-n}^{\ m}$ are constants, the former pair representing what are generally termed *Gaussian constants.*

The series with negative powers of r answers to forces whose origin is within the earth's surface, that with positive powers to forces with an external origin. Gauss found that forces of this latter class if existent were very small, and usually they have been left out of account.

There are three Gaussian constants of the first order g_1^0, g_1^1, h_1^1, five of the second order, seven of the third, and so on. The coefficient of a Gaussian constant of the nth order is a spherical harmonic of the nth degree. It is perhaps most usual to take R as the unit length, in which case the first order terms may be written

$$\mathrm{V}_1=r^{-2}\Big\{g_1^0\sin l+\big(g_1^1\cos\lambda+h_1^1\sin\lambda\big)\cos l\Big\}.$$

In reality the earth is not a perfect sphere, and in the elaborate work on this subject by J. C. Adams it is treated as a spheroid. It is usual, however, to treat the earth as a sphere, and for simplicity we shall here treat it as such. We then have for components of force

$$\mathrm{X}=-r^{-1}(1-\mu^2)^{\frac{1}{2}}(d\mathrm{V}/d\mu)\text{ towards the north,}$$
$$\mathrm{Y}=-r^{-1}(1-\mu^2)^{-\frac{1}{2}}d\mathrm{V}/d\lambda\qquad\text{,,}\qquad\text{west,}$$
$$\mathrm{Z}=-d\mathrm{V}/dr\text{ vertically downwards.}$$

Over the surface $r=\mathrm{R}$, and the expressions for the components of force are functions only of λ and μ. Supposing all the Gaussian constants for any given epoch known, the above expressions would supply the values of X, Y, and Z all over the earth's surface. To determine the Gaussian constants for any given epoch we proceed in the reverse direction, *i.e.*, we equate observed values of X, Y, and Z to the theoretical values involving g_n^m, &c.

If we knew the value of the component forces at regularly distributed stations all over the earth's surface, we could determine each Gaussian constant independently of the others. Different ways of doing this have been indicated by J. C. Adams and Schuster. Our knowledge, however, of either Arctic or Antarctic regions is scanty, and in practice recourse must be had to methods in which the constants are not determined independently. The consequence, unfortunately, is that the values found for some of the less important constants, even of the lower orders, may depend very sensibly on how large a portion of the polar regions is excluded from the calculation, and on the number of constants of the higher orders which are retained. This is shown very clearly by W. G. Adams (*Brit. Assoc. Report* for 1898, p. 109) in discussing the results found by J. C. Adams for the two epochs 1845 and 1880, notably in the case of the constant g_2^0.

W. G. Adams devotes several tables to the values of the Gaussian constants as found by Erman-Petersen for 1829, by Gauss for 1830, by J. C. Adams for 1845 and 1880, and by Neumayer, Schmidt, and Fritsche for 1885. The most recent of these data for the constants of the first order are as follows :—

TABLE XI. —*Gaussian Constants of the First Order.*

Constant	Adams. 1880.	Neumayer. 1885.	Schmidt. 1885.	Fritsche. 1885.
g_1^0 . . .	+ ·316843	+ ·315720	+ ·317346	+ ·31635
g_1^1 . . .	+ ·024273	+ ·024814	+ ·023556	+ ·02414
h_1^1 . . .	− ·060300	− ·060258	− ·059842	− ·05914

The agreement is closer than might have been expected, considering that the number of constants retained was different in each case, Neumayer, for instance, neglecting all but the first twenty-four, as against fifty retained by Adams. Even in the case of the higher constants there are few instances of differences in sign. Still the last two of these figures at least had better be regarded as ornamental. It should be noticed that writers differ in the sign they give to V, and that, owing to a difference in his definition of a surface harmonic, Schmidt's values for the Gaussian constants, as given elsewhere by himself, require multiplication by factors as explained by W. G. Adams (*loc. cit.* pp. 134–136).

§ 24. The neglect of the second series in our original expression for V is, as already stated, one source of uncertainty, and a second is the possibility that some part of the magnetic forces may not arise from a potential. J. C. Adams made some calculations according to which $g_{-1}^{\ 0}/g_1^0$ is very small, but $g_{-5}^{\ 0}$ came out somewhat large. Schmidt's calculations led him to conclude that about one-fortieth of the force on the average arose from a potential answering to external forces, and that an even larger part had no potential. This would imply that the line integral of the magnetic force round closed areas on the earth's surface does not in general vanish. The physical concomitant would be vertical earth-air electric currents. Schmidt's final estimate of the average intensity of these currents at the epoch 1885 appears to be 0·17 ampere per square kilometre (*Abhand. der bayer. Akad. der Wiss.* Bd. xix. 1895). An earlier paper put it at 0·1 (*Brit. Assoc. Report* for 1894, p. 570). Bauer (T, vol. ii. p. 11), employing the same experimental data as Schmidt, reached a similar conclusion from the differences between integrals, taken round parallels of latitude at intervals of 5° from 60° N. to 60° S. Bauer found a very asymmetrical distribution, the current being downwards between 5° and 45° N. and between 15° and 40° S., while elsewhere it was upwards. Von Bezold also took line integrals round parallels of latitude, and comparing their values with the potential ranges as given by Schmidt's figures, obtained evidence favourable to the existence of vertical currents (*Sitz. k. Akad. der Wiss.*, Berlin, 1897, No. xviii. ; also T, vol. iii. p. 191). Fritsche has treated the problem similarly, but has considered a larger number of parallels, and at two separate epochs, viz., 1842 and 1885 (*Die Elemente des Erdmagnetismus*, p. 103). The values of the integrals round the same parallel at the two epochs seldom agreed closely, and sometimes differed in sign. As a large alteration in the phenomena in the course of forty-three years seems improbable, the most natural conclusion is that the values of line integrals round parallels of latitude are too uncertain to afford a satisfactory criterion as to the real existence of earth-air currents. Similar negative results seem to flow from the calculation of line integrals round the best surveyed areas in Europe (see von Bezold, *l.c.* ; Rücker, T, vol. i. p. 77, and *Nature*, vol. lvii. pp. 160 and 180 ; Liznar, *Met. Zeit.* for 1898, p. 175 ; and von Gyllensköld, *k. Svenska Vet. Akad. Handlingar*, vol. xxvii. No. 7, 1895). There are somewhat serious physical difficulties in the way of currents of the size calculated by Schmidt (see ATMOSPHERIC ELECTRICITY, *Ency. Brit.* vol. xxv. § 13).

Influence of altitude.

§ 25. The forces arising from terms in the Gaussian potential which depend on constants of the n^{th} order vary as r^{-n-2}, where r is the distance from the earth's centre. If F represent the value at sea-level of any component of force answering to Gaussian constants of the n^{th} order, the value $\mathrm{F}+\delta\mathrm{F}$ at height h is given by $(\mathrm{F}+\delta\mathrm{F})/\mathrm{F}=\{\mathrm{R}/(\mathrm{R}+h)\}^{n+2}$, where R is the earth's radius. Thus so long as h/R is small we have very approximately $\delta\mathrm{F}/\mathrm{F}=-(n+2)h/\mathrm{R}$. As we have seen, the terms depending on Gaussian constants of the first order (*i.e.*, $n=1$) are much the most important ; thus on the Gaussian theory we should have approximately

$$\delta\mathrm{X}/\mathrm{X}=\delta\mathrm{Y}/\mathrm{Y}=\delta\mathrm{Z}/\mathrm{Z}=-3h/\mathrm{R}.$$

Thus all the components should decrease as we go upwards at the same rate, the declination and inclination remaining unaffected. Liznar has compared this equation with the results of his Austrian survey (*Sitz. der k. Kais. Akad. der Wiss. Wien., Math.-Nat. Classe*, Bd. cvii. Abth. ii., 1898). Subdividing his stations into three groups according to altitude, he concluded that the westerly component and the declination increased with the altitude, and that while the northerly and vertical components decreased, they did so at thrice the rate indicated by theory. These conspicuous departures from theory have been ascribed to electrical currents in the atmosphere, some of which would have to be horizontal. Geitel has pointed out serious difficulties in the way of this explanation (T, vol. iv. p. 63). Van Rÿckevorsel and van Bemmelen found the horizontal force on the Rigi to decrease slightly with the altitude, while the vertical force increased in somewhat larger measure ; but the differences were so small that they were indisposed to regard their conclusions as final (T, vol. ii., 1897, p. 76). It should be noticed that Liznar's theoretical formula, like the Gaussian analysis—so long as only lower order terms are retained—applies only to the earth's field as freed from all local or even regional disturbances ; and that presumably a good deal of the material above sea-level in Austria is by no means non-magnetic. According to Liznar's views, diurnal variation phenomena should vary sensibly with the height : if this be the case, his advocacy of the institution of some high-level magnetic observatories is worthy of support.

§ 26. Schuster has attempted to obtain a potential analogous to the Gaussian potential from which the regular diurnal changes of the magnetic elements all over the earth may be found by differentiation (*Phil. Trans.*, A, vol. clxxx. 1889, p. 467). From the mean summer and winter diurnal variations of the northerly and easterly components of force during 1870 at Greenwich, Lisbon, St Petersburg, and Bombay, he calculated the values of eight constants analogous to Gaussian constants, and from considerations as to the times of occurrence of the diurnal maxima and minima of vertical force he concluded that his potential must, unlike the Gaussian, proceed in positive powers of r. This would ascribe the diurnal variations to a source external to the earth. Schuster found, however, that the amplitude of the diurnal vertical force inequality calculated from his potential did not accord with observation. His final conclusion was that the principal cause of the diurnal variations is probably electric currents in the atmosphere, but that there are also induced currents inside the earth which increase the horizontal components and diminish the vertical component. Von Bezold has based on Schuster's results a series of vector diagrams showing the mean diurnal variation for the summer of 1870, in a variety of latitudes (*Sitz. der k. Preuss. Akad.*, 1897, No. xviii. See also *Met. Zeit.*, February 1898). A repetition of Schuster's calculations for a more recent epoch, making use of the best available data, and a critical comparison with the phénomena at a variety of stations, seems desirable.

Normal field.

§ 27. Employing V as before for the Gaussian potential, von Bezold puts $V=V_n+V_a$, where V_n is the mean value of V for the parallel of latitude, while V_a is the *anomaly* (*Sitz. der k. Preuss. Akad.*, No. xviii., 1895, p. 363). He found that approximately $V_n=V_\nu$ where $V_\nu \equiv K \times$ sin latitude, with K a constant. Von Bezold calls V_n the *empirical normal*, and V_ν the *theoretical normal* potential. He regards V_a as answering to disturbances, and constructs isanomaly curves (along which V_a is constant), from which he draws conclusions as to the character of the disturbing forces. The fact that V_n and V_ν are nearly equal simply means, as pointed out by Schmidt, that g_1^0 is much the largest Gaussian constant of the type g_n^0. Von Bezold mentions this in a second paper, where he compares observed magnetic forces with those calculated from V_ν, accepting the Neumayer-Petersen value ·31572 for g_1^0 (*Sitz. der k. Preuss. Akad.*, No. 50, 1895, p. 1119). Bauer seems originally to have taken the same definition of *normal field* as von Bezold, recognizing, however, what seems to have escaped von Bezold, that V_ν simply answers to a uniform magnetization parallel to the earth's axis (*Amer. Jour. of Sc.* vol. l. pp. 109, 189, 314). In a second paper Bauer takes for the earth's normal field that depending on the Gaussian constants of the first order (T, vol. i. p. 169). This field also answers to a uniform magnetization, but it is parallel to a diameter whose direction cosines relative to the earth's rotation axis and to two perpendicular axes, one in, the other perpendicular to the Greenwich meridian, are proportional to g_1^0, g_1^1, and h_1^1. Accepting the Neumayer-Petersen figures, Bauer calculates the component forces answering to his normal distribution, and attributes the difference between them and the observed values, as tabulated by Schmidt, to a residual or disturbing magnetization whose nature he illustrates diagrammatically. In a third paper he follows a similar course, but takes Schmidt's values for g_1^0, g_1^1, h_1^1, and compares the corresponding theoretical values of the component forces with the observed values at 1800 points, instead of at 84 as previously (T, vol. iv., 1899, p. 33). Bauer concludes that if his residual field arises from electric currents, these must be inside the earth. He is inclined apparently to associate the residual field intimately with the irregularities in temperature distribution on the earth's surface, owing to a resemblance between his curves and the lines of isabnormal temperature in Hann's *Atlas der Meteorologie*.

Rücker (T, vol. iv. p. 113) falls in with the view that the "magnetic field of the earth may be regarded as that primarily due to a uniformly magnetized globe disturbed by some secondary causes." In reference, however, to Bauer's suggestion, he points out that Hann's isabnormals of temperature relate to a purely surface phenomenon, whereas over the greater part of the earth it is the temperature at the bottom of the ocean that would naturally influence magnetic phenomena. Though differing so far from Bauer, Rücker is himself disposed to regard temperature as a not improbable cause of the secondary field. He had been struck by the fact that Wilde had succeeded in reproducing some of the most conspicuous features of the earth's magnetization by a contrivance called a *magnetarium*, consisting essentially of a globe representing the earth's surface inside which is a concentric globe, round which wire is coiled in planes inclined at 23½° to the equator. Between the two globes is a spherical shell of wire gauze, round which another wire is coiled in planes perpendicular to the geographical axis. Currents are sent through the two circuits. By making the axis of the inner globe describe a cone of constant angle about that of the outer, Wilde claims to imitate the secular change met with on the earth. If the two currents in the magnetarium be regarded as answering to the normal field, the chief substitute for the secondary field would seem to be a coating of thin sheet iron put by Wilde over those parts of the interior surface of the outer globe which correspond to oceans. Pursuing this idea, Rücker points out that in tropical oceans the low temperature at the bottom must increase the local thickness of the stratum whose temperature is low enough to permit of magnetic material remaining magnetic. Rücker's calculations, however, as applied to Bauer's figures for the secondary field, seem to show that this explanation will not suffice unless the permeability of sub-oceanic strata largely exceeds that of ordinary basaltic rocks or even magnetite.

Magnetic axis.

§ 28. The magnetic poles where the horizontal component vanishes do not, it is believed, lie on one diameter, and the same is true of the two points where the total force is a maximum; thus the term *magnetic axis* could not correctly be applied to a diameter passing through any one of these points. The term has, however, been applied to that diameter which is parallel to the field which depends on the Gaussian constants of the first order (*i.e.*, Bauer's *normal* field). The position of this diameter varies with the values of the Gaussian constants as shown in Table XII.

TABLE XII.—*Co-ordinates of North End of Magnetic Axis.*

Epoch.	Authority.	North Latitude.	Longitude West of Greenwich.
1650	Fritsche . . .	82° 50′	42° 55′
1836	,, . .	78 27	63 35
1845	Adams (for Gaussian constants) .	78 44	64 20
1880	,, ,, .	78 24	68 4
1885	Neumayer-Petersen and Bauer . .	78 3	67 3
1885	Neumayer-Schmidt	78 34	68 31

According to the table, the magnetic axis has been moving from east to west, inclined at a nearly constant angle to the earth's geographical axis. Other axes possessing more complicated properties in relation to the earth's magnetism, for which distinctive terms seem desirable, have had their positions determined by Schmidt (T, vol. i., 1896, p. 18).

Magnetic moment.

§ 29. If a sphere be uniformly magnetized, the potential at a distance r from its centre, in a direction inclined at an angle δ to the magnetic axis, is $M \cos\delta\, r^{-2}$, where M is the magnetic moment. Comparing this with the expression in § 23 for the earth's potential V, we see that the earth's magnetic moment answering to the Gaussian constants of the first order is given by $M=R^3\left\{(g_1^0)^2+(g_1^1)^2+(h_1^1)^2\right\}^{\frac{1}{2}}$, where R is the earth's radius. M is known as the *earth's magnetic moment*. The following are some of the numerical results found for M/R^3:—

TABLE XIII.—*Value of* M/R^3 *in C.G.S. Units.*

Epoch.	Authority.	Moment÷(Earth's Radius)³.
1650	Fritsche	·3260
1830	Gauss (for constants) . . .	·3309
1836	Fritsche	·3262
1845	Adams (for constants) . . .	·3282
1880	,, ,, ...	·3234
1885	Neumayer-Petersen and Bauer .	·3224
1885	Schmidt	·3230

The table suggests a slight diminution in the moment since 1845, but the degree of accuracy attributable to the figures, especially the earlier ones, is extremely doubtful.

§ 30. Folgheraiter has found that old vases from Etruscan and other sources are magnetic, and from combined observation and experiment he believes that the magnetization they possess was acquired during the cooling which followed their baking, and has remained unaltered since that epoch (*R. Accad. Lincei Atti* viii. 1899, pp. 69, 121, 176, 269; also previous volumes; see also *Séances de la Soc. Franç. de Physique*, 1899, p. 118). Experiment has supplied him with formulæ connecting the magnetization shown by clay vases with their orientation when cooling in known magnetic fields, and the application of these formulæ to the magnetic phenomena presented by old vases leads him to assign definite values to the magnetic inclination at the time and place of their manufacture. According to Folgheraiter, the inclination in central Italy was southerly for at least two centuries prior to 600 B.C., when it changed sign. In 400 B.C. it was about 20° N. Since 100 B.C. the change has been relatively small. If Folgheraiter's conclusions should be confirmed from other sources, we may expect similar reasoning to apply to rocks of volcanic origin which have cooled rapidly. This would certainly open a wide field for inquiry.

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(C. CH.)

Magneto-Optics.—The first relation between magnetism and light was discovered by Faraday,[1] who proved that the plane of polarization of a ray of light was rotated when the ray travelled, through certain substances, parallel to the lines of magnetic force. This power of rotating the plane of polarization in a magnetic field has been shown to be possessed by all refracting substances, whether they are in the solid, liquid, or gaseous state. The rotation by gases was established independently by H. Becquerel,[2] and Kundt and Röntgen,[3] while Kundt[4] found that films of the magnetic metals, iron, cobalt, nickel, thin enough to be transparent, produced enormous rotations, these being in iron and cobalt magnetized to saturation at the rate of 200,000° per cm. of thickness, and in nickel about 89,000°. The direction of rotation is not the same in all bodies. If we call the rotation positive when it is related to the direction of the magnetic force, like rotation and translation in a right-handed screw, or, what is equivalent, when it is in the direction of the electric currents which would produce a magnetic field in the same direction as that which produces the rotation, then most substances produce positive rotation. Among those that produce negative rotation are ferrous and ferric salts, ferri-cyanide of potassium, the salts of lanthanum, cerium and didymium, and chloride of titanium.[5]

For slightly magnetizable substances the amount of rotation in a space PQ is proportional to the difference between the magnetic potential at P and Q; or if θ is the rotation in PQ, Ω_P, Ω_Q, the magnetic potential at P and Q, then

$$\theta = R\ \Omega_P - \Omega_Q),$$

where R is a constant, called Verdet's constant, which depends upon the refracting substance, the wave-length of the light, and the temperature. The following are the values of R (when the rotation is expressed in circular measure) for the D line and a temperature of 18° C. :—

Substance.	$R \times 10^5$.	Observer.
Carbon-bisulphide . .	1·222	Lord Rayleigh[6] and Köpsel.[7]
	1·225	Rodger and Watson.[8]
Water	·377	Arons.[9]
	·3808	Rodger and Watson.[8]
Alcohol	·330	Du Bois.[10]
Ether	·315	Du Bois.[10]
Oxygen (at 1 atmosphere)	·000179	Kundt and Röntgen (*l.c.*).
Faraday's heavy glass .	1·738	

The variation of Verdet's constant with temperature has been determined for carbon-bisulphide and water by Rodger and Watson (*l.c.*). They find if R_t, R_0 are the values of Verdet's constant at t°C. and 0°C. respectively, then for CS_2 $R_t = R_0\ (1 - {\cdot}0016961)$, and for H_2O $R_t = R_0\ (1 - {\cdot}0000305t - {\cdot}00000305t^2)$.

For the magnetic metals Kundt found that the rotation did not increase so rapidly as the magnetic force, but that as this force was increased the rotation reached a maximum value. This suggests that the rotation is proportional to the intensity of magnetization, and not to the magnetic force.

The amount of rotation in a given field depends greatly upon the wave-length of the light; the shorter the wave-length the greater the rotation, the rotation varying a little more rapidly than the inverse square of the wave-length. Verdet[11] has compared in the cases of carbon bisulphide and creosote the rotation given by the formula

$$\theta = mc\gamma \frac{c^2}{\lambda^2}\left(c - \lambda \frac{di}{d\lambda}\right)$$

with those actually observed; in this formula θ is the angular rotation of the plane of polarization, m a constant depending on the medium, λ the wave-length of the light in air, and i its index of refraction in the medium. Verdet found that though the agreement is fair, the differences are greater than can be explained by errors of experiment.

Verdet[12] has shown that the rotation of a salt solution is the sum of the rotations due to the salt and the solvent; thus, by mixing a salt which produces negative rotation with water which produces positive rotation, it is possible to get a solution which does not exhibit any rotation. Such solutions are not in general magnetically neutral. By mixing diamagnetic and paramagnetic substances we can get magnetically neutral solutions, which, however, produce a finite rotation of the plane of polarization. The relation of the magnetic rotation to chemical constitution has been studied in great detail by Perkin,[13] Wachsmuth,[14] Jahn,[15] and Schönrock.[16]

The rotation of the plane of polarization may conveniently be regarded as denoting that the velocity of propagation of circular-polarized light travelling along the lines of magnetic force depends upon the direction of rotation of the ray, the velocity when the rotation is related to the direction of the magnetic force, like rotation and translation on a right-handed screw being different from that for a left-handed rotation. A plane-polarized ray may be regarded as compounded of two oppositely circularly-polarized rays, and as these travel along the lines of magnetic force with different velocities, the one will gain or lose in phase on the other, so that when they are again compounded they will correspond to a plane-polarized ray, but in consequence of the change of phase the plane of polarization will not coincide with its original position.

Reflection from a Magnet.—Kerr[17] in 1877 found that when plane-polarized light is incident on the pole of an electromagnet, polished so as to act like a mirror, the plane of polarization of the reflected light is rotated by the magnet. Further experiments on this phenomenon have been made by Righi,[18] Kundt,[19] Du Bois,[20] Sissingh,[21] Hall,[22] Hurion,[23] Kaz,[24] and Zeeman.[25] The simplest case is when the incident plane-polarized light falls normally on the pole of an electromagnet. When the magnet is not excited the reflected ray is plane-polarized; when the magnet is excited the plane of polarization is rotated through a small angle, the direction of rotation being opposite to that of the currents exciting the pole. Righi found that the reflected light was slightly elliptically polarized, the axes of the ellipse being of very unequal magnitude. A piece of gold-leaf placed over the pole entirely stops the rotation, showing that it is not produced in the air near the pole. Rotation takes place from magnetized nickel and cobalt as well as from iron, and is in the same direction (Hall). Righi has shown that the rotation at reflection is greater for long waves than for short, whereas, as we have seen, the Faraday rotation is greater for short waves than for long. The rotation for different coloured light from iron, nickel, cobalt, and magnetite has been measured by Du Bois; in magnetite the direction of rotation is opposite to that of the other metals. When the light is incident obliquely and not normally on the polished pole of an electromagnet, it is elliptically polarized after reflection, even when the plane of polarization is parallel or at right angles to the plane of incidence. According to Righi, the amount of rotation when the plane of polarization of the incident light is perpendicular to the plane of incidence reaches a maximum when the angle of incidence is between 44° and 68°, while when the light is polarized in the plane of incidence the rotation steadily decreases as the angle of incidence is increased. The rotation when the light is polarized in the plane of incidence is always less than when it is polarized at right angles to that plane, except when the incidence is normal, when the two rotations are of course equal.

Reflection from Tangentially Magnetized Iron.—In this case Kerr[26] found :—(1) When the plane of incidence is perpendicular to the lines of magnetic force, no rotation of the reflected light is produced by magnetization; (2) no rotation is produced when the light is incident normally; (3) when the incidence is oblique, the lines of magnetic force being in the plane of incidence, the reflected light is elliptically polarized after reflection, and the axes of the ellipse are not in and at right angles to the plane of incidence. When the light is polarized in the plane of incidence, the rotation is at all angles of incidence in the opposite direction to that of the currents which would produce a magnetic field of the same sign as the magnet. When the light is polarized at right angles to the plane of incidence, the rotation is in the same direction as these currents when the angle of incidence is between 0° and 75° according to Kerr, between 0° and 80° according to Kundt, and between 0° and 78° 54′ according to Righi. When the incidence is more oblique than this, the rotation of the plane of polarization is in the opposite direction to the electric currents which would produce a magnetic field of the same sign.

The theory of the phenomena just described has been dealt with by Airy,[27] C. Neumann,[28] Maxwell,[29] Fitzgerald,[30] Rowland,[31] H. A. Lorentz,[32] Voight,[33] Ketteler,[34] van Loghem,[35] Potier,[36] Basset,[37] Goldhammer,[38] Drude,[39] J. J. Thomson,[40] and Leatham;[41] for a critical discussion of many of these theories we refer the reader to Larmor's[42] British Association Report. Most of these theories have proceeded on the plan of adding to the expression for the electromotive force terms indicating a force similar in character to that discovered by Hall (see MAGNETISM) in metallic conductors carrying a current in a magnetic field, *i.e.*, an electromotive force at right angles to the plane containing the magnetic force and the electric current, and proportional to the sine of the angle between these vectors. The introduction of a term of this kind gives rotation of the plane of polarization by transmission through all refracting substance, and by reflection from magnetized metals, and shows a fair agreement between the theoretical and experimental results. The simplest way of treating the questions seems, however, to be to go to the equations which represent the propagation of a wave travelling through a medium containing ions. A moving ion in a magnetic field will be acted upon by a mechanical force which is at right angles to its direction of motion, and also to the magnetic force, and is equal per unit charge to the product of these two vectors and the sine of the angle between them. For the sake of brevity we will take the special case of a wave travelling parallel to the magnetic force in the direction of the axis of *z*.

Then supposing that all the ions are of the same kind, and that there are n of these each with mass m and charge e per unit volume, the equations representing the field are (see art. ELECTRICITY, *Electric Waves*, vol. xxviii. p. 71) :—

$$\mathrm{K}_0\frac{d\mathrm{X}_0}{dt}+4\pi ne\frac{d\xi}{dt}=\frac{d\beta}{dz}\,;$$

$$\frac{d\mathrm{X}_0}{dz}=\frac{d\beta}{dt}\,;$$

$$\mathrm{K}_0\frac{d\mathrm{Y}_0}{dt}+4\pi ne\frac{d\eta}{dt}=-\frac{d\alpha}{dz}\,;$$

$$\frac{d\mathrm{Y}_0}{dz}=-\frac{d\alpha}{dt}\,;$$

$$m\frac{d^2\xi}{dt^2}+\mathrm{R}_1\frac{d\xi}{dt}+a\xi=\left(\mathrm{X}_0+\frac{4\pi}{3}ne\xi\right)e+He\frac{d\eta}{dt}$$

$$m\frac{d^2\eta}{dt^2}+\mathrm{R}_1\frac{d\eta}{dt}+a\eta=\left(\mathrm{Y}_0+\frac{4\pi}{3}ne\eta\right)e-He\frac{d\xi}{dt}\,;$$

where H is the external magnetic field, X_0, Y_0 the components of the part of the electric force in the wave not due to the charges on the atoms, α and β the components of the magnetic force, ξ and η the co-ordinates of an ion, R_1 the coefficient of resistance to the motion of the ions, and a the force at unit distance tending to bring the ion back to its position of equilibrium, K_0 the specific inductive capacity of a vacuum. If the variables are proportional to $\epsilon^{\iota(pt-qz)}$ we find by substitution that m is given by the equation

$$q^2-\mathrm{K}_0p^2-\frac{4\pi ne^2p^2\mathrm{P}}{\mathrm{P}^2-\mathrm{H}^2e^2p^2}=\pm\frac{4\pi ne^3\mathrm{H}p^3}{\mathrm{P}^2-\mathrm{H}^2e^2p^2},$$

where

$$\mathrm{P}=\left(a-\frac{4\pi}{3}ne^2\right)+\mathrm{R}_1\iota p-mp^2.$$

If q_1^2, q_2^2 are the roots of this equation, then corresponding to q_1 we have $\mathrm{X}_0=\iota\mathrm{Y}_0$ and to q_2 $\mathrm{X}_0=-\iota\mathrm{Y}_0$. We thus get two oppositely circular-polarized rays travelling with the velocities p/q_1 and p/q_2 respectively. The rotation of the plane of polarization per unit length is m_1-m_2; and this can, if we neglect terms in H^2, be shown to be equal to

$$\frac{(\mu^2-1)^2p^2\mathrm{H}}{\mu 4\pi ne\mathrm{V}_0{}^3},$$

where μ is the refractive index for light of period, p, and V_0 is the velocity of light through a vacuum. We see from the equations that the rotation is very large for such a value of p as makes $\mathrm{P}=0$: this value corresponds to a free period of the ions, so that the rotation ought to be very large in the neighbourhood of an absorption band. This has been verified for sodium vapour by Macaluso and Corbino.[43]

If plane-polarized light falls normally on a plane face of the medium containing the ions, then if the electric force in the incident wave is parallel to x and is equal to the real part of $\mathrm{A}\epsilon^{\iota(pt-qz)}$, if the reflected beam in which the electric force is parallel to x is represented by $\mathrm{B}\epsilon^{\iota(pt+qz)}$ and the reflected beam in which the electric force is parallel to the axis of y by $\mathrm{C}\epsilon^{\iota(pt+qz)}$, then the conditions that the magnetic force parallel to the surface is continuous, and that the electric forces parallel to the surface in the air are continuous with Y_0, X_0 in the medium, give

$$\frac{\mathrm{A}}{(q+q_1)\,(q+q_2)}=\frac{\mathrm{B}}{(q^2-q_1q_2)}=\frac{\iota\mathrm{C}}{q(q_2-q_1)}$$

or approximately, since m_1 and m_2 are nearly equal,

$$\frac{\iota\mathrm{C}}{\mathrm{B}}=\frac{m(m_2-m_1)}{m^2-m_1{}^2}=\frac{(\mu^2-1)p\mathrm{H}}{4\pi\mu ne\mathrm{V}_0{}^2}.$$

Thus in transparent bodies for which μ is real, C and B differ in phase by $\pi/2$, and the reflected light is elliptically polarized, the major axis of the ellipse being in the plane of polarization of the incident light, so that in this case there is no rotation, but only elliptic polarization; when there is strong absorption so that μ contains an imaginary term, C/B will contain a real part so that the reflected light will be elliptically polarized, but the major axis is no longer in the plane of polarization of the incident light; we should thus have a rotation of the plane of polarization superposed on the elliptic polarization.

Zeeman's Effect.—Faraday, after discovering the effect of a magnetic field on the plane of polarization of light, made numerous experiments to see if such a field influenced the nature of the light emitted by a luminous body, but without success. In 1885 Fievez,[44] a Belgian physicist, noticed that the spectrum of a sodium flame was changed slightly in appearance by a magnetic field, but his observation does not seem to have attracted much attention, and was probably ascribed to secondary effects. In 1896 Zeeman[45] saw a distinct broadening of the lines of lithium and sodium when the flames containing salts of these metals were between the poles of a powerful electromagnet; following up this observation, he obtained some exceedingly remarkable and interesting results, of which those observed with the blue-green cadmium line may be taken as typical. He found that in a strong magnetic field, when the lines of force are parallel to the direction of propagation of the light, the line is split up into a doublet, the constituents of which are on opposite sides of the undisturbed position of the line, and that the light in the constituents of this doublet is circularly polarized, the rotation in the two lines being in opposite directions.

When the magnetic force is at right angles to the direction of propagation of the light, the line is resolved into a triplet, of which the middle line occupies the same position as the undisturbed line; all the constituents of this triplet are plane-polarized, the plane of polarization of the middle line being at right angles to the magnetic force, while the outside lines are polarized on a plane parallel to the lines of magnetic force. A great deal of light is thrown on this phenomenon by the following considerations due to H. A. Lorentz.[46]

Let us consider an ion attracted to a centre of force by a force proportional to the distance, and acted on by a magnetic force parallel to the axis of z: then if m is the mass of the particle and e its charge, the equations of motion are

$$m\frac{d^2x}{dt^2}+ax= \quad \mathrm{H}e\frac{dy}{dt};$$

$$m\frac{d^2y}{dt^2}+ay=\mathrm{H}e\frac{dx}{dt};$$

$$m\frac{d^2z}{dt^2}+az=0.$$

The solution of these equations is

$$\begin{aligned} x&=\mathrm{A}\cos(p_1t+\beta)+\mathrm{B}\cos(p_2t+\beta_1)\\ y&=\mathrm{A}\sin(p_1t+\beta)-\mathrm{B}\sin(p_2t+\beta_1)\\ z&=\mathrm{C}\cos(pt+\gamma)\end{aligned}$$

where

$$a-mp_1{}^2=-\mathrm{H}ep_1$$

$$a-mp_2{}^2=\mathrm{H}ep_2$$

$$p^2=a/m,$$

or approximately $p_1=p+\frac{1}{2}\frac{\mathrm{H}e}{m}, \quad p_2=p-\frac{1}{2}\frac{\mathrm{H}e}{m}.$

Thus the motion of the ion on the xy plane may be regarded as made up of two circular motions in opposite directions described with frequencies p_1 and p_2 respectively, while the motion along z has the period p, which is the frequency for all the vibrations when $\mathrm{H}=0$. Now suppose that the cadmium line is due to the motion of such an ion; then if the magnetic force is along the direction of propagation, the vibration in this direction has its period unaltered, but since the direction of vibration is perpendicular to the wave front, it does not give rise to light. Thus we are left with the two circular motions in the wave front with frequencies p_1 and p_2 giving the circularly-polarized constituents of the doublet. Now suppose the magnetic force is at right angles to the direction of propagation of the light; then the vibration parallel to the magnetic force being in the wave front produces luminous effects and gives rise to a plane-polarized ray of undisturbed period (the middle line of the triplet), the plane of polarization being at right angles to the magnetic force. The components in the wave-front of the circular orbits at right angles to the magnetic force will be rectilinear motions of frequency p_1 and p_2 at right angles to the magnetic force—so that they will produce plane-polarized light, the plane of polarization being parallel to the magnetic force; these are the outer lines of the triplet.

If Zeeman's observations are interpreted from this point of view, the directions of rotation of the circularly-polarized light in the doublet observed along the lines of magnetic force show that the ions which produce the luminous vibrations are *negatively* electrified, while the measurement of the change of frequency due to the magnetic field shows that e/m is of the order 10^7. This result is of great interest, as this is the order of the value of e/m in the negatively electrified particles which constitute the Cathode Rays (see ELECTRICITY, *Electric Discharge*, *Ency. Brit.* vol. xxviii.). Thus we infer that the "cathode particles" are found in bodies, even where not subject to the action of intense electrical fields, and are in fact an ordinary constituent of the molecule. Similar particles are found near an incandescent wire, and also near a metal plate illuminated by ultra-violet light.

A more extended study of the behaviour of the spectroscopic lines has afforded examples in which the effects produced by a magnet are more complicated than those we have described. Thus Preston[47] and Cornu[48] have shown that under the action of a transverse magnetic field one of the D lines splits up into four, and the other into six lines; Preston has given many other examples of these quartets and sextets, and has shown that the change in the frequency, which, according to the simple theory indicated, should be the same for all lines, actually varies considerably from one line to another, many lines showing no appreciable displacement. The splitting up of a single line into a quartet or sextet indicates, from the point of view of the ion theory, that the line must have its origin in a system consisting of more than one ion. A single ion having only three degrees of freedom can only have three periods. When there is no magnetic force acting on the ion these periods are equal, but though under the action of a magnetic force they are separated, their number cannot be increased. When therefore we get four or more lines, the inference is that the system giving the lines must have at least four degrees of freedom, and therefore must consist of more than one ion. The theory of a system of ions mutually influencing each other shows, as we should expect, that the effects are more complex than in the case of a single ion, and that the change in the frequency is not necessarily the same for all systems. Preston[49] has proved that in some cases at any rate the change in the frequency of the different lines is of such a character that they can be grouped into series such that each line in the series has the same change in frequency for the same magnetic force, and moreover that homologous lines in the spectra of different metals belonging to the same group have the same change in frequency. Thus the behaviour of the spectrum in the magnetic field promises to throw great light on the nature of radiation, and perhaps on the constitution of the elements. The study of these effects has been greatly facilitated by the invention by Michelson[50] of the echelon spectroscope.

There are some interesting phenomena connected with the Zeeman effect which are more easily observed than the effect itself. Thus Cotton[51] found that if we have two Bunsen flames A and B coloured by the same salt, the absorption of the light of one by the other is diminished if either is placed between the poles of a magnet: this is at once explained by the Zeeman effect, for the times of vibration of the molecules of the flame in the magnetic field are not the same as those of the other flame, and thus the absorption is diminished. Similar considerations explain the phenomenon observed by Egoroff and Georgiewsky,[52] that the light emitted from a flame in a transverse field is partially polarized in a plane parallel to the magnetic force; and also Righi's[53] observation that if a sodium flame is placed in a longitudinal field between two crossed Nicols, and a ray of white light sent through one of the Nicols, then through the flame, and then through the second Nicol, the amount of light passing through the second Nicol is greater when the field is on than when it is off. For further information on the Zeeman effect the reader is referred to a valuable report by Voight.[54]

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[1] *Experimental Researches*, Series 19.
[2] *Comptes Rendus*, 88, p. 709.
[3] *Wied. Ann.* 6, p. 332; 8, p. 278; 10, p. 257.
[4] *Wied. Ann.* 23, p. 228; 27, p. 191.
[5] *Wied. Ann.* 31, p. 941.
[6] *Phil. Trans.* A. 1885, Pt. 11, p. 343.
[7] *Wied. Ann.* 26, p. 456.
[8] *Phil. Trans.* A. 1895, Pt. 11, p. 621.
[9] *Wied. Ann.* 24, p. 161.
[10] *Wied. Ann.* 31, p. 970.
[11] *Comptes Rendus*, 57, p. 670.
[12] *Comptes Rendus*, 43, p. 529; 44, p. 1209.
[13] *Journ. Chem. Soc.* 1884, p. 421; 1886, p. 177; 1887, pp. 362 and 808; 1888, p. 561; 1889, pp. 680 and 750; 1891, p. 981; 1892, p. 800; 1893, pp. 75, 99, and 488.
[14] *Wied. Ann.* 44, p. 377.
[15] *Wied. Ann.* 43, p. 280.
[16] *Zeitschrift f. physikal. Chem.* 11, p. 753.
[17] *Phil. Mag.* [5] 3, p. 321.
[18] *Ann. de Chim. et de Phys.* [6] 4, p. 433; 9, p. 65; 10, p. 200.
[19] *Wied. Ann.* 23, p. 228; 27, p. 191.
[20] *Wied. Ann.* 39, p. 25.
[21] *Wied. Ann.* 42, p. 115.
[22] *Phil. Mag.* [5] 12, p. 171.
[23] *Journ. de Phys.* 1884, p. 360.
[24] *Beiblätter zu Wied. Ann.* 1885, p. 275.
[25] *Messungen über d. Kerr'sche Ercheinung.* Inaugural Dissert. Leyden, 1893.
[26] *Phil. Mag.* [5] 5, p. 161.
[27] *Phil. Mag.* [3] 28, p. 469.
[28] *Die magn. Drehung d. Polarisationsebene des Lichts*, Halle, 1863
[29] *Electricity*

and Magnetism, chap. xxi. [30] *Phil. Trans.* 1880 (2), p. 691. [31] *Phil. Mag.* (5) 11, p. 254, 1881. [32] *Arch. Néerl.* 19, p. 123. [33] *Wied. Ann.* 23, p. 493 ; 67, p. 345. [34] *Wied. Ann.* 24, p. 119. [35] *Wied. Beiblätter*, 8, p. 869. [36] *Comptes Rendus*, 108, p. 510. [37] *Phil. Trans.* 182, A. p. 371, 1892 ; *Physical Optics*, p. 393. [38] *Wied. Ann.* 46, p. 71 ; 47, p. 345 ; 48, p. 740 ; 50, p. 722. [39] *Wied. Ann.* 46, p. 353 ; 48, p. 122 ; 49, p. 690. [40] *Recent Researches*, p. 489 *et seq.* [41] *Phil. Trans.* A. 1897, p. 89. [42] *Brit. Assoc. Report*, 1893. [43] *Comptes Rendus*, 127, p. 548. [44] *Bull. de l'Acad. des Sciences Belg.* (3) 9, pp. 327, 381, 1885 ; 12, p. 30, 1886. [45] *Communications from the Physical Laboratory*, Leyden, No. 33, 1896 ; *Phil. Mag.* 43, p. 226 ; 44, pp. 55 and 255 ; and 45, p. 197. [46] *Arch. Néerl.* 25, p. 190. [47] *Phil. Mag.* 45, p. 325 ; 47, p. 165. [48] *Comptes Rendus*, 126, p. 181. [49] *Phil. Mag.* 46, p. 187. [50] *Phil. Mag.* 45, p. 348. [51] *Comptes Rendus*, 125, p. 865. [52] *Comptes Rendus*, pp. 748 and 949, 1897. [53] *Comptes Rendus*, 127, p. 216 ; 128, p. 45. [54] *Physikalische Zeitschrift*, December 1899.

(J. J. T.)

Magnitnaya, a Cossack village of Russia, government of Orenburg, district Verkhneuralsk, on the Ural river. It was formerly a small frontier fort, but, owing to its advantageous position for trade with the Steppes, it has grown into a place of 10,100 inhabitants, and has an important cattle fair.

Magwe, a district in the Minbu division of Upper Burma, with an area of 3331 square miles and a population (1891) of 219,190, and (1901) 246,740, showing an increase of 12·38 per cent., and an average density of 74 inhabitants to the square mile. Magwe may be divided into two portions: the low, flat country in the Taungdwingyi subdivision, and the undulating high ground extending over the rest of the district. In Taungdwingyi the soil is rich, loamy, and extremely fertile. The plain is about 45 miles from north to south. At its southern extremity it is about 30 miles wide, and lessens in width to the north till it ends in a point at Natmauk. On the east are the Pegu Yomas, which at some points reach a height of 1500 feet. A number of streams run from this westwards to the Irrawaddy, and are used for navigation purposes. The Yin and the Pin, which form the northern boundary, are the chief, and receive the others. The only perennial stream is the Yanpè. Rice is the staple product, and considerable quantities are exported. Sesamum of very high quality, maize, and millet are also cultivated, as well as cotton in patches here and there over the whole district.

In this district are included the well-known Yenangyaung petroleum wells. The state wells have been leased to the Burma Oil Company. The amount of oil-bearing lands is estimated at 80 square miles, and the portion not leased to the company has been demarcated into blocks of one square mile, and offered on lease. The remaining land belongs to hereditary Burmese owners called *Twinsa*, who dig wells and extract their oil by the rope and pulley system as they have always done. There are 319 square miles of forest reserves in the district. Lacquered wood trays, bowls and platters, and cart-wheels, are the only industries of any note in the district. There were 759 villages in the district, paying Rs.5,02,694 in 1898–99. Of a total of 1,864,209 acres, 343,765 were cultivated in that year, 255,360 were under forests, 154,898 acres were available for cultivation. There were 56,396 acres of current fallow, and 1,053,790 acres were not available for cultivation. The rainfall in the year 1898–99 was 27·74 inches. The maximum temperature rises to a little over 100° in the hot weather, and falls to an average minimum of 53° and 54° in the cold weather. In 1891 the population was made up of 216,931 Buddhists and Jains, 725 Mahommedans, 714 Hindus, 581 Karens and Chins, and 239 Christians, 142 of whom were natives. *Magwe*, the headquarters of the district, has a population of about 7000.

Mahadev Govind Ranade (1842–1901), native Indian lawyer, educationist, author, and reformer, was born on the 16th January 1842, at Niphâd, in the Nasik district, his family having been for nine generations in state service. When his father was minister at Kolhapur, Mahadev attended the Anglo-vernacular school in that town, and joined the Elphinstone Institute in Bombay at the age of fourteen. Along with Dr Ramkrishna Gopal Bhandarkar, Bal Mangesh Wagle, and Vaman Abaji Modak, all of whom distinguished themselves in after life, he appeared at the first examinations held by the Bombay University (established 1859). He took the degree of B.A. in 1862, M.A. in 1863, and LL.B in 1866 with high distinction, and his teachers, Professor Harkness and Sir Alexander Grant, moved the University to award him special prizes. He was now known as the "Prince of Graduates," and was soon appointed assistant professor at the Elphinstone College, where his learned and thoughtful lectures drew some of the English professors to hear him. Having entered the Government service in 1866 as a translator, he became prime minister of Kolhapur state in 1868, assistant reporter to the Bombay High Court in 1869, presidency magistrate and then fourth judge of the Small Cause Court at Bombay in 1871, first-class sub-judge at Poona and then at Nasik and Dhulia in 1873, and judge of Poona Small Causes Court in 1884, after which, as special judge under the Deccan Agriculturists' Relief Act from 1887, he came into close contact with the difficulties of the agrarian classes. He was raised to be a judge of the Bombay High Court in 1893. In 1886 he was a member of the Finance Committee appointed to report on the expenditure, both imperial and provincial, with a view to retrenchment. This service won him the decoration of C.I.E. He became a member of the legislative council to the governor of Bombay in 1885, and occupied that position until he was raised to the High Court Bench. Being an energetic social reformer, he directed his efforts against infant marriages, the shaving of widows, the heavy cost of marriages and other social functions, and the caste restrictions on travelling abroad. He strenuously advocated widow remarriage and female education, and considered state legislation necessary for the social well-being of the country. He was the father of the Social Conference movement, which he supported till his death. In the political sphere he founded the Poona Sarvajanik Sabha, through which he frequently helped the Government with his sound advice. He was one of the originators of the Indian National Congress, and invariably attended its meetings. In Bombay University, where he held the offices of syndic and dean in arts, he displayed much organizing power and great intimacy with the needs of the student class. Himself a thorough Marathi scholar, he encouraged the translation of standard English works, and tried, with some success, to promote scholarships in vernacular languages by introducing them into the University curriculum. He was one of the managers of the Victoria Technical Institute. By birth a Chitpavan Brahmin, he was reared in the strictest tenets of Hinduism; but his deep religious feeling and trained intellect craved something higher and broader than he could find in the traditional forms and orthodox teaching of his race. The same spiritual want being felt by many enlightened Hindus, he joined with his friends, Dr Atmaram Pandurang, Bal Mangesh Wagle, and Vaman Abaji Modak, in founding a new sect in Bombay known as the "Pearthana Samaj." This community resembles, in all essential points, the Brahmo Samaj of Bengal. Its principles of enlightened theism are based on the ancient Vedas. He married twice, his second wife being Ramabai, an enlightened and accomplished lady, who proved a fitting helpmate to him. He died childless, after a short illness, on the 16th January 1901, at the age of fifty-eight.

It was the task of Mr Ranade and his band of native reformers to guide and direct the rising force of general education in the second half of the 19th century in India in such a way as to preserve what was best in the past and adapt it to the present. He was therefore the friend, guide, and philosopher of all sections and communities, parties and opinions, as he worked on lines of least resistance. It is no exaggeration to say that there was hardly any good movement in the Bombay Presidency, or more or less in the whole of India—political, social, religious, or industrial—that was not welded by his brain and nurtured by his spirit. He could therefore find no time to write any work on a large scale. Still, the annual addresses he delivered before the Social Conference for the fifteen years he was its general secretary, will long remain as landmarks of the intellect, moral courage, and high ideals of educated India, and he was a frequent contributor to the journal of the Poona Sarvajanik Sabha and the journal of the Bombay branch of the Royal Asiatic Society. His essays on Indian economics were published a few years before his death, and shortly before that event he issued a few chapters of the *History of the Mahrattas*—a work of much original research and thought, which had been left to him as a legacy by his pupil and friend Mr Justice K. T. Telang. (N. B. W.)

Mahallát, a small province of central Persia, situated between Kashán and Irák. It has a population of about 20,000, and pays a yearly revenue of about £2500. Until 1890 it was one of the five "central provinces" (the other four being Irák, Ferahán, Kezzáz, and Sávah), which were under a governor appointed by the Shah; since then it has formed part of the Isfahán government. It is traversed by the Anárbár or Kum river, and comprises the city of Mahallát, divided into upper and lower, or Rívkán and Zanjírván, and twenty-two flourishing villages. It was known in former times as Anár, the Anarus of Peutinger's tables. The city, capital of the province, is situated at an elevation of 5850 feet in 33° 51′ N. and 50° 30′ E., and has a population of about 9000.

Mahan, Alfred Thayer (1840–——), American naval officer, strategist, and historian, was born in New York City on the 27th of September 1840. He graduated at the United States Naval Academy, Annapolis, Maryland, in 1859; became lieutenant in 1861, and served on the *Congress*, *Pocahontas*, *Seminole*, and *James Adger* during the Civil War, meanwhile acting as instructor at the Naval Academy for a year. At the close of the struggle he was made lieutenant-commander (commander in 1874), and subsequently, following the usual fortune of a naval officer, saw service in the Gulf of Mexico, the South Atlantic coast, the Pacific, and Asia, and did shore duty at Boston, New York, and Annapolis. In 1885 he became captain, and in 1886 president of the Naval War College at Newport, Rhode Island. Between 1889 and 1892 he was engaged in special service for the Bureau of Navigation, and in 1893 was made commander of the *Chicago*, of the European squadron. In 1896 he retired from active service, but was a member of the naval board of strategy during the war between the United States and Spain (1898), and the Peace Congress at The Hague in 1899. This long and varied service gave him extensive opportunities for observation, which he accompanied by constant study of naval authorities and reflection on the interpretation of the problems of maritime history. His first book was a modest and compact story of the doings in *The Gulf and Inland Waters* (1883), in a series of volumes by various writers, entitled *The Navy in the Civil War;* but in 1890 he suddenly acquired fame by the appearance of his masterly work entitled *The Influence of Sea-Power upon History, 1660–1783.* Having been impressed by the historian Mommsen's failure to allow for the influence of sea-power upon the career of Hannibal, he was led to make prolonged investigations of this general theme, especially for the period of time named in the title. The reception accorded the volume was instant and hearty; in England, in particular, it was deemed almost an epoch-making work, and was studied by naval specialists, Cabinet Ministers, and journalists, as well as by a large part of the general public. It was followed by *The Influence of Sea-Power upon the French Revolution and Empire* (2 vols. 1892); *The Life of Nelson, The Embodiment of the Sea-Power of Great Britain* (1897); and *The Interest of America in Sea-Power, Present and Future* (a smaller and more fragmentary collection of chapters, 1897). The author's general aim in these works—some of which have been translated into French, German, and Japanese—was to make the consideration of maritime matters paramount to that of military, political, or economic movements, without, however, as he himself says, "divorcing them from their surroundings of cause and effect in general history, but seeking to show how they modified the latter, and were modified by them." He selected the year 1660 as the beginning of his narrative, as being the date when "the sailing-ship era, with its distinctive features, had fairly begun." The series as a whole has been accepted as finally authoritative, supplanting its predecessors of similar aim, and almost—in the words of Theodore Roosevelt—founding a new school of naval historical writing. Lesser works by the author are a *Life of Admiral Farragut* (1892), and a collection of articles grouped under the title of *Lessons from the Spanish War, and other Papers* (1899). Captain Mahan, in addition to other honours, received the degree of D.C.L. from Oxford, and that of LL.D. from Cambridge.

Mahanoy City, a borough of Schuylkill county, Pennsylvania, U.S.A., in the valley of Mahanoy river, in the eastern part of the state, at an altitude of 1240 feet. It has a level site, on which it is laid out regularly. It is on branches of the Lehigh Valley and the Philadelphia and Reading railways. Mahanoy is in the anthracite coal region, is surrounded by mines, and its industries are closely associated with mining and shipping coal. Population (1890), 11,286; (1900), 13,504, of whom 3877 were foreign-born.

Mahi Kantha, a political agency or collection of native states in India, within the Gujarat division of Bombay. The number of separate states is thirty-nine, many of which are under British administration. The only important one is Idar. Total area, 9300 square miles. Population (1881), 517,485; (1891), 581,568; (1901), 361,508, showing an increase of 12 per cent. between 1881 and 1891, but a decrease of 37·8 per cent. between 1891 and 1901; average density, 39 persons per square mile; estimated gross revenue, Rs.12,69,453, of which Rs.82,194 were expended on public works in 1897–98; tribute (mostly to the Gaekwar of Baroda), Rs.1,43,743; number of stipendiary police, 1723, maintained at a cost of Rs.1,89,126; number of schools, 105, with 6911 pupils. Many of the inhabitants belong to the wild tribes of Bhils and Kolis. In 1897 a metre-gauge railway was opened from Ahmedabad through Parantij to Ahmednagar; total length, 55 miles. At Sadra (population, 1839), is the Scott College for the education of the sons of chiefs on the lines of an English public school. In 1896–97 there were 35 boys, maintained at a total cost of Rs.3,135. There are also Anglo-vernacular schools at Sadra, Idar, and Mansa. The famine of 1899–1900 was severely felt in this tract.

Mahommed Ahmed [The Mahdi] (1848–1885), the Sudanese tyrant, was born in Dongola in 1848. He was at first in the Egyptian Civil Service, but had disputes with his superior officials, and then took up slave-dealing. He settled on Abba Island, and acquired a reputation for sanctity which he used for stirring up disaffection with Egyptian rule. The Egyptian officials attempted to suppress him, but a force sent in 1881 for that purpose was resisted and defeated, and Mahommed Ahmed proclaimed himself the *Mahdi* (or Messiah), being assisted by Abdullah (*q.v.*) as his *Khalifa* or vicegerent. The revolt in the Sudan spread, and the Mahdi was soon at the head of a powerful force; and 6000 Egyptian troops under Yusef Pasha, advancing from Fashoda, were nearly annihilated in June 1882. By the end of 1882 the whole of the Sudan south of Khartum was in rebellion, with the exception of the Bahr-el-Ghazal and the Equatorial Provinces. In November 1883 General Hicks's force of 10,000 men was destroyed at Kashgil, and in the same year the Mahdi's lieutenant, Osman Digna, raised the tribes in the eastern Sudan, and besieged Sinkat and Tokar, near Suakin, routing General Baker's force of 2500 men at El Teb. The military operations undertaken by Great Britain in face of this state of affairs are narrated under EGYPT. It need only be added here that General Gordon (*q.v.*) was entangled at Khartum, and that he was killed and Khartum captured by the Mahdists on 26th January 1885. The Mahdi himself died at Omdurman a few months later (22nd June 1885), and was succeeded in power by the Khalifa, Abdullah.

Mahommedan Law.—The Mahommedan law is always spoken of by Mahommedans as a sacred law, and as contained in the Koran. But the Koran itself could not have supplied the wants even of the comparatively rude tribes to whom it was first addressed. Still less has it proved sufficient to satisfy the requirements of successive generations. No doubt the great veneration which Mahommedans have for the Koran has caused them to be less progressive than members of other religious creeds. But in human affairs some change is inevitable, and the law of the Koran, like other sacred laws, has had to undergo the supplementary and transforming influence of custom and interpretation, though not of legislation. This direct method of changing the law by human agency, natural and simple as it appears to us, is scarcely acknowledged by Orientals even in the present day, except in the rare instances in which it has been forced upon them by Western authority. But besides custom and interpretation, another influence of a special kind has been brought to bear upon Mahommedan law. Besides those utterances which the Prophet himself announced as the inspired message of God, whatever he was supposed to have said and whatever he was supposed to have done have been relied upon as furnishing a rule for guidance. This tradition (*sunnah*) is only to be accepted if it can be traced up to a narrator at first hand, though it would be rash to say that the chain of evidence is always very strong. Mahommedans also, in support of a legal rule for which there is no direct authority, resort to the argument from analogy (*kiyas*). The principle involved in a rule for which authority can be quoted is extended so as to cover other analogous cases. There have also been accepted amongst Mahommedans, as authoritative, certain opinions on points of law delivered by those who were actual companions of the Prophet; these opinions are spoken of collectively under the name of *ijmaa*. Some of these methods of extending and modifying the law have produced changes which it would be very difficult to reconcile with a strict adherence to the language of the Koran.

Still, so far as it speaks at all, the text of the Koran remains the basis of Mahommedan law; and probably the Koran has had more practical effect on the lives and actions of those who accept it than any other revelation accepted by a portion of the human race as inspired. In comparison with the Jewish or Vedic scriptures, the Koran may be properly described as a modern book. We know exactly when, where, and how it was produced. The divine message was not written down by the Prophet himself. Some passages may have been written down at the time they were delivered by his hearers; others were committed to memory. But a written collection was begun shortly after the Prophet's death (A.D. 632), and was completed within three years of that event. Fifteen years later, however, it being found that there were already considerable differences between the various copies of the Koran then in existence, a recension of the text was ordered, and measures were taken to destroy all previous copies as spurious. The authenticity of the text then constructed has never been seriously disputed. Whether in the operation of gathering together the scattered fragments from "palm leaves, skin, bladebones, and the hearts of men," and in preparing them for publication, the exact words used by the Prophet may not have undergone some change, it would be difficult to say. Having regard to the circumstances above stated, it is not surprising to find that the development of the Mahommedan law has not, in the great variety of peoples who have accepted the Mahommedan faith, proceeded always upon the same lines. Naturally also political differences have not been without their influence in these divergences of opinion, and of these political differences the most important of all was that which split the whole of Islam into the two great divisions of Sunnis and Shiahs. These terms represent the two great parties into which Mahommedans were divided by the disputes as to the succession to the caliphat, which commenced very shortly after the death of the Prophet. These disputes culminated in the massacre of the descendants of Ali, the son-in-law of the Prophet, and the fourth caliph, by Yezid, who represented the rival or Omeyyad line. But the defeated party were not entirely destroyed, and, under the name of Shiahs, have still maintained their authority. Other Mahommedans, to distinguish them, are called Sunnis, and, except in Persia, the Sunnis are the prevailing sect, the Shiahs only being found elsewhere in scattered families. The dynastic quarrel which gave rise to the schism has long been dead; the memory of it only survives in the anniversary of the Mohurrum, when Mahommedans still bewail the massacre of more than twelve hundred years ago. But the doctrinal differences involved in it still survive, and the legal systems of the Sunnis and Shiahs differ in many important particulars. The Sunnis themselves are divided into four great sects or schools, each being called after the most conspicuous early exponent of its doctrines. These are the Hanafite school, called after Hanafa, who died in 702; the Malikite school, called after Malik-Ibn-Anas, who died in 812; the Shafaite school, called after Mahommed-as-Shafi, who died in 826; and the Hanbalite school, called after Ahmad-Ibn-Hanbal, who died in 863.

Sunnis and Shiahs.

Of the various existing forms of Mahommedan law, the one that has attained the greatest degree of coherence is that which prevails in India. Mahommedan law is administered in India to more than sixty millions of Mahommedans. If reference is made to the article HINDU LAW, it will be seen how it was that the Mahommedan law came to be administered by British courts of justice in India. The legislative enactments there quoted do not indicate exactly the limits of the application; practically the topics to which it is applied are the family relations, ownership, succession, and those religious questions in which civil rights are also involved. The Mahommedans of India generally are Sunnis of the Hanafite school. The two principal authorities on Mahommedan law to which recourse is had by the courts in India are the Hedaya and the Futwa Alumgiri. The Hedaya was translated into English by Mr Hamilton. The Futwa Alumgiri was compiled under the orders of the Emperor Aurungzib Alumgir. It is a collection of the opinions of learned Mahommedans on points of law. It has not been translated, but it forms the basis of the *Digest of Mahommedan Law* compiled by Mr Neil Baillie. The Mahommedan law, like the Hindu law, is a personal law. It is essentially so in its nature. Persons of any other religion are to a large extent outside its pale. And in India, in civil matters, its application has been expressly limited to Mahommedans. At one time endeavour was made to administer the Mahommedan criminal law as the general territorial law of India, but it had constantly to be amended, and it was at length abolished and the penal code substituted. To be a Mahommedan, and so to claim to be governed by the Mohammedan law, it is necessary to profess the Mahommedan faith.

Intestate succession.

All that we find on the subject of intestate succession in the Koran are certain directions as to the shares which certain members of the family are to take in the estate of their deceased relative. So far as they go, these are rules of distribution—that is to say, they depend, not on consanguinity only, but on certain equitable considerations, by which rules founded on consanguinity are modified. But these latter rules, though nowhere laid down in the Koran, still play a large part in Mahommedan law. There can be no doubt that they represent the pre-existing Arabian custom, which it was not the intention of the Prophet to displace, but only to modify. The claimants under these rules take whatever is left after the specific shares assigned by the Koran to individual members of the family have been satisfied; if in any case there are no such shares, they take the whole. The Arabic term for this class of heirs is *asabah*, which literally means persons connected by a ligament. The term used by English writers is "residuaries," but this description of them has the disadvantage that it entirely loses sight of the connexion on which the claim to succeed is based. They would be more correctly described as the "agnates" of the deceased, but the term "residuaries" is too firmly established to be displaced. Those persons who take a share of the property, under the specific rules laid down in the Koran, we call "sharers," and this word has acquired a technical meaning; it is not used to describe those who can claim a portion of the estate in any other way. It is hardly likely that females, or relatives through females, had any claim to the succession under any Arabian custom, nor, except so far as they are made sharers, are they recognized by the Koran as having a title to succeed. The proper description of this class of persons is *zavi-ul-arham, i.e.,* "uterine kindred," and they have, in default of other heirs, established a claim to succeed. English writers have erroneously called them "distant kindred," but distance has nothing to do with the matter.

There is no right of primogeniture under Mahommedan law; there is a general preference of males over females, and if males and females take together as residuaries by an express provision of the Koran, each male takes as much as two females. Females are also expressly forbidden by the Koran to take more than two-thirds of the property; but in the application of these two rules the shares of the mother and the wife are not included. No person can claim to take any portion of the property who traces his relationship to the deceased through a living person, but this rule does not apply to brothers and sisters whose mother is alive. If several persons all stand in the same degree of relationship to the deceased, they take equally, *per caput* and not *per stirpem.*

It will now be convenient to state the rules for finding which of the agnates take as residuaries of the deceased. These are, in ordinary circumstances, the male agnates only, and the rule in question depends upon a classification of the male agnates which is common in other parts of the world. Every family consisting of several generations of male agnates may be broken up into groups, each of which has a separate common ancestor of its own. Thus, suppose A to be the person from whom the descent is to be traced. A belongs to a large group of persons, all of whom are males descended from a common ancestor D. But A and his or her own male descendants form a smaller group, which we may call the group A. This is the first class of male agnates of A. Then suppose A to be the son or daughter of B, excluding those who are descendants of A, and as such included in the first class, the remaining male descendants of B will form the second class of male agnates of A. In like manner we get a third class of male agnates of A who are descendants of C, excluding those who are descendants of A or B; and a fourth class of male agnates of A who are descendants of D, excluding those who are descendants of A, B, or C. This classification can obviously be carried through as many generations as we please. Mahommedan lawyers adopt this classification with only one difference. Between the first and second classes they interpose a class consisting entirely of the direct male ancestors, which they call the "root," so that the male descendants of A (the person whose heirs are in question) would be the first class of residuaries. B, C, D, &c. would be the second class of residuaries; the male descendants of B, other than the descendants of A, would be the third class of residuaries; the male descendants of C, other than the descendants of B and A, would be the fourth class of residuaries, and so on. In order to find the residuaries who are to succeed, we have only to take the classes in their order, and of the highest class which is represented to select the nearest to the deceased. If there are several who are equidistant, they will take equally *per caput.*

The sharers are, of course, those to whom a share is assigned by the Koran. They are (1) the father, (2) lineal male ancestors, whom Mahommedans call the "true grandfathers," (3) uterine half-brothers, *i.e.,* the half-brothers by the mother, (4) daughters, (5) daughters of a son, or other direct male descendant, whom we call daughters of a son how low and soever, (6) the mother, (7) true grandmothers, *i.e.,* female ancestors into whose line no male except a lineal male ancestor enters, (8) full sisters, (9) consanguine half-sisters, *i.e.,* half-sisters by the father, (10) uterine half-sisters, (11) the husband, (12) the wives. The right to a share and the amount of it depends upon the state of the family. Under Mahommedan law not only, as elsewhere, the nearer relative excludes the more remote, but there are special rules of total or partial exclusion arising out of the equitable considerations upon which all rules of distribution are based.

These rules are best shown by taking the case of each member of the family in turn, and at the same time it will be useful to explain the general position of each member. First, the sons. They take no share, but they are first in the first class of residuaries, and their position is a very strong one; they exclude entirely sisters and daughters from a share, and they reduce considerably the shares of the husband, the widows, and the mother. The position of the other male descendants is very similar to that of the sons. They are not sharers; they are residuaries of the first class, and will take as such if the intermediate persons are dead. They reduce the shares of some of the sharers, but not to the same extent as the sons. The father is a residuary of the second class, and the first in that class. But he is also a sharer, and as such is entitled to a share of one-sixth. He can take in both capacities. The father's father is also a residuary of the second class, and he is a sharer, entitled to a share of one-sixth, but of course he cannot take either as sharer or residuary if the father is alive. The position of any true grandfather is analogous. An only daughter takes as sharer one-half of the property, two or more daughters take one-third between them. But sons exclude daughters from a share, and they would get nothing. Naturally this was considered unjust, and a remedy has been found by making the daughters what are called "residuaries in right of their brothers," each daughter taking half of what a son takes. The mother gets a share of one-sixth when there is a child of the deceased, or a child of any son how low and soever; also when there are two or more brothers or sisters. In any other case her share is one-third. If, however, the wife, or the husband (as the case may be), and the father are alive, the share of the mother is only one-third of what remains after deducting the share of the husband or the wife. The brother is never a sharer. He is a residuary of the third class, and he excludes some sharers. The daughters of a son how low and soever get a share of two-thirds between them if there are several; if there is only one she gets one-half. But the daughters of a son are excluded by any direct male descendant who is nearer to the deceased than themselves, or at the same distance from him. If, however, they are excluded by a person who is at the same distance from the deceased as themselves, Mahommedan lawyers again say that they come in as residuaries in right of that person, each female as usual taking half as much as each male. Of course the daughters of a son may also be excluded by the daughters having exhausted the two-thirds allotted to females. A single sister takes a share of one-half; several sisters take two-thirds between them. Sisters are excluded from a share by any residuary of the first class, and their own brothers also exclude them, but in the latter case they take as residuaries in right of their brothers, each sister taking half what a brother takes. So, again, the sisters may be excluded from a share by the daughters or daughters of sons having exhausted the two-thirds allotted to females, and the residue would go to the nearest male agnate—that is, the uncle or the nephew of the deceased, or some more distant relative. To prevent this Mahommedan lawyers say that in this case the sisters are residuaries, basing their assertion upon a somewhat vague tradition. The share of the husband in the property of the wife is one-fourth if there are surviving children, one-half if there are none. The share of the widow in the property of her deceased husband is one-eighth if there are surviving children, one-fourth if there are not. The nearest true grandmother takes a share of one-sixth. If there are several equidistant, they take one-sixth between them. The uterine half-brothers take a share of one-third when there is only one, but they are excluded by any direct descendant and by any direct male ascendant. Uterine half-sisters are in the same position as uterine half-brothers. Consanguine half-brothers are residuaries of the same class as brothers, but only take in default of full brothers. Consanguine half-sisters take a share of two-thirds, or if there is only one she takes a share of one-half. But if there is a full sister also, the full sister takes one-half, and the consanguine sisters one-sixth between them. The consanguine half-sisters, like the full sisters, are excluded from a share by the children and the father of the deceased, and also by full brothers and consanguine brothers; but in the last case they come in again as residuaries, taking half what a brother takes.

The sharers must, of course, unless excluded, be all satisfied before anything is taken by the residuaries. But the sharers may not only exhaust the property; there may not be enough to satisfy all the claimants. Thus, if a man died leaving a wife, a mother, and two daughters, the shares are one-fourth, one-sixth, and two-thirds, and the sum of the shares being greater than unity, they cannot all be satisfied. The difficulty is met by decreasing the shares rateably, in other words, by increasing the common denominator of the fractions so as to produce unity; hence the process is called the "increase." The converse case arises when the shares of the sharers do not exhaust the property, but there are no residuaries to take what remains. It has been doubted whether the residue does not fall to the Government as *bona vacantia*. But it is now settled that the surplus is to be divided rateably amongst the sharers in proportion to their shares. The process is called the "return." The husband and the wife are excluded from the benefit of the return. If there are no sharers, the whole estate will go to the residuaries. If there are neither sharers nor residuaries, it will go to the (so-called) distant kindred. Their claim is strong on equitable grounds, as some of them are very near relations; such, for example, as a daughter's children or a sister's children. Nevertheless their claim has been doubted, and it must be admitted that there is no very clear ground upon which it can be based. They are not mentioned as sharers in the Koran, and it is not very clear how, as cognates, they could have been recognized by any ancient Arabian custom. However, their claim is now well established, and, in default of both sharers and residuaries, they succeed on a plan somewhat resembling that on which male agnates are classified as residuaries. If all the claimants fail the property goes to the Government, but there is one peculiar case. Supposing a man dies leaving a widow, or a woman dies leaving a husband, and no other relative. There is then a residue and no one whatever to take it, as the husband and wife are excluded from the return. Strictly speaking it would fall to the Government as *bona vacantia*, but the claim is never made, and would now be considered as obsolete, the husband or wife being allowed to take the property.

Under Mahommedan law there are certain grounds upon which a person who would otherwise succeed as heir to a deceased person would be disqualified. These grounds are—(1) that the claimant slew the deceased by an act which, under Mahommedan law, would entail expiation or retaliation, and this would include homicide by misadventure; (2) that the claimant is a slave; (3) that he is an infidel, *i.e.*, not of the Mahommedan faith. The second impediment cannot now have any application in India; the third has been removed by Act 21 of 1850. There is a rule of Mahommedan law that if two persons die in circumstances which render it impossible to determine which died first, as, for example, if both went down in the same ship, for the purposes of succession it is to be assumed that both died simultaneously.

Testamentary succession.

Mahommedan lawyers appear always to have recognized the validity of wills, and they are said to be recognized by a passage in the Koran. But the power of testamentary disposition is restricted within very narrow limits. It only extends to one-third of the property after the payment of debts and funeral expenses. There is no hint of this restriction in the Koran, and it rests upon tradition. If the one-third has been exceeded the legacies must be reduced rateably. The heirs, however, by assenting to the legacies, may render them valid even though they exceed the prescribed amount.. There is no restriction as to the form of making a will; it may be either oral or written. A legacy cannot be given to an heir. Mahommedan law contains some very simple and wise provisions for preventing the reckless and often unjust dispositions of property which persons are apt to make upon the approach of death. A man who is "sick," that is, who is suffering from illness which ends in death, can only give away one-third of his property; and if he has also made a will containing legacies, the gifts and the legacies must be added together in the computation of the disposable one-third. So long as slaves had a money value, the value of the slaves liberated by a man on his deathbed was also included, which reminds us of the *Lex Furia Caninia* of the Roman law. Another transaction by which the restriction on the testamentary power might be eluded is that called *mohabat*. By this is meant a transaction in the form of a sale, but which, from the inadequacy of the price named, is obviously intended as a gift. If such a transaction is entered into during "sickness," the loss to the estate would have to be reckoned in computing the disposable one-third. But the *mohabat* transaction takes precedence of legacies. Another obvious mode of eluding the restriction on the testamentary power is the acknowledgment by a man on his deathbed of a fictitious debt; and it would seem that such acknowledgments ought to have been put under restriction. But Mahommedans, like other Orientals, have a useful, though possibly a superstitious, dread of leaving the debts of a deceased person unpaid, and it is this, no doubt, which has prevented their questioning the deathbed acknowledgment of a debt, even though there is every reason to believe it to be fictitious. All that has been done is to prescribe that debts of health should be paid before debts of sickness, and that debts cannot be acknowledged by a sick man in favour of an heir.

Administration.

When a Mahommedan dies, the funeral expenses and the creditors must first be paid; then the legatees, then the claims of the sharers, and, lastly, those of the residuaries; or, if there are neither sharers nor residuaries, those of the (so-called) distant kindred. The administration of the estate need present no difficulties if there are no disputes, and if there is some one empowered to take possession of the property, to get in the debts, to satisfy the creditors, and distribute the assets amongst the various claimants; and such a person may be appointed by a Mahommedan in his will, who will perform these duties. He is called a *wasi*, and he is in a position very similar to an executor under English law. But if there is no *wasi*, even if there are no disputes, there may be a good deal of trouble. It would have been in accordance with the spirit of Mahommedan law, and with general principles of equity, if an officer of the courts established under British rule had been regularly empowered to take possession of the property, and to take such measures as were necessary to ensure all the claimants being satisfied in their proper order. But this view of their powers has not been taken by the courts in India; recently, however, they have been enabled by legislation to grant the power of administering the estate to a single person.

Fictitious relationships.

There is scarcely any part of Europe or Asia where the creation of fictitious relationships is altogether unknown. In many cases the object of the creation is simply to obtain an heir. This is the object of adoption amongst modern Hindus, and it is this, no doubt, which has led some persons to speak of Hindu adoption as a rudimentary will. But adoption, as such, has never obtained a footing in Mahommedan law. The fictitious relationships which that law recognizes are based upon a different idea. There was in early times a widespread notion that every man must belong to some family either as a freeman or a slave. The family to which a slave belongs is always that of his owner, and that of a freeman is generally indicated by his birth. But a liberated slave has no family, at least no recognized family; and as he cannot stand alone, it was necessary to attach him to some family. Now, just as in Roman law the freedman became a member of his master's family under the relationship of *patronus* and *cliens*, so in Mahommedan law a liberated slave becomes a member of the master's family under the relationship called *mawalat*. The object, of course, was to make the master's family liable for the consequences of the wrongful acts of the freed slave. As a compensation for the liability undertaken by the master's family, in default of residuaries of the slave's own blood (who can only be his own direct descendants), the master's family are entitled to succeed as what are called "residuaries for special cause." Of course the relationship of master and slave cannot now be created, and it is scarcely probable that any case of inheritance could arise in which it came into question. The relationship of *mawalat* may, under Mahommedan law, also be created in a case where a freeman is converted to Islam. From a Mahommedan point of view he then stands alone, and would be required to attach himself to some Mahommedan family. The form of the transaction exactly indicates the nature of it. The party wishing to attach himself says to the person ready to receive him, "Thou art my kinsman, and shalt be my successor after my death, paying for me any fine or ransom to which I may be liable." In this case also the family of the person who receives the convert is entitled, in default of other residuaries, to succeed to him as "residuaries for special cause." But this transaction can have no meaning under English law, which does not recognize the joint responsibility of the family, and it is therefore also obsolete. In the case of *mawalat* the rights of the persons concerned are not reciprocal. The person received gains no right of inheritance in the family into which he enters, and incurs no responsibility for their acts. An important part may still be played in Mahommedan law by the creation of relationships by acknowledgment. Any such relationship may be created, provided that the parentage of the person acknowledged is unknown; a person of known parentage cannot be acknowledged. The age, sex, and condition of the person acknowledged must also be such that the relationship is not an impossible one; for, as was said in the Roman law, *fictio naturam imitatur*. The relationship thus constituted is, in the case of a father, mother, child, or wife, complete, and must be treated for all purposes as having a real existence. But in any other case the acknowledgment, although good as between the parties thereto, has no effect upon the rights of other parties. The acknowledgment which we have just been considering contemplates the possibility at any rate, and in most cases the certainty, that the relationship is entirely fictitious, and has no connexion with any rule of evidence in whatever sense the term is understood. But there is a rule of Mahommedan law that, in cases where the paternity of a child is in dispute, the acknowledgment of the child by the father is conclusive. Whether this would now be maintained in face of the Evidence Act, 1870, which deals with cases of conclusive evidence, and expressly repeals all previously existing rules of evidence, may be doubtful.

Marriage.

Marriage is a transaction based upon consent between a man and a woman, or between persons entitled to represent them. The result of the transaction is that certain family relationships involving legal rights and duties are created by the law, and these are not wholly under the control of the parties. But as to some of them, to some extent they may be regulated by agreement, and it is customary amongst Mahommedans at the time of a marriage to come to such an agreement. The only condition necessary to the constituting of a valid marriage between persons of full age is the consent of the parties. It is, however, the practice to conclude the transaction in the presence of two males, or one male and two female witnesses; and the omission of this formality would always throw a doubt upon the intention of the parties finally to conclude a marriage. It is even said that the absence of such witnesses would justify a judge in annulling the marriage. Minors of either sex may be given in marriage by their guardian, and the transaction will be irrevocable if the guardian be the father or any direct male ascendant. In any other case the marriage may be repudiated when the minor arrives at the age of puberty, but the repudiation is not effectual until confirmed by a judge of the civil court. A marriage may be conducted through agents. A woman can have only one husband; a man can have four wives; if he married a fifth the marriage would be annulled by a judge on the application of the woman. Mahommedans have a table of prohibited degrees within which parties cannot marry not very dissimilar to that in force in Great Britain. Nor can a man be married at the same time to two women nearly related to each other, as to two sisters. It is also considered that if a woman take a child to nurse she contracts a sort of maternity towards it, and that if a boy and girl are nursed by the same woman they become brother and sister, and, in a general way, it is said "that whatever is prohibited in consanguinity is prohibited in fosterage"; but it is doubtful whether the law goes so far. The widow, or a divorced woman, is not allowed to marry again during her *iddut*. This is a period of chastity which a woman is bound to observe in order to avoid confusion of issue. If she is pregnant it lasts until the child is born; if not, then in case of divorce it lasts through three periods of menstruation; if she is a widow it lasts for four months and ten days. A Mahommedan man cannot marry an idolatress, but Jews and Christians are not thereby excluded, because, although infidels, they are not idolatresses. A woman is forbidden by Mahommedan law to marry any one who is not a Mahommedan; but if the marriage took place in conformity with the Act of 1872 it might be valid, if it amounted to a repudiation by the woman of her Mahommedanism. It is important to remember, when considering the validity of a Mahommedan marriage, that a distinction is drawn between marriages which are simply void (*batil*) and those which can only be annulled by judicial decision (*farid*), for such a decision has no retrospective effect, so that the children already born are legitimate; and if no step is taken to obtain such a decision during the existence of the marriage, it cannot be questioned afterwards. What marriages are absolutely void, and what are only capable of being declared void, is not very clearly settled, but the evident leaning of Mahommedan law is against absolute invalidity, and there is strong authority for the opinion that no marriages are absolutely void except a marriage by a woman who has a husband living and such as are declared to be incestuous.

Divorce.

A Mahommedan has the absolute right to divorce his wife whenever he pleases without assigning any reason whatever for doing so. There are, however, very strong social reasons which have considerable influence in restraining the arbitrary exercise of the power. The power to divorce remains notwithstanding any formal promise by the husband not to exercise it, and it is even said that a divorce pronounced in a state of intoxication, or by a slip of the tongue, or under coercion, is valid. The divorce can, however, be revoked by the husband, but not after it has been three times pronounced, or after the *iddut* has been passed by the woman. Nor can the husband remarry his divorced wife unless she has been again married, and has been again divorced or become a widow, and the intermediate marriage must have been consummated. The power to divorce a wife may be entrusted by the husband to an agent acting on his behalf, and this contrivance is sometimes made use of to enable a woman's friends to rid her of her husband if he ill-treats her. The husband may even empower the wife to divorce herself. If the husband or the wife should happen to die whilst the divorce is still revocable, he or she will inherit; and even a triple repudiation pronounced during "sickness," that is death-sickness, will not deprive the woman of her inheritance if the *iddut* has not been passed. Of course there is nothing to prevent the husband and the wife from agreeing to a divorce, and to the terms on which it is to take place, and such an arrangement is very common. The treatment of the wife by the husband is not a ground upon which the marriage can be dissolved, but the impotence of the husband is a ground of dissolution. The courts in India consider that they have the power under Mahommedan law to grant a decree for the restitution of conjugal rights.

Dower.

Dower in Mahommedan law is in the nature of a gift from the husband to the wife on the marriage, like the *donatio propter nuptias* of the Roman law, or the *morgengabe* of Teutonic nations. It may be either "prompt," that is, payable at once, or the payment of it may be deferred, or it may be partly the one and partly the other. The amount of the dower and the time of payment ought to be settled by agreement before the marriage takes place; if this is not done there is some trouble in ascertaining the rights of the parties. It seems clear that a woman is entitled as a matter of right to what is called a "proper" dower. If the dower is payable at once the woman may, before consummation, refuse herself to her husband unless it is paid; whether she can do so after consummation is doubtful. If the husband capriciously repudiates the wife before consummation, or the wife before consummation repudiates the husband for his misconduct, then half the dower agreed on must be paid. If it is her misconduct which has caused the repudiation, she is not entitled to anything. Deferred dower becomes payable on the dissolution of the marriage either by death or by divorce. Probably a judge, when called upon to dissolve or annul a marriage, could make reasonable stipulations as to the dower. The dower is the wife's own property, and, as the wife is entirely independent of the husband in regard to her property, she can sue him or his representatives for the dower like any other creditor. Mahommedans generally before marriage enter into a formal contract which regulates not only the dower, but various other matters under the control of the parties, such as the visits the wife is to pay or receive, the amount of liberty which she is to have, and so forth.

Pre-emption.

The right of pre-emption under Mahommedan law is the right of a third person, in certain circumstances, to step in and take the place of a buyer, at the same price and on the same conditions as the buyer has purchased. It applies only to the purchase of real property, and it can only be exercised upon one of the three following grounds:—(1) That the claimant is owner of property contiguous to that sold; (2) That he is a co-sharer in the property of which a share is being sold; (3) that he is a participator in some right over the property, such, for example, as a right of way over it. The claimant must announce his claim as soon as he hears of the sale, and he must follow up this announcement by a further claim in the presence of witnesses and of the seller, or, if possession has been transferred, of the buyer.

Mahommedan law, so far as it is administered by the courts of British India for Sunnis of the Hanafite school—that is, for the great bulk of Mahommedans—has attained a fair degree of precision, owing to the care bestowed on their decisions by the judges of those courts, and the assistance derived from Mahommedan lawyers.

Shiah system.

But much difficulty is experienced as soon as we come to deal with Mahommedans of any other description. No doubt in India any clearly-established custom prevalent amongst a well-defined body of persons would be recognized, or any rule of law founded upon texts which they accepted as authoritative. But it is not always easy to determine when these conditions have been satisfied. And to allow Mahommedans to set up a standard of rights and duties different from that of the bulk of their correligionists without this proof would lead not only to confusion but injustice. There is the further difficulty that Mahommedan law, as applied to any Mahommedans except those of the Hanafite school, has as yet been comparatively little studied by modern lawyers, so that very little that is certain can be said about it. There is, however, a considerable body of Shiahs in India whose legal system undoubtedly differs in some material particulars from that of the Sunnis. The Mahommedans of Oudh are generally Shiahs, and Shiah families, mostly of Persian descent, are to be found in other parts of India. The following points seem clear. A marriage which the parties agree shall last for a fixed time, even for a few hours only, is a valid marriage, and at the expiration of the time agreed on the marriage ceases to exist. The relatives of the deceased, whether male or female, and whether tracing their connexion through males or females, may be sharers or residuaries. Both as sharers and residuaries the children can claim to take the place of their parents in the succession upon the principle of what we call representation. If there are parents or descendants of the deceased, and the sharers do not exhaust the property, the surplus is distributed amongst the sharers of that class in proportion to their shares. If the property is not sufficient to pay in full the shares of all the sharers, the shares do not abate rateably; *e.g.*, as between daughters and the parents, or the husband, or the wife of the deceased, the whole deduction is made from the daughters' share.

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Maidenhead, a municipal borough and market-town in the Wokingham parliamentary division of Berkshire, England, on the Thames, 24½ miles west of London by rail. A technical school has been opened; the remains of a Roman villa have been discovered in the neighbourhood; a richly-wooded recreation ground (14 acres) and Kidwells Park (12 acres) have been presented to the town. Population (1881), 8220; (1901), 12,980.

Maidstone, a municipal and parliamentary borough and the county town of Kent, England, in the Medway parliamentary division of the county, 47 miles south-south-east of London by rail, on the river Medway. It is the headquarters of a military district. The Bently Art Gallery was presented to the town in 1890, and the West Kent and General Hospital extended. There are an oil mill, rope, sacking, and twine factories, and cement, lime, and brick works. Famous hop gardens are in the district. Population (1881), 29,623; (1901), 33,516.

Maihar, a native state of Central India, in the Baghelkhand agency. Area, about 400 square miles. Population (1881), 71,709; (1891), 77,546, showing an increase of 8·1 per cent. The estimated revenue is Rs.71,000. The number of schools in 1897–98 was 8, with 247 pupils. The chief, whose title is Raja, is a Hindu of the Jogi sect. The state suffered severely from famine in 1896–97. The town of MAIHAR (about 6500) is on the East Indian railway, 97 miles north of Jubbulpore.

Maimansingh. See MYMENSING.

Maine, the most north-easterly state of the American Union, and by far the largest of the New England states. The development of its resources since 1880 has not produced much change in the tendency of its population, which in 1890 was 661,086, and in 1900 was 694,466, an increase of 5 per cent. The total land surface of the state is about 29,895 square miles, and the average number of persons to the square mile was therefore 22·1 in 1890 and 23·2 in 1900. The death-rate in 1900 was 17·5. There were in 1900 twenty-five places having a population of more than 4000 inhabitants each and a total population of 251,685. The urban population in 1900, including in this class all persons in cities of more than 8000 inhabitants, was 164,639, or 23·7 per cent. of the total population, as compared with 130,346, or 19·7 per cent., in 1890. There were in 1900 nine of such cities, of which the most important, with their population, were: Portland (50,145), Lewiston (23,761), and Bangor (21,850). Of the total population in 1900, 350,995 (50·5 per cent.) were males and 343,471 were females; 601,136 (86·6 per cent.) were native-born, and 93,330 foreign-born; 692,226 (99·7 per cent.) were white, and 2240 (only 0·3 per cent.) coloured, including 1319 negroes, 119 Chinese, 4 Japanese, and 798 Indians. Of the total native-born population, it is calculated that 588,000 were Maine-born. There were 215,000 Maine-born people residing in other states. Of the total foreign-born, it is estimated that 53,000 were from the adjacent British provinces, and 11,500 from Ireland. The French-speaking population numbers about 50,000. They are of two quite distinct classes. One, numbering about 15,000, includes those who became citizens by the establishment of the northern boundary in 1842, and their descendants. They are largely of Acadian stock, are good citizens, feeling pride in their allegiance to the Union, and are coming more and more under the influence of the public schools. The state has established among them a well-appointed training school for teachers, conducted in the English language, the graduates of which render excellent service in the common schools. The other class is of French-Canadian immigrants, who find profitable employment in the manufacturing centres. With their savings they are building homes and buying abandoned farms. Very few have any desire to return to Canada, or any thought of establishing a "French Empire" in New England. At the same time, their numbers are felt in the communities where they reside, and as they show a disposition to become naturalized citizens, their political weight is considerable. Parochial schools are encouraged by their Church, the Roman Catholic, but the young people incline towards the public schools. The colony of Swedes established by the state near its north-eastern border in 1869 has proved in every way successful. These people, who number about 2000, are already in sympathy with American institutions, and their steady increase will go far to make good the loss by removal of some of the best native stock. The shores of Maine, as also its lakes and woods, have become great resorts for tourists and summer residents. It is estimated that these sojourners number 250,000 annually, and that their expenditure in the state amounts to $12,000,000.

Public Works.—The United States Government has done much in deepening harbours and river channels, removing obstructions, and marking the approaches by lights, buoys, and beacons. The state has provided for a thorough topographical survey, in co-operation with the surveys by the United States. The general government has also given special attention to coast and harbour defences. Obsolete works have been replaced by modern fortifications of the most effective order. The defences of the approaches to Portland have been also greatly extended, so as perfectly to guard the magnificent anchorage-grounds behind the sheltering islands. A coaling station and naval rendezvous has been established on Frenchman's Bay, east of Mount Desert.

Property and Taxes.—The state assessors' valuation of property for purposes of taxation for 1900 was $287,691,790, of which the real estate was 78 per cent., and the personal, 22. The annual increase in the value of real estate during several preceding years averaged over $3,000,000, mostly in buildings and improvements. The increase in personal property was at a much lower rate, and chiefly in value of live stock. The state debt in 1900 amounted to $2,153,000. The state tax is 2¾ mills on the dollar, while the average local rate is ten times this.

Banks, &c.—There were in 1900 thirty-two national banks, with a capital of $10,971,000, and for that year surplus and undivided profits of $4,260,722, and total resources of $41,992,070; fifty-one savings banks, with deposits of $71,076,212, by 177,600 depositors; seventeen trust companies, with capital stock of $1,651,400, and total resources of $11,802,257; thirty-two loan and building associations, with total resources of $2,975,766. The legal rate of interest is 6 per cent., but safe investments do not often return more than 4 or 5 per cent. There is no legal limit to rate by contract.

Industries.—The various branches of agriculture still constitute the leading industry of the state. In 1900 there were 59,299 farms, containing 6,299,946 acres, of which about 38 per cent. was improved land. The total value of farm property was $122,410,904, made up as follows: land, improvements, and buildings, $96,502,150; implements and machinery, $8,802,720; live stock, $17,106,034. The total value of farm products for the preceding year was $37,113,469. The number and value of the most important farm animals in 1900 were: 173,592 dairy cows, $5,060,048; 165,255 other neat cattle, $2,525,497; 106,299 horses, $7,058,989; 252,213 sheep (excluding lambs), $751,777; 79,018 swine, $516,015. The principal crops and their values in 1899 were: oats, $1,374,573; hay and forage, $10,641,546; potatoes, $3,711,999; miscellaneous vegetables, $1,207,075; and orchard fruits, $833,634.

Mechanical industries have grown in extent and in productive power. General good feeling between employers and workmen prevailing, strikes have not been common. Shipbuilding has revived. It is now carried on at advantageous points, with concentration of capital and large use of machinery, and is chiefly directed to vessels for heavy domestic trade. Building is going on at the rate of 5000 tons a month. Iron ships are successfully built at Bath. The Bath Iron Works have a continuous line of contracts for Government ships, and keep 1000 men at work all the year. In the cotton factories the employés are mostly French-Canadians, in the woollen factories mostly natives. There are two flourishing plush factories, using the hair of the Angora goat of Asiatic Turkey, and California and Oregon, and of the llama of South America, with some native wools. These goods find a large market in Russia and Japan. There are quarries of granite, of lime, and of slate. Ice is a staple product, amounting in some years to over 3,000,000 tons. A growing industry is sardine-packing, largely carried on in the south-eastern part of the state. The general statistics of manufactures are shown by the following table:—

	1890.	1900.	Per cent. of Increase.
Number of establishments . . .	5,010	6,702	33·8
Capital . . .	$80,419,809	$122,918,826	52·8
Salaried officials, clerks, &c.	5,406[1]	3,329	58·4[2]
Salaries . . .	$3,563,635[1]	$3,171,433	11·0[2]
Wage-earners (average number) . . .	70,374	74,816	6·3
Total wages . . .	$22,962,582	$28,527,849	24·2
Miscellaneous expenses	$5,394,694	$7,774,216	44·1
Cost of materials .	$51,520,589	$68,863,408	33·7
Value of products .	$95,689,500	$127,361,485	33·1

The following table shows statistics of six leading industries:—

Industry.	Number of Establishments.	Wage-earners.	Value of Products.
Boots and shoes . . .	48	6,432	$12,295,847
Cotton goods . . .	15	13,723	14,631,086
Fish, canning and preserving	117	5,567	4,779,733
Lumber and timber products	838	6,834	13,489,401
Paper and wood pulp . .	35	4,851	13,223,275
Wool manufactures . .	79	7,155	13,412,784

Lumber and Wood Pulp.—There are 21,000 square miles of forest. The pine region of the south-west is well cut over, and owners of these lands are taking pains to promote new growth. Spruce is now the chief tree. This is worked into long lumber to the extent of 250,000,000 feet a year, and into pulp for paper to the extent of 350,000,000 feet. In the former great advance has been made in the process of manufacture, chiefly by economies in machinery and motive power. The pulp industry has advanced rapidly. Large tracts of timber lands have been bought and extensive mills built. Some of the finest of book-paper is made here. The advent of this immense pulp industry has given rise to fears of the rapid destruction of the forests, with serious detriment to natural conditions, such as rainfall, water-storage, climate, &c.; but the necessity of securing a long supply of material for such costly plants will lead to the adoption of rigid and intelligent economy, so that, as one consequence of the pulp operations, a system of forestry will supersede the reckless waste of old lumber operations under "permits" from distant owners.

Railways.—The total mileage of steam railways in Maine in 1901 was 1919 miles. The capitalization of these within the state is $63,955,121. The gross earnings within the state for the year ending 30th June 1901 amounted to $10,930,003. Numerous electric street railways have been constructed, with a total mileage on 30th June 1901 of 286 miles, and an investment value of about eight million dollars. The gross earnings for the year were over one million dollars; and the number of passengers carried was nearly twenty millions. The principal railway systems are the Boston and Maine, Maine Central, Grand Trunk, Canadian Pacific, Bangor and Aroostook, Rumford Falls, and Washington County lines. Several new lines connecting with the Maine Central are being built. The most remarkable of interior developments has been brought about by the Bangor and Aroostook railway opening up in the three north-eastern counties an area of over 4,000,000 acres—almost equal to that of the state of Massachusetts. These lands are fertile, well wooded and watered, with abundant water-power. Every available tract of timber on the line of this railway has been taken up for the purpose of some form of manufacture. Mills have been erected with an annual capacity of 125,000,000 feet of long lumber. Other wood products have been transported by this railway amounting to 226,000 tons a year. A pulp and paper mill is under construction, of an annual capacity of 120,000 tons. The soil in this region is well adapted to the raising of grain, in which there is accordingly a rapid increase. Five million bushels of potatoes go out to market each season, and fifty starch factories in Aroostook county consume three million bushels more. Every industry feels the stimulus of better facilities for moving products. This railway has already 325 miles in operation, and is pushing its branches wherever opportunities offer.

Trade, Domestic and Foreign.—Foreign trade is mostly for the foreign account, and is carried on in foreign ships. Much of this is for the Canada trade connected with the Grand Trunk railway. The value of the exports through the port of Portland for the year ending 30th June 1900 is seen in the following items: domestic, $9,731,373; foreign (Canada), $8,333,407; from frontier ports, $14,708,285; a total of $32,773,065. The value of the imports for the same period was: domestic consumption, $782,863; in transit, $8,254,064; a total of $9,036,927, and grand total of business, $41,809,992. The amount of duties assessed at this port was $5,524,707, of which only $98,297 was collected here, the balance being settled in other ports. The total amount of collections here, however, for the fiscal year 1900 from all sources was $129,271, an increase over the same for the previous year of $30,000. A very large amount of foreign business is done here which is without pecuniary benefit to the United States revenue, and which does not appear in any reports published by the Government.

Education.—The percentage of illiterates in this state is very low, and among the families of the original stock is almost inappreciable. Among the native-born adult males, 5671, out of a total of 178,931, or 3·2 per cent., were unable to write; while among the foreign-born, 8281, out of a total of 38,732, or 21·4 per cent., were unable to write. Out of all adult males, 6·4 per cent. were unable to write. The laws requiring school attendance for at least 16 weeks in each year of children under 15 years of age employed in factories are strictly enforced. The number of pupils in the public schools is about 200,000; the teachers number 6500; the annual school expenditure is $1,600,000. There are four normal schools for the training of teachers, with a total average attendance of 485. Besides the high schools connected with the public school system, there are thirty-seven academies for secondary instruction, with a permanent investment of nearly $50,000 and an average attendance of 2400. Great advance has been made in the means and methods of superior instruction. The leading colleges in the state are Bowdoin, Colby, Bates, and the University of Maine (College of Agriculture and Mechanic Arts). They have a total annual attendance of students averaging 1033, with 88 academic instructors, and a total endowment of $3,059,200. They are receiving generous gifts from friends, especially for libraries and laboratories. Not less than half a million dollars have lately been so given to Bowdoin. The Congregationalists have a theological seminary at Bangor, and the Free Baptists one at Lewiston. A law school has been established at Bangor connected with the University at Orono. The Maine Medical School, attached to Bowdoin College, is an institution of the first class. Free public libraries are rapidly extending through the towns.

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[1] Includes proprietors and firm members, with their salaries.

[2] Decrease.

Charitable Institutions.—Among institutions of a charitable or remedial nature are the Maine General Hospital at Portland, and similar establishments at Lewiston and Bangor; the Asylum for the Insane at Augusta, and another at Bangor; the Eye and Ear Infirmary, and School for the Deaf at Portland. Other institutions of similar general character are the Soldiers' Orphans' Home at Bath; the Industrial School for Girls at Hallowell; the Good Will Farm at Fairfield; and perhaps to be classed here, the Reform School for Boys at Portland, although this is in some aspects a penal institution. The National Home for Volunteer Soldiers at Togus and the Marine Hospital at Portland are institutions of the national Government.

Military.—There is an effective militia organization in the state, from which a volunteer regiment of infantry and four batteries of artillery—an aggregate of 1821 officers and men—were furnished for the Spanish war, in addition to detachments for the U.S. Volunteer Signal Service, Engineers, and Naval Reserve, and others for the regular army.

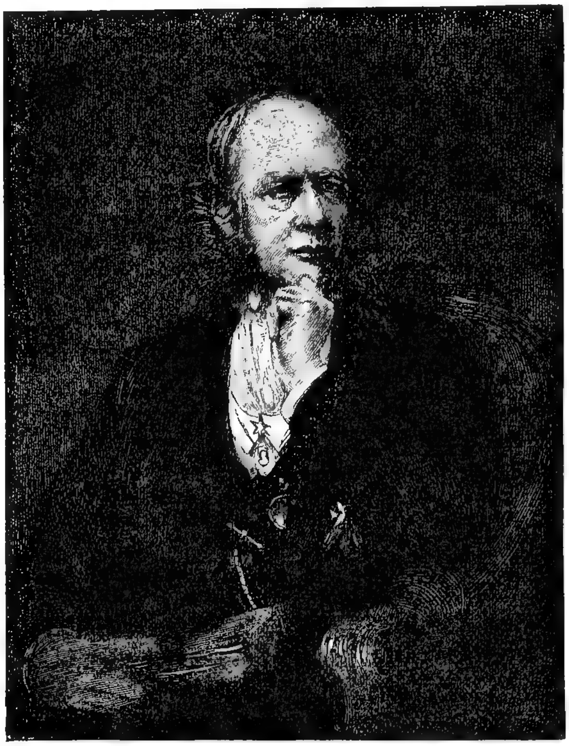
Liquor Laws.—The prohibitory liquor law, although supported by a recent constitutional amendment to a similiar effect, labours under the disadvantage of all laws not vigorously sustained by general public sentiment. For the most part it is executed to the degree demanded by local sentiment in the several municipalities, thus operating in practice much the same as a "local option" law. This is not through default of moral sense among the people; it is simply a question of expediency as to what measures will best, with least attendant evil, restrain indulgence in intoxicating liquors. On this the judgment of fair-minded citizens is divided. The present law looks to checking the demand by preventing the supply; and since habitual reliance on the stringency of law tends to the neglect of other influences for the removal of evils from the community, the citizens seem to absolve themselves from personal responsibility both for the execution of the law and for the existence of the evil itself. At the same time, the existing law sets a standard of moral conduct for the community, which is supposed to express its best sentiment; and even though it fails fully to effect its immediate object, the people would probably be unwilling to repeal the legal and constitutional prohibition. (See LIQUOR LAWS.)

Religion.—The most prominent religious denominations are the Congregationalists, who have 250 churches and 21,600 members; the Baptists, with 249 churches and 20,051 members; the Methodists, 304 churches and 19,483 members; the Free Baptists, 240 churches and 13,703 members; and the Roman Catholics, who report 86 churches and a Catholic population of 96,400. Religious tendencies are towards practical rather than dogmatic questions—towards a liberalizing of the scholastic creeds and closer fellowship of all Christians. (J. L. C.)

Maine, Sir Henry James Sumner (1822–1888), the principal founder in Great Britain of the historical and comparative study of jurisprudence, was born on 15th August 1822. He was at school at Christ's Hospital, and thence went up to Pembroke College, Cambridge, in 1840. At Cambridge he was one of the most brilliant classical scholars of his time. Some of his Greek translations from English poetry are preserved in *Arundines Cami.* He took a Craven University scholarship and other prizes, and graduated as senior classic in 1844, being also senior Chancellor's medallist in classics. Shortly afterwards he accepted a tutorship at Trinity Hall. In 1847 he was appointed regius professor of civil law, and he was called to the Bar three years later; he held this chair till 1854. It will be remembered that even the rudiments of Roman law were not then included in the ordinary training of English lawyers; it was assumed at the universities that any good Latin scholar could qualify himself at short notice for keeping up such tradition of civilian studies as survived. Maine cannot have known much Roman law in 1847, but in 1856 he contributed to the *Cambridge Essays* the essay on Roman Law and Legal Education, republished in the later editions of *Village Communities,* which was the first characteristic evidence of his genius. Meanwhile he had become one of the Readers appointed by the Inns of Court, in the first of their many half-hearted attempts at legal education, in 1852. Lectures delivered by Maine in this capacity were the groundwork of *Ancient Law,* published in 1861, the book by which his reputation was made at one stroke. Its object, as modestly stated in the preface, was "to indicate some of the earliest ideas of mankind, as they are reflected in Ancient Law, and to point out the relation of those ideas to modern thought." Within a year of its publication the post of Legal Member of Council in India was offered to Maine, then a junior member of the Bar with little practice, few advantages of connexion, and no political or official claims; in short, with none of the common qualifications. He declined once, on grounds of health; the very next year the office was again vacant. This time Maine was persuaded to accept, not that his health had improved, but that he thought India might not make it much worse. It turned out that India suited him much better than Cambridge or London. His work, like most of the work done by Englishmen in India in time of peace, was not of a showy kind; its value is shown by the fact that he was asked to prolong his services beyond the regular term of five years, and returned to England only in 1869. The subjects on which it was his duty to advise the Government of India were as much political as legal. They ranged from such problems as the land settlement of the Punjab, or the introduction of civil marriage to provide for the needs of unorthodox Hindus, to the question how far the study of Persian should be required or encouraged among European civil servants. On the civil marriage question in particular, and some years earlier on the still more troublesome one of allowing the remarriage of native converts to Christianity, his guidance, being not only learned but statesmanlike, was of the greatest value. Plans of codification, moreover, were prepared, and largely shaped, under Maine's direction, which were carried into effect by his successors Fitzjames Stephen and Mr Whitley Stokes. The results are open to criticism in details, but form on the whole a remarkable achievement in the conversion of unwritten and highly technical law into a body of written law sufficiently clear to be administered by officers to many of whom its ideas and language are foreign. All this was in addition to the routine of legislative and consulting work, and the establishment of the legislative department of the Government of India on substantially its present footing.

Maine's power of swiftly assimilating new ideas and appreciating modes of thought and conduct remote from modern Western life came into contact with the facts of Indian society at exactly the right time, and his colleagues and other competent observers expressed the highest opinion of his work. In return Maine brought back from his Indian office a store of knowledge which enriched all his later writings, though he took India by name for his theme only once. This essay on India was his contribution to the composite work entitled *The Reign of Queen Victoria* (ed. T. H. Ward, London, 1887). Not having been separately published, it is perhaps the least known of Maine's writings; but its combination of just perception and large grasp with command of detail is not easily matched outside Bishop Stubbs's prefaces to some of the chronicles in the Rolls series. As vice-chancellor of the University of Calcutta Maine commented, with his usual pregnant ingenuity, on the results produced by the contact of Eastern and Western thought. Three of these addresses were published, wholly or in part, in the later editions of *Village Communities;* the substance of others is understood to be embodied in the Cambridge Rede lecture of 1875, which is to be found in the same volume. The practical side of Maine's experience was not long lost to India; he became a member of the Secretary of State's council in 1871, and remained so for the rest of his life. In 1869 Maine was appointed to the chair of historical and comparative jurisprudence newly founded in the University of Oxford by Corpus Christi College. Residence at Oxford was not required, and altogether the election amounted to an invitation to the new professor to resume and continue in his own way the work he had begun in *Ancient Law.* During the next eight years he published the principal matters of his lectures in a carefully revised literary form: *Village Communities in the East and the West,* 1871; *Early History of Institutions,* 1875; *Early Law and Custom,* 1883. In all these works the phenomena of societies in an archaic stage, whether still capable of observation or surviving in a fragmentary manner among more modern surroundings or preserved in contemporary records, are brought into line, often with quite peculiar felicity, to establish and illustrate the normal process of development in legal and political ideas.

In 1877 the Mastership of Trinity Hall, Cambridge, where Maine had formerly been tutor, became vacant. There were two strong candidates whose claims were so nearly equal that it was difficult to elect either; the difficulty was solved by a unanimous invitation to Maine to accept the post. His acceptance entailed the resignation of the Oxford chair, though not continuous residence at Cambridge. Ten years later considerations of a somewhat similar kind led to his election to succeed Sir William Harcourt as Whewell professor of international law at Cambridge. His all too short performance in this office is represented by a posthumous volume which had not received his own final revision (*International Law,* 1888).


Sir Henry Maine.
(*From a photograph by Fredk. Hollyer of the painting by Lowes Dickinson.*)

Meanwhile Maine had published in 1885 his one work of speculative politics, a volume of essays on *Popular Government,* designed to show that democracy is not in itself more stable than any other form of government, and that there is no necessary connexion between democracy and progress. The book was deliberately unpopular in tone; it excited much controversial comment and some serious and useful discussion.

In 1886 there appeared in the *Quarterly Review* (clxii. 181) an article on the posthumous work of J. F. M'Lennan, edited and completed by his brother, entitled "The Patriarchal Theory." The article, though necessarily unsigned, was Maine's reply to the M'Lennan brothers' attack on the historical reconstruction of the Indo-European family system put forward in *Ancient Law* and supplemented in *Early Law and Custom.* Maine was generally averse from controversy, but showed on this occasion that it was not for want of controversial power. He carried the war back into the invader's country, and charged J. F. M'Lennan's theory of primitive society with owing its plausible appearance of universal validity to general neglect of the Indo-European evidence and misapprehension of such portions of it as M'Lennan did attempt to handle.

Maine's health, which had never been strong, gave way towards the end of 1887. He went to the Riviera under medical advice, and died at Cannes on 3rd February 1888. He left a wife and two sons, of whom the elder died soon afterwards.

An excellent summary of Maine's principal writings may be seen in Sir Mountstuart Grant Duff's memoir. The prompt and full recognition of Maine's genius by Continental publicists must not pass unmentioned even in the briefest notice. France, Germany, Italy, Russia have all contributed to do him honour; this is the more remarkable as one or two English publicists of an older school signally failed to appreciate him. Maine warned his countrymen against the insularity which results from ignorance of all law and institutions save one's own; his example has shown the benefit of the contrary habit. His prominent use of Roman law and the wide range of his observation have made his works as intelligible abroad as at home, and thereby much valuable information—for example, concerning the nature of British supremacy in India, and the position of native institutions there—has been made the property of the world of letters instead of the peculiar and obscure possession of a limited class of British public servants. Foreign readers of Maine have perhaps understood even better than English ones that he is not the propounder of a system but the pioneer of a method, and that detailed criticism, profitable as it may be and necessary as in time it must be, will not leave the method itself less valid or diminish the worth of the master's lessons in its use. The rather small bulk of Maine's published and avowed work may be accounted for partly by a fine literary sense which would let nothing go out under his name unfinished, partly by the drawbacks incident to precarious health. Maine's temperament was averse from the labour of minute criticism, and his avoidance of it was no less a matter of prudence. But it has to be remembered that Maine also wrote much which was never publicly acknowledged. Before he went to India he was one of the original contributors to the *Saturday Review,* founded in 1855, and the inventor of its name. Like his intimate friend Fitzjames Stephen, he was an accomplished journalist, enjoyed occasional article-writing as a diversion from official duties, and never quite abandoned it. The practice of such writing probably counted for something in the freedom and clearness of Maine's style and the effectiveness of his dialectic. His books are a model of scientific exposition which never ceases to be literature.

Authorities.—Lyall, Sir A., and others, in *Law Quart. Rev.* iv. 129 *sqq.* Lond. 1888.—Pollock, Sir F. "Sir Henry Maine and his Work," in *Oxford Lectures, &c.* Lond. 1890.—Grant Duff, Sir M. E. *Sir Henry Maine: a brief Memoir of his Life, &c.* Lond. 1892; and see same author's *Notes from a Diary, passim.*—Stephen, L. Article on Maine in *Dict. Nat. Biogr.* Lond. 1893.—"Sir Henry Maine as a Jurist," *Edin. Rev.*, July 1893. (F. Po.)

Maine-et-Loire, a department of the west of France, watered by the Loire and its affluent the Maine, which is itself formed by the confluence of the Mayenne and the Sarthe.

Area, 2812 square miles. From 527,680 in 1886 the population decreased to 513,208 in 1901. The births in 1899 numbered 9404, of which 595 were illegitimate; deaths, 10,054; marriages, 3843. There were in 1896, 979 primary schools, with 62,000 pupils, the illiterate constituting 5 per cent. of the population. The area under cultivation amounted (1896) to 1,624,193 acres, of which 1,132,738 acres were plough-land and 99,323 acres vineyards. Of considerable agricultural wealth, the department in 1899 produced wheat valued at £1,718,000; barley, £104,000; oats, £312,000; vines, £600,000; potatoes, £340,000; mangold-wurzel, £132,000; hemp, in harl and in seed, £56,000; flax, in harl and in seed, £34,000; walnuts, £16,000. The live stock included (1899) 63,620 horses, 277,220 cattle, 59,250 sheep, and 100,000 pigs. Mining in 1898 produced 14,600 tons of coal, but there is no industry in metals. The slate quarries of Angers are noted for their abundance and quality. The manufacture of hempen and other textile stuffs is in an advanced state. Angers, the capital, in 1901 had 82,966 inhabitants.

Mainpuri, a town and district of British India, in the Agra division of the North-West Provinces. The town is on the Agra branch of the Grand Trunk road, 36 miles from the station of Shikohabad. Population (1881), 20,236; (1891), 18,551. Registered death-rate (1897), 41·8 per thousand. The municipal income in 1897–98 was Rs.16,580, the incidence of taxation being 12 annas per head. It has a speciality of wooden articles inlaid with wire. The American Presbyterian mission manages a high school.

The district of Mainpuri lies in the central Doab. Area, 1701 square miles; population (1881), 801,216; (1891), 762,163; (1901), 829,350, showing a decrease of 5 per cent. between 1881 and 1891, and an increase of 8·8 between 1891 and 1901; average density, 487 persons per square mile. The land revenue and rates are Rs.14,86,835, the incidence of assessment being R.1.2.4 per acre; cultivated area (1896–97), 494,779 acres, of which 395,831 were irrigated from wells, &c., including 176,754 from Government canals; number of police, 2392; number of vernacular schools (1896–97), 121, with 3744 pupils. The registered death-rate in 1897 was 36 per thousand. The district is watered by two branches of the Ganges canal, and is traversed for 23 miles by the main line of the East Indian railway, with two stations. Indigo is an important crop, grown on 35,000 acres, with an out-turn valued at Rs.4,71,000.

Mainz, in French *Mayence,* a first-class fortress, river port, and bishop's see of Germany, grand-duchy of Hesse-Darmstadt, on the left bank of the Rhine (*q.v.*), almost directly opposite the influx of the Main, though the fortress, manned by a garrison of 8000 men, belongs to the empire. Since the defensive works were pushed back in 1871, a new quarter of straight wide streets, intersecting at right angles, has been built on the north of the old town, room being also found for two spacious harbours, completed in 1887 at a cost of a quarter of a million sterling. The river front has been converted into a fine promenade, over 300 feet wide, and planted with trees. From the middle of it an equally wide and handsome street, the Kaiserstrasse, goes from the Rhine to the new central railway station (1884), and at the same time separates the new town from the old town. In 1881–85 a new bridge of five arches (the centre arch with a span of 335 feet) was thrown across the Rhine to the opposite suburb of Kastel. The concert hall (a handsome Renaissance building) on the Rhine promenade, the concert hall (1890) of the Mainz Musical Society, the new classical school (gymnasium), the imperial bank (1894), and the offices of the Hesse-Ludwig Railway Company, and Christ Church (1899–1900) are the more noteworthy of modern public buildings. Of the older, the church of St Stephen's (1257–1328; restored in 1857) and St Emmeran's (restored in 1881) should be mentioned. Mainz has theological seminaries and an industrial art school. There is a very considerable trade, by river and rail, principally in wine, cereals and flour, timber, petroleum, paper, iron and steel, and vegetables. The industries are chiefly concerned with the production of artistic furniture and leather goods, carriages, vegetables (asparagus, &c.), preserved foods for the army, tobacco, boots, pianos, varnishes, books, &c. Population (1885), 65,852; (1900), 84,335.

Maitland, East and West, adjoining municipalities, in New South Wales, Australia, in the county of Northumberland, 120 miles north of Sydney by rail, on the Hunter river about 4 miles above the limit of navigation for steamers. They are the centre of the agricultural district of the Hunter valley. Public buildings include a large town hall (1890), court-house, and new masonic hall. West Maitland is protected from floods by stone embankments built at a cost of £30,000, and flood-gates costing £12,000 have been erected on Wallis Creek at East Maitland. Population of West Maitland (1881), 5703; (1901), 6798; of East Maitland (1881), 2302; (1901), 3287.

Majorca, or Mallorca. See Balearic Islands.

Makart, Hans (1840–1884). See Schools of Painting (*Austria*).

Malabar, a district of British India, in the Madras presidency. Geographically the name is sometimes extended to the entire western coast of the peninsula. Properly it should apply to the strip below the Ghats, which is inhabited by people speaking the Malayalam language, a branch of the Dravidian stock, who form a peculiar race, with castes, customs, and traditions of their own. It would thus be coextensive with the old kingdom of Chera, including the modern states of Travancore and Cochin, and part of Kanara. In 1891 the total number of persons speaking Malayalam was 5,428,250.

The district of Malabar extends for 145 miles along the coast, running inland to the Ghats for a breadth varying from 70 to 25 miles. The administrative headquarters are at Calicut. Area, 5585 square miles; population (1881) 2,365,035; (1891), 2,652,565; (1901), 2,788,043, showing an increase of 12 per cent. between 1881 and 1891, and of 5·1 per cent. between 1891 and 1901; average density, 499 persons per square mile, being the second highest in the province. The land revenue and rates in 1897–98 were Rs.23,41,854, the incidence of assessment being Rs.2.2.9 per acre; cultivated area, 959,239 acres, of which 39,344 were irrigated from tanks, &c.; number of police, 1463; boys at school (1896–97), 66,274, being 33·6 of the male population of school-going age; girls at school, 18,499, being 9·2 per cent.; registered death-rate (1897), 30·2 per thousand, the mortality from cholera alone having been 10·4 per thousand. The one staple crop is rice, the next most important product being cocoa-nuts. Coffee is grown on 17,872 acres, chiefly in the upland track known as the Wainad, where also there are 855 acres under tea. The chief means of communication is by the backwaters or lagoons, which form almost a complete chain along the coast. The Madras railway crosses the district for 90 miles, and is being extended from Calicut to Cannanore (62 miles). There are 11 seaports, of which the principal are Calicut, Tellicherry, Cannanore, and Cochin. In 1897–98 the seaborne trade was valued at Rs.6,27,14,875, the principal exports being coffee, cocoa-nut products, and timber. There are factories for cleaning coffee, pressing coir and making matting, making tiles, sawing timber, and weaving cotton.

Malacca, a town situated on the west coast of the Malay Peninsula, in 2° 14′ N. and 102° 12′ E., which gives its name to the strait dividing the island of Sumatra from the mainland. Its name, which is more correctly transliterated Mĕlâka, means a species of jungle fruit, and is also borne by a river on the right bank of which the old Dutch town stands, being connected by a bridge with the business quarter on the left bank, which is inhabited almost exclusively by Chinese, Eurasians, and Malays.

Malacca, now a somnolent little town, visited by few ships, and holding the least important position of all the three settlements in that strait, has a remarkable history. An account of it given in 1503 by a Roman youth, Ludovigo Barthema, called Vertomannus in Eden's translation of 1576, shows that even at that time Malacca was one of the most important centres of trade in the East. Its Malay sultan was perhaps the most considerable chief of his race, and was certainly more powerful than any other ruler then living in the Peninsula. Malacca is also one of the oldest European settlements in eastern Asia, it having been wrested from Sultan Muhammad Shah by Albuquerque in 1511, in punishment for an attack made in 1509 on his lieutenant Sequeira. It was held by the Portuguese until 1641, when the Dutch, with the help of the Achinese, succeeded in capturing the citadel, several attempts to take it having previously been made without success. It was under the Portuguese Government that St Francis Xavier started a mission in Malacca, the first Christian mission to Malayan lands. The Dutch held Malacca until 25th August 1795, when it was taken from them by a British expedition, and the Dutch Government was dissolved on 4th December of the same year. The British administration under Admiral Mainwaring abolished the system of monopoly in the Straits, as Raffles did afterwards throughout Malaya in 1813. In 1818 Malacca was restored to the Dutch under the Treaty of Vienna, but in 1824 it came finally into the hands of Great Britain, being exchanged by a treaty with Holland for the East India Company's settlement of Bencoolen and a few other unimportant places on the western coast of Sumatra. By this treaty the Dutch were precluded from interference in the affairs of the Malay Peninsula, and Great Britain from similar action in regard to the states of Sumatra, with the sole exception of Acheen, the right to protect which state was not abandoned by Great Britain until 1872 by the treaty concluded with Holland in that year. It was not until 1833 that the whole territory lying to the back of Malacca was finally brought under British control, and as late as 1887 the Nĕgri Sămbilan, or Nine States, which adjoin Malacca territory on the east and north-east, were completely independent. They now, with the state of Sŭngei Ujong, form part of the Federated Malay States under British protection. Malacca is administered by a resident councillor, who is responsible to the governor of the Straits Settlements, and by a number of district officers and other officials under his direction. The population of the town and territory of Malacca in 1901 was 95,487, of whom only 74 were Europeans and Americans, 1598 were Eurasians, the rest being Asiatics (chiefly Malays, with a considerable sprinkling of Chinese). The population in 1891 was 92,170. The birth-rate in 1898 was 35 per thousand, the death-rate 28·97. The revenue for 1898 amounted to $376,335, and the expenditure to $393,411. In 1900 the imports totalled $2,322,036, and the exports $2,787,128. During 1898, 1503 ships, with an aggregate tonnage of 306,580, entered the port of Malacca; this will serve to show how completely the trade of this once flourishing port has declined, most of the vessels being merely coasting craft, and no large line of steamers holding any communication with the place. This is accounted for partly by the shallowness of the harbour, and partly by the fact that the ports of Penang and Singapore, at either entrance to the Strait of Malacca, draw all the trade and shipping to themselves. Malacca is chiefly remarkable for the number of wealthy retired Chinese merchants who resort thither to pass the years of their old age in preference to returning to China, where they would become a prey to the avarice of Chinese officials.

See Newbolt. *History of Malacca* (long out of print).—Cameron. *Our Tropical Possessions in Malayan India.*—Dudley Hervey. *Journal of the Straits Branch of the Royal Asiatic Society*, Singapore.—*Straits Directory*, 1900, Singapore.

(H. CL.)

Malacostraca.—Under the zoological title Malacostraca are included several groups of Crustacea (*q.v.*), united by characters which attest their common origin, though some, and probably all of them, were already separated in distant geological ages, and some have now attained a peculiar isolation. Throughout the whole, the researches made since 1860 have not only added a great throng of new species, genera, and families, but have thrown a flood of light upon questions of their phylogeny, systematic arrangement, horizontal and bathymetric distribution, organization, habits of life, and economic importance. There are at least seven orders: the stalk-eyed Brachyura, Macrura, Schizopoda, Stomatopoda, and the sessile-eyed Sympoda, Isopoda, Amphipoda. An ocular segment claimed by the former division is not present or in no case demonstrable in the latter. In neither does the terminal segment or telson, whether large or obsolescent, whether articulated or coalescent, carry appendages, unless occasionally in fusion with itself. Between the eyes and the tail-piece in all the orders nineteen segments are counted, the proof of a segment's existence depending on its separateness, complete or partial, or on a sutural indication, or else on the pair of appendages known to belong to it. All these marks may fail, and then the species must be proved to be Malacostracan by other evidence than the number of its segments; but if some exceptions exhibit fewer, none of the Malacostraca exhibit more than 19 (+1 or +2) segments, unless the Nebaliidæ be included. Of the corresponding pairs of appendages thirteen belong to the head and trunk, two pairs of antennæ, one pair of mandibles, two pairs of maxillæ, followed by three which may be all maxillipeds or may help to swell the number of trunk-legs to which the next five pairs belong. The abdomen or pleon carries the remaining six pairs, of which from three to five are called pleopods and the remainder uropods. Underlying the diversity of names and functions and countless varieties of shape, there is a common standard to which the appendages in general can be referred. In the maxillipeds and the trunk-legs it is common to find or otherwise easy to trace a seven-jointed stem, the endopod, from which may spring two branches, the epipod from the first joint, the exopod from the second.[1] The first antennæ are exceptional in branching, if at all, at the third joint. In the mandibles and maxillæ some of the terminal joints of the stem are invariably wanting. In the rest of the appendages they may either be wanting or indistinguishable. The latter obscurity results either from coalescence, to which all joints and segments are liable, or from subdivision, which occasionally affects joints even in the trunk-legs. The carapace, formerly referred only to the antennar-mandibular segments, may perhaps in fact contain elements from any number of other segments of head and trunk, Huxley, Alcock, Bouvier giving support to this opinion by the sutural or other divisional lines in *Potamobius*, *Nephrops*, *Thalassina*, and various fossil genera. Not all questions of classification internal to this division are yet finally settled. Between the Brachyura and Macrura some authors uphold an order Anomura, though in a much restricted sense, the labours of Huxley, Boas, Alcock, and conjointly Alphonse Milne-Edwards and Bouvier, having resulted in restoring the Dromiidea and Raninidæ to the Brachyura, among which de Haan long ago placed them. The French authors argue that from the macruran lobsters (*Nephropsidæ*) anciently diverged two lines, one leading through the Dromiidea to the genuine Brachyura or crabs, the other independently to the Anomura proper, which may conveniently be named and classed as *Macrura anomala*. Spence Bate maintained that the Schizopoda ought not to form a separate order but to be ranged as a macruran tribe, "more nearly allied to the degraded forms of the Penæidea than to those of any other group" ("*Challenger*" *Reports*, "Macrura," p. 472, 1888). According to Sars, the Sympoda (or Cumaceans), in spite of their sessile eyes, have closer affinities with the stalk-eyed orders. H. J. Hansen and others form a distinct order Tanaidea for the decidedly anomalous group called by Sars *Isopoda chelifera*.

Brachyura.—For the present, as of old, the true Brachyura are divided into four tribes:—*Cyclometopa*, with arched front as in the common eatable crab; *Catometopa*, with front bent down as in the land-crabs and the little oyster-crab; *Oxyrhyncha*, with sharpened beak-like front as in the various spider-crabs; *Oxystomata*, including the Raninidæ, and named not from the character of the front but from that of the buccal frame which is usually narrowed forwards. In these tribes the bold and active habits, the striking colours, or the fantastic diversities of structure, have so long attracted remark that recent investigations, while adding a multitude of new species and supplying the specialist with an infinity of new details, have not materially altered the scientific standpoint. New light, however, has been thrown upon the "intellectual" capacity of Crustacea by the proof that the spider-crabs deliberately use changes of raiment to harmonize with their surroundings, donning and doffing various natural objects as we do our manufactured clothes. Others have the power of producing sounds, one use to which they put this faculty being apparently to signal from their burrow in the sand that they are "not at home" to an inopportune visitor. Deep-sea exploration has shown that some species have an immensely extended range, and still more, that species of the same genus and genera of the same family, though separated by great intervals of space, may be closely allied in character. A curious effect of parasitism, well illustrated in crabs, though not confined to them, has been expounded by Professor Giard, namely, that it tends to obliterate the secondary sexual characters. Modern research has discovered no crab to surpass *Macrocheira kämpferi*, de Haan, that can span between three and four yards with the tips of its toes, but at the other end of the scale it has yielded *Collodes malabaricus*, Alcock, "of which the carapace, in an adult and egg-laden female, is less than one-sixth of an inch in its greatest diameter." The most abyssal of all crabs yet known is *Ethusina abyssicola*, Smith, or what is perhaps only a variety of it, *E. challengeri*, Miers. Of the latter the *Albatross* obtained a specimen from a depth of 2232 fathoms (Faxon, 1895), of the former from 2221 fathoms, and of this S. I. Smith remarks that it has "distinctly faceted black eyes," although in them "there are only a very few visual elements at the tips of the immobile eye-stalks."

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[1] In Huxley's terminology the first two or three joints of the stem constitute a "protopodite," from which spring the "endopodite" and "exopodite."

The *Brachyura anomala* or Dromiidea "have preserved the external characters and probably also the organization of the Brachyura of the Secondary epoch" (Milne-Edwards and Bouvier, 1901). They agree with the true crabs in not having appendages (uropods) to the sixth segment of the pleon, the atrophy being complete in the Homolidæ and Homolodromiidæ, whereas in the Dromiidæ and Dynomenidæ a pair of small plates appear to be vestiges of these organs. In the family Homolidæ stands the strange genus *Latreillia* (Roux), with long slender limbs and triangular carapace after the fashion of oxyrhynch spider-crabs. In *Homola* the carapace is quadrilateral. Between these two a very interesting link was discovered by the *Challenger* in the species *Latreillopsis bispinosa*, Henderson. Bouvier (1896) has shown that *Palæinachus longipes*, Woodward, from the Forest Marble of Wiltshire, is in close relationship, not to the oxyrhynch Inachidæ, but to the genera *Homolodromia* and *Dicranodromia* of the Homolodromiidæ, and that the Jurassic crabs in general, of the family Prosoponidæ (Meyer), are Dromiidea.

2. MACRURA.—The *Macrura anomala*, or Anomura in restricted sense, are popularly known through the hermit-crabs alone. These only partially represent one of the three main divisions Paguridea, Galatheidea, Hippidea. The first of these is subdivided into *Pagurinea*, *Lithodinea*, *Lomisinea*, each with a literature of its own. Among the Pagurinea is the *Birgus latro* or robber-crab, whose expertness in climbing the cocoanut palm need no longer be doubted, since in recent years it has been noted and photographed by trustworthy naturalists in the very act. Alcock "observed one of these crabs drinking from a runnel of rain-water, by dipping the fingers of one of its chelipeds into the water and then carrying the wet fingers to its mouth." Hermits of the genus *Cœnobita* he found feeding voraciously on nestling sea-terns. That pagurids must have the usually soft pleon or abdomen protected by the shell of a mollusc is now known to be subject to a multitude of exceptions. *Birgus* dispenses with a covering; *Cœnobita* can make shift with half the shell of a cocoanut; *Chlœnopagurus* wraps itself up in a blanket of colonial polyps; *Cancellus tanneri*, Faxon, was found in a piece of dead coral rock; *Xylopagurus rectus*, A. Milne-Edwards, lodges in tubes of timber or bits of hollow reed. The last-named species has a straight symmetrical abdomen, with the penultimate segment expanded and strongly calcified to form a back-door to the very unconventional habitation. This it enters head-foremost from the rear, while "hermits" in general are forced to go backwards into their spiral or tapering shelters by the front. Some of the species can live in the ocean at a depth of two or three miles. Some can range inland up to a considerable height on mountains. The advantage that this group has derived from the adoption of mollusc shells as houses or fortresses, ready-built and light enough for easy transport, is obviously discounted by a twofold inconvenience. There is nothing to ensure that the supply will be equal to the demand, and Nature has not arranged that the borrowed tenement shall continue to grow with the growth of its new tenant. To meet these defects it is found that numerous species encourage or demand the companionship of various zoophytes, simple or colonial. These sometimes completely absorb the shell on which they are settled, but then act as a substitute for it, and in any case by their outgrowth they extend the limits of the dwelling, so that the inmate can grow in comfort without having to hunt or fight for a larger abode. Among the *Lithodinea* or stone-crabs, besides important readjustments of classification (Bouvier, 1895, 1896), should be noticed the evidence of their cosmopolitan range, and the species *Neolithodes agassizii* (Smith) and *N. grimaldii*, Milne-Edwards and Bouvier, which carry to an extreme the spinosity characteristic of the group (Fig. 1). S. I. Smith's investigations on the early stages of *Hippa talpoida*, Say, were published in 1877.

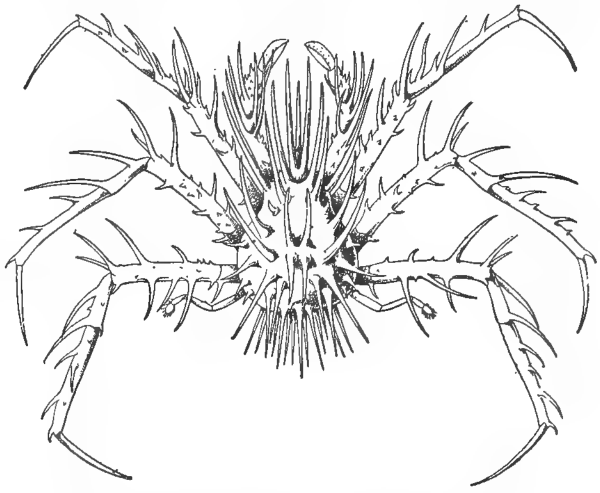

FIG. 1.—*Neolithodes grimaldii*, A. Milne-Edwards and Bouvier.

With regard to the accessions to knowledge in the enormous group of the genuine Macrura, reference need only be made to the extensive reports in which Spence Bate, S. I. Smith, Faxon, Wood-Mason, Alcock, and others have made known the results of celebrated explorations. Various larval stages have been successfully investigated by Sars. Alcock (1901) describes from his own observation the newly hatched *Phyllosoma* larva of *Thenus orientalis* (Fabricius). An admirable discrimination of the larval and adult characters of the genus *Sergestes* has been given by H. J. Hansen (*Proc. Zool. Soc.*, London, 1896). Singularity excites our wonder in *Thaumastocheles zaleucus* (v. Willemoes Suhm), which makes up for its vanished eyes by its extraordinary elongate and dentated claws; in *Psalidopus huxleyi*, Wood-Mason and Alcock (1892), bristling with spikes from head to tail; in the Nematocarcinidæ, with their long thread-like limbs and longer antennæ; in species of *Aristæopsis* reported by Chun from deep water off the east coast of Africa, bright red prawns nearly a foot long, with antennæ about five times the length of the body. That certain species, particularly many from deep water, have disproportionately large eggs, is explained by the supposition that the young derive the advantage of being hatched in an advanced stage of development.

3. SCHIZOPODA.—This order of animals, for the most part delicately beautiful, has for the moment five families—Lophogastridæ, Eucopiidæ, Euphausiidæ, Mysidæ, and Anaspididæ. In the Euphausiidæ the digitiform-arborescent branchiæ, as if conscious of their own extreme elegance, remain wholly uncovered. In the two preceding families they are partially covered. In the Mysidæ the branchiæ are wanting, and some would form this family into a separate order, Mysidacea. In *Anaspides*, a peculiar fresh-water genus discovered in 1892 by G. M. Thomson on Mount Wellington, in Tasmania, the gills are not arborescent, and there are seven segments of the trunk free of the carapace (Fig. 2). A membranaceous carapace separates the Eucopiidæ from the more solidly invested Lophogastridæ. Among many papers that the student will find it necessary to consult may be mentioned the

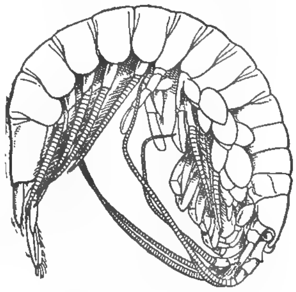

FIG. 2.—*Anaspides tasmaniæ*, Thomson.

"*Challenger*" *Report* on Schizopoda, by Sars, 1885, dealing with the order at large; "British Schizopoda," by Norman, *Ann. Nat. Hist.*, 1892; "Decapoden und Schizopoden," *Plankton-Expedition*, Ortmann, 1893; "Euphausiidæ," by Stebbing, *Proc. Zool. Soc.*, London, 1900; *Mysidæ of the Russian Empire*, by Czerniavski, 1882–83; and *Mysidæ of the Caspian*, by Sars, 1893–95–97.

4. Stomatopoda.—This order, at one time a medley of heterogeneous forms, is now confined to the singularly compact group of the Squillidæ. Here the articulation of the ocular segment is unusually distinct, and here two characters quite foreign to all the preceding groups come into view. The second maxillipeds are developed into powerful prehensile organs, and the branchiæ, instead of being connected with the appendages of head and trunk, are developed on the pleopods, appendages of the abdomen. At least three segments of the trunk are left uncovered by the carapace. The developing eggs are not carried about by the mother, but deposited in her subaqueous burrow, "where they are aërated by the currents of water produced by the abdominal feet of the parent." An excellent synopsis of the genera and species is provided by R. P. Bigelow (*Proc. U. S. Mus.* vol. xvii., 1894). For the habits and peculiarities of these and many other Crustaceans, Verrill and Smith on the *Invertebrates of Vineyard Sound* should be consulted (1874). The general subject has been illuminated by the labours of Claus, Miers, Brooks ("*Challenger*" *Report*, 1886), and the latest word on the relationship between the various larvæ and their respective genera has been spoken by H. J. Hansen (*Plankton-Expedition Report*, 1895). The striking forms of *Alima* and *Erichthus*, at one time regarded as distinct genera, are now with more or less certainty affiliated to their several squillid parents.

5. Sympoda.—This order of sessile-eyed decapods was absolutely unknown to science till 1779. A species certainly belonging to it was described by Lepekhin in 1780, but the obscure *Gammarus esca*, "food Gammarus" beloved of herrings, described by J. C. Fabricius in the preceding year, may also be one of its members. Nutritious possibilities are implied in *Diastylis rathkii* (Kröyer), one of the largest forms, which, though slender and rarely an inch long, in its favourite Arctic waters is found "in incalculable masses, in thousands of specimens" (Stuxberg, 1880). Far on in the 19th century eminent naturalists were still debating whether in this group there were eyes or no eyes, whether the eyes were stalked or sessile, whether the animals observed were larval or adult. The American Say in 1818 gave a good description of a new species and founded the premier genus *Diastylis*, but other investigators derived little credit from the subject till more than sixty years after its introduction by the Russian Lepekhin. Then Goodsir, Kröyer, Lilljeborg, Spence Bate, and one or two others made considerable advances, and in 1865 a memorable paper by G. O. Sars led the way to the great series of researches which he has continued to the present day. The name *Cumacea*, however, which he uses cannot be retained, being founded on the preoccupied name *Cuma* (Milne-Edwards, 1828). The more recent name *Sympoda* (see Willey, *Results*, part v. p. 609, 1900) alludes to the huddling together of the legs, which is conspicuous in most of the species. Ten families are now distinguished — Diastylidæ, Lampropidæ, Platyaspidæ, Pseudocumidæ, all with an articulated telson; without one, the Bodotriidæ (formerly called *Cumidæ*), Vaunthompsoniidæ, Leuconidæ, Nannastacidæ, Campylaspidæ, Procampylaspidæ. All the Leuconidæ and Procampylaspidæ are blind, and some species in most of the other families. Usually the sides of the carapace are strangely produced into a mock rostrum in front of the ocular lobe, be it oculiferous or not. The last four or five segments of the trunk are free from the carapace. The slender pleon has always six distinct segments, the sixth carrying two-branched uropods, the preceding five armed with no pleopods in the female, whereas in the male the number of pairs varies from five to none. The resemblance of these creatures to miniature Macrura is alluded to in the generic name *Nannastacus*, meaning dwarf-lobster. In this genus alone of the known Sympoda the eyes sometimes form a pair, in accordance with the custom of all other malacostracan orders except this and of this order itself in the embryo (Sars, 1900). The most but not the only remarkable character lies in the first maxillipeds. These, with the main stem more or less pediform, have the epipod and exopod modified for respiratory purposes. The backward-directed epipods usually carry branchial vesicles. The forward-directed exopods either act as valves or form a tube (rarely two tubes), protensile and retractile, for regulating egress of water from the branchial regions. This mechanism as a whole is unique, although, as Sars observes, the epipod of the first maxillipeds has a respiratory function also in the Lophogastridæ and Mysidæ and in the cheliferous isopods. As a rule armature of the carapace is much more developed in the comparatively sedentary female than in the usually more active male. Only in the male do the second antennæ attain considerable length, with strong resemblance to what is found in some of the Amphipoda. About 150 species distributed among thirty-four genera are now known, many from shallow water and from between tide-marks, some from very great depths. H. J. Hansen concludes that "they are all typically ground animals, and as yet no species has been taken under such conditions that it could be reckoned to the pelagic plankton." As they have been found in all zones and chiefly by a very few observers, it is probable that a great many more species remain to be discovered. In recent years thirteen species, all belonging to the same genus *Pseudocuma* (Fig. 3), have been recorded by Sars from the Caspian Sea. A bibliography of the order is given in that author's *Crustacea of Norway*, vol. iii., 1899–1900.

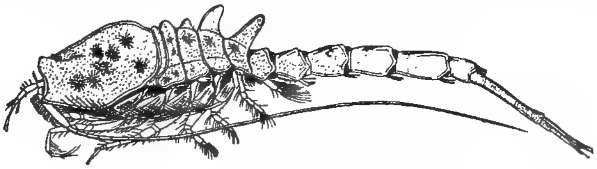

Fig. 3.—*Pseudocuma Pectinatum*, Sowinsky.

6. Isopoda.—This vast and populous order can be traced far back in geological time. It is now represented in all seas and lands, in fresh-water lakes and streams, and even in warm springs. It adapts itself to parasitic life not only in fishes, but in its own class Crustacea, and that in species of every order, its own included. In this process changes of structure are apt to occur, and sometimes unimaginable sacrifices of the normal appearance. The order has been divided into seven tribes, of which a fuller summary than can here be given will be found in Stebbing, *History of Crustacea*, 1893. The first tribe, called Chelifera, from the usually chelate or claw-bearing first limbs, may be regarded as *Isopoda anomala*, of which some authors would form a separate order, Tanaidea. Like the genuine isopods, they have seven pairs of trunk-legs, but instead of having seven segments of the middle body (or peræon) normally free, they have the first one or two of its segments coalesced with the head. Instead of the breathing organs being furnished by the appendages of the pleon with the heart in their vicinity, the respiration is controlled by the maxillipeds, with the heart in the peræon (see Delage, *Arch. Zool. expér. et gén.* vol. ix., 1881). There are two families, Tanaidæ and Apseudidæ. Occasionally the ocular lobes are articulated.

The genuine Isopoda are divided among the *Flabellifera*, in which the terminal segment and uropods form a flabellum or swimming fan; the *Epicaridea*, parasitic on Crustaceans; the *Valvifera*, in which the uropods fold valve-like over the branchial pleopods; the *Asellota*, in which the first pair of pleopods of the female are usually transformed into a single opercular plate; the *Phreatoicidea*, a fresh-water tribe, known as yet only from subterranean waters in New Zealand and an Australian swamp nearly 6000 feet above sea-level; and lastly, the *Oniscidea*, which are terrestrial. Only the last of these, under the contemptuous designation of wood-lice, has established a feeble claim to popular recognition. Few persons hear without surprise that England itself possesses more than a score of species in this air-breathing tribe. Those known from the world at large number hundreds of species, distributed among dozens of genera in six families. That a wood-louse and a land-crab are alike Malacostracans, and that they have by different paths alike become adapted to terrestrial life, are facts which even a philosopher might condescend to notice. Of the other tribes which are aquatic there is not space to give even the barest outline. Their swarming multitudes are of enormous importance in the economy of the sea. If in their relation to fish it must be admitted that many of them plague the living and devour the dead, in return the fish feed rapaciously upon them. Among the most curious of recent discoveries is that relating to some of the parasitic *Cymothoidæ*, as to which Bullar has shown that the same individual can be developed first as a male and then as a female. Of lately-discovered species the most striking is one of the deep-sea Cirolanidæ, *Bathynomus giganteus*, A. M. Edwards, 1879, which is unique in having supplementary ramified branchiæ developed at the bases of the pleopods. Its eyes are said to contain nearly 4000 facets. The animal attains what in this order is the monstrous size of 9 inches by 4. A general uniformity of the trunk-limbs in Isopoda justifies the ordinal name, but the valviferous Astacillidæ, and among the Asellota the Munnopsidæ, offer some remarkable exceptions to this characteristic. Among many essential works on this group may be named the *Monogr. Cymothoarum* of Schiödte and Meinert, 1879–1883; "*Challenger*" *Report*, Beddard, 1884–86; *Cirolanidæ*, H. J. Hansen, 1890; *Isopoda Terrestria*, Budde-Lund, 1885; *Bopyridæ*, Bonnier, 1900; *Crustacea of Norway*, vol. ii. (Isopoda), Sars, 1896–99, while their multitude precludes specification of important contributions by Benedict, Bovallius, Chilton, Dohrn, Dollfus, Fraisse, Giard and Bonnier, Harger, Haswell, Kossmann, Miers, M'Murrich, Norman, Harriet Richardson, Ohlin, Studer, G. M. Thomson, A. O. Walker, Max Weber, and many others.

7. Amphipoda.—As in the genuine Isopoda, the eyes of Amphipoda are always sessile, and generally paired, and, in contrast to crabs and lobsters, these two groups have only four pairs of mouth-organs instead of six, but seven pairs of trunk-legs instead of five. From the above-named isopods the present order is strongly differentiated by having heart and breathing organs not in the pleon, but in the peræon, or middle body, the more or less simple branchial vesicles being attached to some or all of the last six pairs of trunk-legs. Normally the pleon carries six pairs of two-branched appendages, of which the first three are much articulated flexible swimming feet, the last three few-jointed comparatively indurated uropods. There are three tribes, *Gammaridea*, *Caprellidea*, *Hyperiidea*. The middle one contains but two families, the cylindrical and often thread-like skeleton shrimps, Caprellidæ, and their near cousins, the broad, flattened, so-called whale-lice, Cyamidæ. This tribe has the pleon dwindled into insignificance, whereas in the other two tribes it is powerfully developed. The Hyperiidea are distinguished by having their maxillipeds never more than three-jointed. In the companion tribes these appendages have normally seven joints, and always more than three. The order thus sharply divided is united by an intimate interlacing of characters, and forms a compact whole at present defying intrusion from any other crustacean group. Since 1775, when J. C. Fabricius instituted the genus *Gammarus* for five species, of which only three were amphipods, while he left five other amphipods in the genus *Oniscus*, from this total of eight science has developed the order, at first very slowly, but of late by great leaps and bounds, so that now the *Gammaridea* alone comprise more than 1300 species, distributed among some 300 genera and 39 families. They burrow in the sands of every shore; they throng the weeds between tide-marks; they ascend all streams; they are found in deep wells, in caverns, in lakes; in Arctic waters they swarm in numbers beyond computation; they find lodgings on crabs, on turtles, on weed-grown buoys; they descend into depths of the ocean down to hundreds or thousands of fathoms; they are found in mountain streams as far above sea-level as some of their congeners live below it. The Talitridæ, better known as sandhoppers, can forego the briny shore and content themselves with the damp foliage of inland forests or casual humidity in the crater of an extinct volcano. Over the ocean surface, as well as at various depths, float and swim innumerable *Hyperiidea*—the wonderful *Phronima*, glass-like in its glassy barrel hollowed out of some Tunicate; the *Cystisoma*, 4 or 5 inches long, with its eye-covered head; the *Rhabdosoma*, like a thin rod of glass, with needle-like head and tail, large eyes, but limbs and mouth-organs all in miniature, and the second antennæ of the male folding up like a carpenter's rule (Fig. 4). On jelly-fishes are to be found species of *Hyperia* and their kindred, so fat and wholesome that they have been commended to shipwrecked men in open boats as an easily procurable resource against starvation. Many of the amphipoda are extremely voracious. Some of them are even cannibals. The Cyamidæ afflict the giant whale by nibbling away its skin; the *Chelura terebrans* is destructive to submerged timber. But, on the other hand, they largely help to clear the sea and other waters of refuse and carrion, and for fishes, seals, and whales they are food desirable and often astoundingly copious. From the little flea-like species, scarcely a tenth of an inch long, up to the great and rare but cosmopolitan *Eurythenes gryllus* (Lichtenstein), and the still larger *Alicella gigantea*, Chevreux, nearly half a foot long, captured by the prince of Monaco from a depth of 2936 fathoms, not one of these ubiquitous, uncountable hordes has ever been accused of assailing man. For the naturalist they have the recommendation that many are easy to obtain, that most, apart from the very minute, are easy to handle, and that all, except as to the fleeting colours, are easy to preserve. A nearly complete bibliography of the order down to 1888 will be found in the "*Challenger*" *Reports*, vol. xxviii., and supplementary notices in della Valle's *Monograph of the Gammarini*, 1893, the scope of his work, however, not covering the Hyperiidea and Oxycephalidæ of Bovallius, 1889, 1890; but since these dates very numerous additions to the literature have been made by Birula, Bonnier, Norman, Walker, and others, especially the *Crustacea of Norway*, vol. i. (*Amphipoda*), Sars, 1890–95, demanding attention, and the quite recent *Amphipoda of the Hirondelle*, Chevreux, 1900, and *Hyperiidea of the Plankton-Expedition*, Vosseler, 1901.

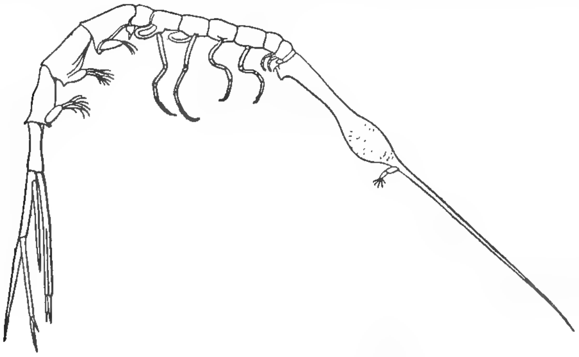

Fig. 4.—*Rhabdosoma Piratum*, Stebbing.

(T. R. R. S.)

Malaga, a maritime province of southern Spain. It has an area of 2823 miles, and had a population of 519,977 in 1887 and 490,331 in 1897. It is divided into 14 administrative districts and 103 parishes. The birth-rate is 3·95 per cent., the death-rate 3·49 per cent., and the proportion of illegitimate births 3·42 per cent. The decrease in population was due to emigration to Brazil, the Argentine, and French Algeria. Communication by state, provincial, and municipal roads has been somewhat improved since 1890, but only very slightly. There are only 50 miles of first-class roads. A railway has been built from Bobadilla to Algeciras, and other lines have been planned. The province is one of the most backward as regards education. Agriculture has not much improved, despite the fertility of the soil. In 1895, 330,380 acres were devoted to wheat, 21,250 to chick-peas and beans, and 35,000 to vines. Beetroot and sugar-cane alone have been grown in larger proportion to meet the demands of the manufacturers, which increased greatly on the loss of the colonial imports of sugar. The live stock in 1895 included 5504 horses, 9759 mules, 11,835 asses, 19,499 cattle, 62,366 sheep, 77,951 goats, 29,185 pigs. In 1898 eight iron mines had an output of 26,142 tons. There is little other mining industry, but 182 mines (141 iron) are registered, though unproductive. Manufactures have advanced somewhat, especially distilling, since the almost prohibitive duties were laid on foreign alcohols. The sugar factories are some of the most prosperous in Spain. The fisheries are important, giving occupation to about 300 boats, which bring in annually 18,000,000 ℔ of fish, nearly 25 per cent. of which is exported.

Malaga, the capital of the above province, is a rapidly growing seaport and a busy railway terminus. Its population was 134,016 in 1887, and in 1897, 125,434. The popularity of the town as a winter resort has increased with the spread of well-built suburbs into the rich, beautiful country that lies all around, invalids attracted by the climate being at last able to find, in the new quarters, abodes that are both healthy and pleasant. There are fine, broad streets and squares, gardens, promenades, and other improvements, due as much to private enterprise as to the municipal authorities. On the outskirts, too, are several factories that have been started for many local industries: iron foundries, distilling, and manufactures of textiles, sugar, soap, and chemicals. The trade, however, is chiefly in agricultural products, wine, and minerals. The movement of shipping in the port is considerable. In 1898 the shipping totalled 1874 vessels of 1,404,531 tons (1412 of 905,117 tons Spanish). Of the foreign shipping nearly half was British. Among the principal imports in 1898 were 27,847 tons of coal, 5897 tons of pod fruit, 3877 tons of guano, 1012 of iron of all kinds, and 395 tons of machinery. The principal exports in 1898 were olive oil 30,547 tons, almonds 1613 tons, barley 3212 tons, chick-peas 1660 tons, lemons 5056 tons, oranges 1265 tons, raisins 6516 tons, lead 23,132 tons. The quantity of wine exported was 2,234,855 gallons, a slight increase on 1897. Lemons, oranges, and wine went mostly to England; lead to France. The raisin crop was 600,000 boxes, and the olive also increased remarkably. The wine trade has fallen off considerably, owing to a variety of reasons, but latterly the demand for the better class of least-adulterated wines has increased. After much of the general trade of the port had been lost, the harbour works have been so far completed as to enable ships of considerable size to discharge on the quays directly, and to load, as a line of railway connects them with the main system. The average depth of the harbour is 30 to 32 feet, the minimum 23 feet. The local corporations have turned into a "park" and public promenade several acres of land redeemed from the sea, have extended the use of electric light, and have developed the tramways.

Malakoff, town, arrondissement of Sceaux, department of Seine, France, lying south by west of Paris, close to the fortifications and on the road to Montrouge. The church contains a painting by Philippe de Champagne of "The Flight into Egypt." The town is quite modern, having its origin in a village named California, founded about 1848, but owing its present name to a building erected by a local benefactor, Alexander Chauvelot, which he called the Tower of Malakoff, in commemoration of that captured at Sebastopol by MacMahon. This tower was taken down in 1870, lest it should serve as a mark for the Prussians. After the war the place grew rapidly, and in 1884 it became a separate commune. Population (1896), 10,796; (1901), 14,341.

Malan, Solomon Cæsar (1812–1894), divine and Orientalist, was by birth a Swiss descended from an exiled French family, and was born at Geneva, 22nd April 1812, where his father, Dr Cæsar Malan, enjoyed a great reputation as a Protestant divine. From his earliest youth he manifested a remarkable faculty for the study of languages, and when he came to Scotland as tutor in the marquis of Tweeddale's family at the age of 18 he had already made progress in Sanskrit, Arabic, and Hebrew. In 1833 he matriculated at St. Edmund's Hall, Oxford; and English being almost an unknown tongue to him, he petitioned the examiners to allow him to do his paper work of the examination in French, German, Spanish, Italian, Latin, or Greek, rather than in English. But his request was not granted. After gaining the Boden and Pusey and Ellerton scholarships, he graduated 2nd class in *Lit. Hum.* in 1837. He then proceeded to India as classical lecturer at Bishop's College, Calcutta, to which post he added the duties of secretary to the Bengal branch of the Royal Asiatic Society; and although compelled by illness to return in 1840, laid the foundation of a knowledge of Tibetan and Chinese. After serving various curacies, he was presented in 1845 to the living of Broadwinsor, Dorset, which he held until 1886. During this entire period he continued to augment his linguistic knowledge, which he carried so far as to be able to preach in that most difficult language, Georgian, on a visit which he paid to Nineveh in 1872. His translations from the Armenian, Georgian, and Coptic were numerous; he also applied his Chinese learning to the determination of important points connected with Chinese religion, and published a vast number of parallel passages illustrative of the Book of Proverbs. In 1880 the University of Edinburgh conferred upon him the honorary degree of D.D. No modern scholar, perhaps, has so nearly approached the linguistic omniscience of Mezzofanti; but, like Mezzofanti, Dr Malan was more of a linguist than a critic. He made himself conspicuous by the vehemence of his opposition to Westcott and Hort's text of the New Testament, and to the transliteration of Oriental languages, on neither of which points did he in general obtain the suffrages of scholars. His extensive and valuable library, some special collections excepted, was presented by him in his lifetime to the Indian Institute at Oxford. He died at Bournemouth, 25th November 1894. His life has been written by his son. (R. G.)

Mälar, a lake of Sweden, lying immediately west of Stockholm, with an area of 449 square miles, of which 189 square miles are covered by the numerous islands which stud its waters. Length, 73 miles; breadth, one-third mile to 30 miles. Area of drainage basin, 8789 square miles, of which 1224 are occupied by lakes. The shores are deeply indented, running out in places into long winding arms. Two channels connect the lake with the Baltic—Norrström, 7⅓ feet deep at low water, on the north of the old "town" of Stockholm; and Söderström, 11½ feet deep, on the south of the same, where the outflow is regulated by a sluice (1630). The former is the channel used by vessels up to but not exceeding 350 tons. A proposal has been made to cut a new channel out of the lake at Danvik, 3¾ miles below the Söderström sluice, where the oldest dam was constructed by Gustavus Vasa in the middle of the 16th century. The difference of level between the lake and Saltsjö (the arm of the Baltic immediately below the city) is so slight (11 inches) that not infrequently the Baltic water flows into the lake. The bottom of the lake consists of a series of basins, separated by ridges; greatest depth, 200 feet; minimum depth, 30 feet. The lake is fed by several rivers, all small, and is connected with Lake Hjelmar to the south-west (i.) by the Arboga river and the Hjelmar canal, and (ii.) by the Eskilstuna river and the Thorshälla canal (1856–1860). It also has navigable connexion with the Baltic through the Södertelge canal (10 feet minimum depth). On the shores of Lake Mälar stand, besides Stockholm, the historic cities of Sigtuna, Vesterås, and Strengnäs; further, the royal castles of Drottningsholm (on Lof Island) and Gripsholm, the former built in the 17th century, the latter in 1537. Gripsholm is now, however, a museum of antiquities.

See G. Nerman, in *Ymer* (1897); and *Bihang till Kong. Svensk. Vetensk. Akad. Handlingar* (1895 and 1896); also, for the forcing of the Normalm (Stoksund) by St Olaf, king of Norway, in the year 1007, *Heimskringla*, chap. iv.

Malaria.—From the time of Hippocrates onwards the malarial or periodical fevers have engaged the attention of innumerable observers, who have suggested various theories of causation, and have sometimes anticipated—vaguely, indeed, but with surprising accuracy—the results of modern research; but the true nature of the disease remained in doubt until the closing years of the 19th century. It has now been demonstrated by a series of accurate investigations, contributed by many workers, that malaria is caused by a microscopic parasite in the blood, into which it is introduced by the bites of certain species of mosquito. Many points still remain to be explained, and the mosquito theory has not yet been universally accepted as covering the whole ground; but the main fact that malaria is so caused has been established beyond question, and it goes far to explain much that has hitherto been obscure. The discovery has also greatly stimulated the general study of this destructive group of diseases, particularly in the direction of prevention.

Causation.

History of discovery.

The successive steps by which the present position has been reached form an interesting chapter in the history of scientific progress. The first substantial link in the actual chain of discovery was contributed in 1880 by Laveran, a French army surgeon serving in Algeria. On the 6th of November in that year he plainly saw the living parasites under the microscope in the blood of a malarial patient, and he shortly afterwards communicated his observations to the Paris

Académie de Médecine. They were confirmed, but met with little acceptance in the scientific world, which was preoccupied with the claims of a subsequently discredited *Bacillus malariæ*. In 1885 the Italian pathologists came round to Laveran's views, and began to work out the life-history of his parasites. The subject has a special interest for Italy, which is devastated by malaria, and Italian science has contributed materially to the solution of the problem. The labours of Golgi, Marchiafava, Celli, and others established the nature of the parasite and its behaviour in the blood; they proved the fact, guessed by Rasori so far back as 1846, that the periodical febrile paroxysm corresponds with the development of the organisms; and they showed that the different forms of malarial fever have their distinct parasites, and consequently fall into distinct groups, defined on an etiological as well as a clinical basis—namely, the mild or spring group, which includes tertian and quartan ague, and the malignant or "æstivo-autumnal" group, which includes a tertian or a semi-tertian and the true quotidian type. Three distinct parasites, corresponding with the tertian, quartan, and malignant types of fever, have been described by Italian observers, and the classification is generally accepted; intermediate types are ascribed to mixed and multiple infections. So far, however, only half the problem, and, from the practical point of view, the less important half, had been solved. The origin of the parasite and its mode of introduction into the blood remained to be discovered. An old popular belief current in different countries, and derived from common observation, connected mosquitoes with malaria, and from time to time this theory found support in more scientific quarters on general grounds, but it lacked demonstration and attracted little attention. In 1894, however, Manson, arguing with greater precision by analogy from his own discovery of the cause of filariasis and the part played by mosquitoes, suggested that the malarial parasite had a similar intermediate host outside the human body, and that a suctorial insect, which would probably be found to be a particular mosquito, was required for its development. Following up this line of investigation, Ross in 1895 found that if a mosquito sucked blood containing the parasites they soon began to throw out flagellæ, which broke away and became free; and in 1897 he discovered peculiar pigmented cells, which afterwards turned out to be the parasites of æstivo-autumnal malaria in an early stage of development, within the stomach-wall of mosquitoes which had been fed on malarial blood. He further found that only mosquitoes of the genus *Anopheles* had these cells, and that they did not get them when fed on healthy blood. Then, turning his attention to the malaria of birds, he worked out the life-history of these cells within the body of the mosquito. "He saw that they increased in size, divided, and became full of filiform spores, then ruptured and poured out their multitudinous progeny into the body-cavity of their insect host. Finally, he saw the spores accumulate within the cells of the salivary glands, and discovered that they actually passed down the salivary ducts and along the grooved hypopharynx into the seat of puncture, thus causing infection in a fresh vertebrate host" (Sambon). To apply these discoveries to the malaria of man was an obvious step. In working out the details the Italian school have again taken a prominent part.

Experiment.

Thus we get a complete scientific demonstration of the causation of malaria in three stages: (1) the discovery of the parasite by Laveran; (2) its life-history in the human host and connexion with the fever demonstrated by the Italian observers; (3) its life-history in the alternate host, and the identification of the latter with a particular species of mosquito by Ross and Manson. The conclusions derived from the microscopical laboratory were confirmed by actual experiment. In 1898 it was conclusively shown in Italy that if a mosquito of the *Anopheles* variety bites a person suffering from malaria, and is kept long enough for the parasite to develop in the salivary gland, and is then allowed to bite a healthy person, the latter will in due time develop malaria. The converse proposition, that persons efficiently protected from mosquito bites escape malaria, has been made the subject of several remarkable experiments. One of the most interesting was carried out in 1900 for the London School of Tropical Medicine by Dr Sambon and Dr Low, who went to reside in one of the most malarious districts in the Roman Campagna during the most dangerous season. Together with Signor Terzi and two Italian servants, they lived from the beginning of July until the 19th of October in a specially protected hut, erected near Ostia. The sole precaution taken was to confine themselves, between sunset and sunrise, to their mosquito-proof dwelling. All escaped malaria, which was rife in the immediate neighbourhood. Mosquitoes caught by the experimenters, and sent to London, produced malaria in persons who submitted themselves to the bites of these insects at the London School of Tropical Medicine. Experiments in protection on a larger scale, and under more ordinary conditions, have been carried out with equal success by Professor Celli and other Italian authorities. The first of these was in 1899, and the subjects were the railway-men employed on certain lines running through highly malarious districts. Of 24 protected persons, all escaped but four, and these had to be out at night or otherwise neglected precautions; of 38 unprotected persons, all contracted malaria except two, who had apparently acquired immunity. In 1900 further experiments gave still better results. Of 52 protected persons on one line, all escaped except two, who were careless; of 52 protected on another line, all escaped, while of 51 unprotected persons, living in alternate houses, all suffered except seven. Out of a total of 207 persons protected in these railway experiments, 197 escaped. In two peasants' cottages in the Campagna, protected with wire netting by Professor Celli, all the inmates—10 in number—escaped, while the neighbours suffered severely; and three out of four persons living in a third hut, from which protection was removed, owing to the indifference of the inmates, contracted malaria. In the malarious islet of Asinara a pond of stagnant water was treated with petroleum and all windows were protected with gauze. The result was that the houses were free from mosquitoes, and no malaria occurred throughout the entire season, though there had been 40 cases in the previous year. Eight Red Cross ambulances, each with a doctor and attendant, were sent into the most malarious parts of the Campagna in 1900. By living in protected houses and wearing gloves and veils at night, all the staff escaped malaria except one or two attendants. These and other experiments, described by Dr Manson in the *Practitioner* for March 1900, confirming the laboratory evidence as they do, leave no doubt whatever of the correctness of the mosquito-parasitic theory of malaria. It is possible, though not probable, that malaria may also be contracted in some other way than by mosquito bite, but there are no well-authenticated facts which require any other theory for their explanation. The alleged occurrence of the disease in localities free from mosquitoes or without their agency is not well attested; its absence from other localities where they abound is accounted for by their being of an innocent species, or—as in England—free from the parasite. The old theory of paludism or of a noxious miasma exhaled from the ground is no longer necessary. The broad facts on which it is based are sufficiently accounted for by the habits of mosquitoes. For instance, the swampy character of malarial areas is explained by their breeding in stagnant water; the effect of drainage, and the general immunity of high-lying, dry localities, by the lack of breeding facilities; the danger of the night air, by their nocturnal habits; the comparative immunity of the upper storeys of houses, by the fact that they fly low; the confinement of malaria to well-marked areas and the diminution of danger with distance, by their habit of clinging to the breeding-grounds, and not flying far. Similarly, the subsidence of malaria during cold weather and its seasonal prevalence find an adequate explanation in the conditions governing insect life. At the same time it should be remembered that many points await elucidation, and it is unwise to assume conclusions in advance of the evidence.

Parasites.

With regard to the parasites which are the actual cause of malaria in man, an account of them is given under the heading of PATHOLOGY (*Parasitic Diseases*), and little need be said about them here. They belong to the group of Protozoa, and, as already explained, have a double cycle of existence: (1) a sexual cycle in the body of the mosquito, (2) an asexual cycle in the blood of human beings. They occupy and destroy the red corpuscles, converting the hæmoglobin into melanin; they multiply in the blood by sporulation, and produce accessions of fever by the liberation of a toxin at the time of sporulation (Ross). The number in the blood in an acute attack is reckoned by Ross to be not less than 250 millions. A more general and practical interest attaches to the insects which act as their intermediate hosts. These mosquitoes or gnats—the terms are synonymous—belong to the family *Culicidæ* and the genus *Anopheles*, which was first classified by Meigen in 1818. It has a wide geographical distribution, being found in Europe (including England), Asia Minor, Burma, Straits Settlements, Java, China, Formosa, Egypt, West, South, and Central Africa, Australia, South America, West Indies, United States, and Canada, but is generally confined to local centres in those countries. About fifty species are recognized at present. It is believed that all of them may serve as hosts of the parasite. The species best known in connexion with malaria are *A. maculipennis* (Europe and America), *A. funestus*, and *A. costales* (Africa). In colour *Anopheles* is usually brownish or slaty, but sometimes buff, and the thorax frequently has a dark stripe on each side. The wings in nearly all species have a dappled or speckled appearance, owing to the occurrence of blotches on the front margin and to the arrangement of the scales covering the veins in alternating light and dark patches (Austen). The genus with which *Anopheles* is most likely to be confounded is *Culex*, which is the commonest of all mosquitoes, has a world-wide distribution, and is generally a greedy blood-sucker. A distinctive feature is the position assumed in resting; *Culex* has a hump-backed attitude, while in *Anopheles* the proboscis, head, and body are in a straight line, and in many species inclined at an angle to the wall, the tail sticking outwards. In the female of *Culex* the palpi are much shorter than the proboscis; in *Anopheles* they are of the same length. The wings in *Culex* have not the same dappled appearance. *Anopheles* is also a more slender insect, with a smaller head, narrower body, and thinner legs. There are further differences in the other stages of life. Mosquitoes go through four phases: (1) ovum, (2) larva, (3) nympha, (4) complete insect. The ova of *Anopheles* are tiny black rod-shaped objects, which are deposited on the water of natural puddles, ponds, or slowly-moving streams, by preference those which are well supplied with vegetation; they float singly or attached to other objects or clustered together in patterns. They can live in brackish, and even in sea water. The lava has no breathing-tube, and floats horizontally at the surface, except when feeding; it does not frequent sewage or foul water. The ova of *Culex*, on the other hand, are deposited in any stagnant water, including cesspools, drains, cisterns, or water collected in any vessel; they float in boat-shaped masses on the surface. The lava has a breathing-tube, and floats head downwards; when disturbed, it wriggles to the bottom (Christy). Some observers maintain that *Anopheles* does not "sing" like the common mosquito, and its bite is much less irritating. Only the females suck blood; the act is believed to be necessary for fertilization and reproduction. *Anopheles* rarely bites by day, and then only in dark places. In the daytime "the gorged females rest motionless on the walls and ceilings of rooms, choosing always the darkest situations for this purpose" (Austen). In temperate climates the impregnated females hibernate during the winter in houses, cellars, stables, the trunks of trees, &c., coming out to lay their eggs in the spring. The four phases are passed in thirty days in a favourable season, and consequently there are ordinarily four or five generations from April to September (Celli).

The most important question raised by the mosquito-parasitic theory of malaria is that of prevention. This may be considered under two heads: (1) individual prophylaxis; (2) administrative prevention on a large scale.

Prophylaxis.

(1) In the first place, common sense suggests the avoidance, in malarious countries, of unhealthy situations, and particularly the neighbourhood of stagnant water. Among elements of unhealthiness is next to be reckoned the proximity of native villages, the inhabitants of which are infected. In the tropics "no European house should be located nearer to a native village than half a mile" (Manson); and since children are almost universally infected, "the presence of young natives in the house should be absolutely interdicted" (Manson). When unhealthy situations cannot be avoided, they may be rendered more healthy by destroying the breeding-grounds of mosquitoes in the neighbourhood. All puddles and collections of water should be filled in or drained; as a temporary expedient they may be treated with petroleum, which prevents the development of the larvæ. When a place cannot be kept free from mosquitoes the house may be protected, as in the experiments in Italy, by wire gauze at the doors and windows. The arrangement used for the entrance is a wire cage with double doors. Failing such protection mosquito curtains should be used. Mosquitoes in the house may be destroyed by the fumes of burning sulphur or tobacco smoke. According to the experiments of Celli and Casagrandi, these are the most effective culicides; when used in sufficient quantity they kill mosquitoes in one minute. The same authorities recommend a powder composed of larvicide (an aniline substance), chrysanthemum flowers, and valerian root, to be burnt in bedrooms. Anointing the skin with strong-smelling substances is of little use in the open air, but more effective in the house; turpentine appears to be the best. Exposure at night should be avoided. All these prophylactic measures are directed against mosquitoes. There remains the question of protection against the parasite. Chills are recognized as predisposing both to primary infection and to relapses, and malnutrition is also believed to increase susceptibility; both should therefore be avoided. Then a certain amount of immunity may be acquired by the systematic use of quinine. Manson recommends five to ten grains once or twice a week; Ross recommends the same quantity every day before breakfast.

There is some evidence that arsenic has a prophylactic effect. An experiment made on the railway staff at Bovino, a highly malarious district on the Adriatic, gave a striking result. The number of persons was 78, and they were divided into two equal groups of 39 each. One group was treated with arsenic, and of these 36 escaped altogether, while three had mild attacks; the remaining 39, who were not treated, all had fever. In a more extended experiment on 657 railway-men, 402 escaped. This was in 1889, but in spite of the encouraging results the use of arsenic does not appear to have made any further progress. Experiments in immunizing by sero-therapeutic methods have not as yet met with success.

Administrative measures.

(2) Much attention has been directed in scientific circles to the possibility of "stamping out" epidemic malaria by administrative measures. The problem is one of great practical importance, especially to the British empire. There are no data for estimating the damage inflicted by malaria in the British colonies. It is, indeed, quite incalculable. In Italy the annual mortality from this cause averages 15,000, which is estimated to represent two million cases of sickness and a consequent loss of several million francs. In British tropical possessions the bill is incomparably heavier. There is not only the heavy toll in life and health exacted from Europeans, but the virtual closing of enormous tracts of productive country which would otherwise afford scope for British enterprise. The "deadly" climates, to which so much dread attaches, generally mean malaria, and the mastery of this disease would be equivalent to the addition of vast and valuable areas to the empire. The problem, therefore, is eminently one for the statesman and administrator. A solution may be sought in several directions, suggested by the facts already explained. The existence of the parasite is maintained by a vicious interchange between its alternate hosts, mosquitoes and man, each infecting the other. If the cycle be broken at any point the parasite must die out, assuming that it has no other origin or mode of existence. The most effective step would obviously be the extermination of the *Anopheles* mosquito. A great deal may be done towards this end by suppressing their breeding-places, which means the drying of the ground. It is a question for the engineer, and may require different methods in different circumstances. Put comprehensively, it involves the control of the subsoil and surface waters by drainage, the regulation of rivers and floods, suitable agriculture, the clearing of forests or jungles, which tend to increase the rainfall and keep the ground swampy. The city of Rome is an example of what can be done by drainage; situated in the midst of malaria, it is itself quite healthy. A systematic campaign for the destruction of breeding-places has been inaugurated in the British West African colonies, with encouraging results. The planting of eucalyptus trees is out of favour at present, but it appears to have been successful in Portugal, not from any prophylactic virtues in the plant, but through the great absorption of moisture by its deep roots, which tend to dry the subsoil. Treating the breeding-ponds with petroleum or similar preparations seems to be hardly applicable on a large scale, and in any case can only be a temporary expedient. Short of suppressing mosquitoes, the parasitic circle may theoretically be broken by preventing them from giving the infection to man or taking it from him. The means of accomplishing the former have been already pointed out, but they are obviously difficult to carry out on a large scale, particularly in native communities. It is one thing to protect individuals from mosquito bites, another to prevent the propagation of the parasite in a whole community. Perhaps the converse is more feasible in some circumstances—that is to say, preventing mosquitoes from having access to malarial persons, and so propagating the parasite in themselves. It could be carried out where the infected persons are few, by isolating and protecting them, but not where many are infected, as in native villages. Koch has suggested that the disinfection of malarial persons by quinine would have the desired effect, but other authorities of greater experience do not consider it practicable. In spite of the difficulties, however, there is no doubt that a great deal can be done to reduce, if not stamp out, malaria by the methods indicated, which should be applied according to circumstances. An encouraging example is afforded by the remarkable fact that malaria, which was once rife in certain districts of England, has now died out, although the *Anopheles maculipennis* mosquito still exists there. The parasitic cycle has been broken, and the insect is no longer infected. The suggested causes are (1) reduction of insects by drainage, (2) reduced population, (3) the use of quinine. Dr Manson has suggested that the problem of stamping out malaria may be assisted by the discovery of some at present unknown factors. He has pointed out that certain areas and certain islands are entirely free from the disease, while neighbouring areas and islands are devastated. This immunity is apparently not due to the absence of favourable conditions, but rather to the presence of some inimical factor which prevents the development of the parasite. If this factor could be discovered it might be applied to the suppression of the disease in malarious localities.

A few other points may be noted. The pathological changes in malaria are due to the deposition of melanin and the detritus of red corpuscles and hæmoglobin, and to the congregation of parasites in certain sites (Ross). In chronic cases the eventual effects are anæmia, melanosis, enlargement of the spleen and liver, and general cachexia. Apparently the parasites may remain quiescent in the blood for years, and may cause relapses by fresh sporulation. Recent discoveries have done little or nothing for treatment. Quinine still remains the one specific. In serious cases it should not be given in solid form, but in solution by the stomach, rectum, or—better—hypodermically (Manson). According to Ross, it should be given promptly, in sufficient doses (up to 30 grains), and should be continued for months. Euquinine is by some preferred to quinine, but it is more expensive. The nature of immunity is not known. Some persons are naturally absolutely immune (Celli), but this is rare; immunity is also sometimes acquired by infection, but as a rule persons once infected are more predisposed than others. Races inhabiting malarious districts acquire a certain degree of resistance, no doubt through natural selection. Children are much more susceptible than adults.

Blackwater fever is a disease occurring in tropical countries and elsewhere, which is often classed with malaria. It is characterized by irregular febrile paroxysms, accompanied by rigors, bilious vomiting, jaundice, and hæmoglobinuria (Sambon). It has a wide geographical distribution, including tropical Africa, parts of Asia, the West Indies, the southern United States, and —in Europe—Greece, Sicily, and Sardinia; but its range is not coextensive with malaria. Malarial parasites have occasionally been found in the blood. Some authorities believe it to be caused by the excessive use of quinine, taken to combat malaria. This theory has the support of Koch, but is not generally accepted. If it were correct, one would expect blackwater fever to be regularly prevalent in malarial countries and to be more or less coextensive with the use of quinine, which is not at all the case. It often resembles yellow fever, but the characteristic black vomit of yellow fever rarely occurs in blackwater fever, while the black urine from which the latter derives its name is equally rare in the former. According to the new school of tropical parasitology, blackwater fever is neither a form of malaria nor produced by quinine, but a specific disease due to a protozoal parasite not yet identified, but akin to that which causes the redwater fever of cattle.

Malaria in the Lower Vertebrates.—Birds are subject to malaria, which is caused by blood parasites akin to those in man and having a similar life-history. Two species, affecting different kinds of birds, have been identified. Their alternate hosts are mosquitoes of the *Culex* genus. Oxen, sheep, dogs, monkeys, bats, and probably horses also suffer from similar parasitic diseases. In the case of oxen the alternate host of the parasite is a special tick (Smith and Kilborne). In the other animals several parasites have been described by different observers, but the alternate hosts are not known.

AUTHORITIES.—CELLI. *Malaria.*—CHRISTY. *Mosquitoes and Malaria.*—MANSON. *Tropical Diseases.*—Appendix to Allbutt's *System of Medicine.*—ROSS. "Malaria," Quain's *Dictionary of Medicine*, 3rd edition.—*The Practitioner*, March 1901 (Malaria Number).

Malatia, or ASPUZU, the chief town of a sanjak of the same name in the Memuret el-Aziz vilâyet of Asia Minor, and a military station on the Samsún–Sivas–Diarbekr road, altitude 2900 feet, situated about 10 miles south-west of the junction of the Tokhma Su with the Euphrates, near the south end of a fertile plain. It has been rebuilt since the earthquake of 1893, contains fine public buildings, and is noted for its fruit orchards. There are Protestant (American) and Roman Catholic missions. During the massacres of 1895 about 3000 Gregorian and Protestant Armenians perished, and many churches and houses were destroyed. The population comprises 26,800 Moslems, Kúrds, and Kizilbash, and 3200 Armenians. Old Malatia (*Melitene*), which lies 5 miles to the north-east, is deserted. The earliest site was possibly Arslan Tepe, where "Hittite" remains have been found.

Malay Archipelago.—The Malay, or Indian, Archipelago, as now restricted, ethnogeographically includes the Sunda Islands, the Moluccas, New Guinea, and the Philippine Islands, but excludes the Andaman-Nicobar group. Politically the whole of the archipelago (except a moiety of Borneo (British) and of Timor (Portuguese), New Guinea, east of the 141st meridian (British and German), and the Philippine Islands), belongs to the Netherlands. The Philippine Islands, which had been for several centuries a possession of the Spanish Crown, passed in 1898 by conquest to the United States of America.

In regard to the extent and population of the archipelago, the area of the Dutch possessions has been computed to be rather less than formerly stated; but the population has greatly increased.

	Area.	Population.	
		1897.	1900.
Sunda Islands . .	459,578	32,500,000	32,632,400
Moluccas, with Celebes	115,334	2,397,000	3,000,000
New Guinea . .	151,789	800,000	800,000[1]
Philippine Islands .	11,440	7,450,000	8,000,000

In regard to physical geography, the result of investigations in the island of Celebes, which was considered to belong to the eastern (or Austro-Malayan) biological subregion, proves it to have a somewhat closer affinity with the Indian region, so that it would seem to have been connected longer with Asian than with the Australasian lands.

The most notable fact in the geological history of the archipelago is the discovery in Java of the fossil remains of *Pithecanthropus erectus*, a form intermediate between the higher apes and man. In its structure and cranial capacity it is entitled to a higher place in the zoological scale than any anthropoid, for it walked almost certainly erect; and, on the other hand, in its intellectual powers it must have been much below the lowest of the human race at present known. The strata in which it was found belong to the Miocene or Upper Pliocene. Another notable event, unprecedented even in the history of so volcanic a region as the archipelago, was the disastrous eruption of Krakatoa in 1883, a little island-crater situated in the Strait of Sunda, between Java and Sumatra. The effects of the eruption were recognizable over a wider area of the globe than any other on record. The noise of the final explosion travelled farther than any previous sound is known to have reached. The marine and aërial waves generated by it travelled several times round the globe, and some of the débris projected into the atmosphere—causing in many parts of the world very brilliant sunset effects—fell even in Europe.

Ethnologically some considerable advances in our knowledge of the races of the Indian Archipelago have been made. The Malays (*q.v.*) predominate in the Sunda Islands, and have spread sporadically over the eastern half of the archipelago, in which the Melanesian is now the race of the soil. "The Malays, as known to us in the purer Atjinese and Sundanese—a race developed through the commingling of Caucasian and predominating Mongol blood in Indo-China—were the last incursionists into the region. They followed an earlier pure Caucasian migration, known as Polynesians, whose last remnants in the archipelago linger in the Mentawi Islands on the west coast of Sumatra, who drove the Negrito autochthones of the archipelago out into the remote interior of the Philippine and other islands, and were themselves overwhelmed by the half-breeds of Mongol and predominating Caucasian blood, now known as Indonesians, of whom the Battaks and Dyaks are survivors. In like manner the Melanesians of the Solomon and New Hebrides Islands, migrating westwards over the eastern part of the archipelago, partly supplanted, partly commingled with the Negrito autochthones and these Caucasian (Polynesian) pre-incursionists, whose strain appears still in many of the people, as well in their language as in their customs." (Forbes.)

Here we shall deal with the Dutch East Indies as a whole, the different islands being considered under their own headings.

The Dutch possessions in Asia lie between 6° N. and 11° S. and 95° E. and 141° E. Politically they are divided into lands under the direct government of the Netherlands, vassal lands, and confederated lands. Administratively they are further divided into residencies, divisions, regencies, districts, and *dessas* or villages. They are often described as of two groups, Java and Madura forming one, and the other consisting of Sumatra, Borneo, Riouw-Lingga Archipelago, Banca, Billiton, Celebes, Molucca Archipelago, the small Sunda Islands, and a part of New Guinea—the Outposts as they are collectively named. A governor-general holds the superior administrative and executive authority, and is assisted by a council of five members, partly of a legislative and partly of an advisory character, but with no share in the executive work of the government. The governor-general not only has supreme executive authority, but can of his own accord pass laws and regulations, except in so far as these, from their nature, belong of right to the home government, and as he is bound by the constitutional principles on which, according to the *Regulations for the Government of Netherlands India*, passed by the king and States-General in 1854, the Dutch East Indies must be governed. The following table gives the area and population of Java (including Madura) and of the Outposts:—

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[1] Estimate.

		Area: English Square Miles.	Population in 1897.	Density per Square Mile.
	Java and Madura	50,554	26,125,053	517
Island of Sumatra	Sumatra, West Coast	31,649	1,353,515[1]	42
	Sumatra, East Coast	35,312	335,432[2]	9
	Bencoolen	9,399	158,767[2]	17
	Lampong	11,284	137,501[1]	12
	Palembang	53,497	692,317[1]	13
	Atjeh	20,471	531,705[2]	26
	Riouw-Lingga Archipelago	16,301	107,861[2]	6
	Banca	4,446	93,600[1]	21
	Billiton	1,863	41,558[1]	22
	Borneo, West Coast	55,825	370,775[2]	6
	Borneo, South and East Districts	156,912	809,803[3]	5
Island of Celebes	Celebes	49,390	1,448,722[3]	29
	Menado	22,080	549,138[3]	25
	Molucca Islands	43,864	399,208[2]	9
	Timor Archipelago	17,698	119,239[2]	6
	Bali and Lombok	4,065	1,044,757[3]	256
	New Guinea to 141° E. long.[4]	151,789	200,000[3]	1
	Total	736,399	34,518,951[5]	40

The total number of Europeans and persons assimilated to them at the beginning of 1896 was 35,489 males and 27,826 females; of these 33,055 males and 27,222 females were Dutch, of whom 25,351 males and 23,648 females were born in the East Indies; of the remainder, 1192 were German, 300 French, 318 English, 184 Swiss, 292 Belgians; the remainder being mostly Austrians and Armenians. Of the remaining population about 469,500 were Chinese, 24,400 Arabs, and 11,600 other Orientals, and the rest natives.

The movement of population between Europeans and persons assimilated to them was as follows:—

		Marriages.	Births.	Deaths.
1889	Java and Madura	443	2126	1473
	Outposts	122	626	904
1894	Java and Madura	541	2343	1192
	Outposts	109	691	387
1898	Java and Madura	647	1916	1227
	Outposts	111	489	484

The population of the principal towns in January 1897 was:—

	Europeans.	Natives.	Chinese.	Arabs.	Other Orientals.	Total.
Batavia	9423	76,751	26,433	2828	132	115,567
Samarang	3355	67,236	11,870	765	1040	84,266
Surabaya[6]	6988	121,075	12,133	2332	452	142,980
Surakarta	1370	79,802	4,571	85	246	86,074
Jokjokarta	2240	54,219	3,836	86	142	60,523
Palembang	243	46,655	4,463	1797	125	53,283

Religion and Instruction.—Entire liberty is granted to the members of all religious confessions. In 1899 the Reformed Church counted 37 ministers and 24 assistants, the Roman Catholic 31 curates and 17 priests, not salaried out of the public funds. The number of Christians among the natives and foreign Orientals was:—

In Java and Madura in 1873 . 5,673, and in 1896 . 19,193
,, the Outposts ,, . 148,672 ,, ,, . 290,065

In 1900, 141 missionaries of various societies were working to propagate Christianity in the Dutch East Indies. In 1899, 7694 natives went to Mecca on pilgrimage, of whom 6652 returned.

For the education of Europeans and persons assimilated with them there were, in 1899, 7 public middle-class schools, with 1051 pupils and 118 teachers. The cost of these schools to the Government in the same year was 591,332 guilders, and the revenue out of the school fees 87,211 guilders. In 1899 there were for Europeans 135 mixed public elementary schools, and 30 for girls only, with 20 private schools, or a total of 185 elementary schools. The 165 public schools had a teaching staff of 546, and an attendance of 15,132 pupils, whereof 1626 were natives; and the 20 private schools a teaching staff of 166, and an attendance of 3270 pupils. The cost of the public elementary schools was, in 1899, 2,546,529, and the income 284,095 guilders.

The following statement relates to schools for natives:—In 1899 Dutch India had 5 normal schools, with 27 teachers and 144 pupils; besides, there were 4 schools for sons of native chiefs, with 202 pupils. The elementary schools for natives were, for Java and Madura, in 1875: 104 Government schools with 14,906 pupils, and 132 private schools with 6978 pupils; and in 1899, 232 Government schools with 40,956 pupils, and 236 private schools with 26,524 pupils.[7] In the Outposts in 1881, 281 Government schools with 21,388 pupils, and 205 private schools with 10,696 pupils; and in 1898, 297 Government schools with 44,259 pupils, and 546 private schools with 26,847 pupils.

In 1875 the Government spent 803,906 guilders for the education of natives, and in 1899, 1,501,291 guilders. For foreign Orientals there were in 1899, 434 schools with 7637 pupils.

Justice and Crime.—The administration of justice is based on the principle that Europeans and persons assimilated with them are subject to laws nearly similar to those of the mother country, while the natives are subject to their own customs and institutions. The administration of justice for Europeans is entrusted to European judges, while for natives their own chiefs have a large share in the trial of cases. There is a High Court of Justice at Batavia—courts of justice at Batavia, Samarang, Surabaya, Padang, and Macassar—resident and regent courts, courts of circuit, district courts, and courts of priests. There are about 300 prisons; their population was 24,712 at the end of 1898. The relations of the state to pauperism are limited to subvention to Protestant and Catholic orphan houses; for this purpose the budget contains about 100,000 guilders yearly.

Finance.—The local revenue is derived from land, taxes on houses and estates, from licences, customs duties, personal imposts, the Government monopolies of salt and opium, railways, and a number of indirect taxes. But the chief part of the large profits is indirect, being obtained by the sale of a vast amount of coffee, grown under the "culture system," and sold in India and Europe.

The following table shows the revenue and expenditure for 1880, 1890, and 1900:—

Year.	Revenue.	Expenditure.	Surplus or Deficit.
	Guilders.	Guilders.	Guilders.
1880	146,838,000	146,936,000	− 98,000
1890	137,789,482	127,736,739	+ 10,052,743
1900	141,989,008	147,766,255	− 5,777,247

About one-third of the annual expenditure is for the army and navy, and another third for the general administration, both in Java and in the Netherlands.

Defence.—The army is purely colonial, and comprised at the end of 1899, 1345 officers and 39,388 non-commissioned officers and men, of whom 14,960 were Europeans, 45 Africans, 4251 Amboinese, and 20,132 natives. The number of horses was 1346. No portion of the regular army of the Netherlands is allowed to be sent on colonial service, but individual soldiers are at liberty to enlist, by permission of their commanding officers, and they form the nucleus of the army of Dutch India. Native and European soldiers are generally mixed together in the same battalions, though in separate companies. The artillery is composed of European gunners, with native riders, while the cavalry are Europeans and natives. A military academy is established at Meester Cornelis, near Batavia. Schools for soldiers are attached to every battalion. Unlike the army, which is purely colonial, the navy in Dutch India is partly colonial, partly belonging to the royal navy, and its expenses are therefore borne partly by the mother country and partly by the colony. The *personnel* in the Dutch Indies numbered in 1899 about 3300 men, thus divided: 1300 Europeans and 700 natives with the Indian marine (20 ships); about 1100 Europeans and 200 natives with the auxiliary squadron (4 ships).

Production and Industry.—The greater part of the soil of Java is claimed as Government property, and it is principally in the residencies in the western part of Java that there are private estates, chiefly owned by Europeans and by Chinese. The bulk of the people are agricultural labourers. The Government or private landowners can enforce one day's gratuitous work out of seven, or more, from all the labourers on their estates; in 1882 the greater part of these enforced services for the Government was abolished, in return for the payment of one guilder per head yearly. Great power is vested in the Resident and his European and native officials to enforce a strict adherence to all the laws regulating labour.

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[1] Tolerably accurate. [2] Approximately. [3] Mere conjecture.

[4] New Guinea belongs to the residency of Ternate, Molucca Islands.

[5] Approximate total. The population of several unexplored countries is not included.

[6] This is presumably the population of the town of Surabaya and its environs.

[7] The returns of six private schools are not included in this total.

The extent of the soil of Java and Madura regularly cultivated by the natives was, in 1899, 6,935,300 acres (1¾ acre=1 bahu). The total areas in acres under the several crops in 1899 were as follows:—rice, 5,199,160; maize, arachis, cotton and various plants, 4,331,330; sugar-cane, 265,380; tobacco, 265,810; indigo, 61,000. Thus the total area under these kinds of cultivation was 10,122,680 acres.

Owing to the "agrarian law" (1870), which has afforded opportunity to private energy for obtaining waste lands on hereditary lease (*emphyteusis*) for seventy-five years, private agriculture has greatly increased both in Java and in the Outposts. In 1899 there were ceded to 785 companies and Europeans, 967,155 acres; to 52 Chinese, 33,292 acres; to 6 natives, 2319 acres—total, 1,002,766 acres. Since 1816 no land in Java has been alienated by the Government. The lands now the property of Europeans have an extent of 2,241,170 acres; of Chinese, 470,810 acres; and of other foreign Orientals, 35,650 acres.

In 1891 the government ceased to cultivate sugar. The sugar is grown on lands hired from the natives, or on lands held on emphyteutic tenure from the Government, or on private properties. In 1891 the number of sugar estates was 211; in 1899, 207. The yield of sugar since 1894 has been as follows:—

Year.	Pounds.	Year.	Pounds.	Year.	Pounds.
1894	1,076,431,400	1896	1,126,774,900	1898	1,538,701,400
1895	1,230,003,700	1897	1,220,605,200	1899	1,608,718,400

The production of coffee in Dutch India in the years 1894–99 was, in pounds:—

Year.	Government Lands.	Free Cultivation by Natives.	Lands on Emphyteusis and on Lease.	Private Lands.	Total.
1894	52,043,252	15,671,148	60,840,919	3,277,181	131,832,500
1895	48,333,858	13,564,994	48,559,186	3,765,239	114,223,277
1896	42,164,666	10,663,066	58,309,333	4,928,000	116,065,065
1897	68,338,400	12,947,200	70,228,600	4,994,666	156,508,866
1898	17,676,800	9,814,800	27,973,600	5,104,400	60,569,600
1899	32,988,533	7,884,800	69,646,000	7,609,467	118,128,800

In 1890, 8 Government plantations produced 588,018 ℔ of cinchona; 118 plantations held on emphyteusis, 5,360,025 ℔; 2 private plantations, 58,472 ℔. In 1899 the 8 Government plantations produced 878,891 ℔; 85 plantations held on emphyteusis, 8,997,238 ℔; and 5 private plantations, 1,261,508 ℔. Of tobacco, 31,630,211 ℔ were produced from 102 plantations in Java in 1890; in Sumatra (Deli, &c.), 46,237,261 ℔ from 276 plantations. In 1899, 53,562,600 ℔ were produced from 131 plantations in Java, and 52,708,410 ℔ from 130 plantations in Sumatra (Deli, &c.). Java further produced 9,083,870 ℔ of tea in 1893, and 11,996,100 in 1899 (110 plantations); also 1,398,895 ℔ of indigo in 1890, and 1,722,890 ℔ in 1899 (129 plantations). The tin mines of Banca are worked by the Government, those of Billiton and Riouw by private enterprise. The total yield increased from 12,212 tons in 1890-91 to 16,460 tons in 1899–1900. The principal coal mines in Java, Sumatra, and Borneo yielded only 5489 tons in 1890, but 128,849 tons in 1895, and, with a steady increase, 185,636 tons in 1899, of which 181,325 tons, or 98 per cent. of the whole, came from the Ombilien coalfields in Sumatra. The production of the principal mineral oil enterprises was 1,627,560 gallons in 1891, of which 997,920 gallons came from the east coast of Sumatra; and 66,021,560 gallons in 1898, of which 45,635,480 gallons came from the east coast of Sumatra, and 20,381,020 gallons from Java (Rembang and Surabaya); but in 1899 the total production fell to 43,903,860 gallons.

At the end of 1895 there were in Java in all about 2,643,000 buffaloes, 2,572,000 oxen and cows, and 485,500 horses. Horses are never used in India for agricultural purposes.

In 1899 there were 49 printing offices, 70 ice and soda water manufacturies, 29 soap factories, 9 arrack distilleries, 15 saw-mills, and 91 rice mills.

Commerce.—The values of the imports and of the exports in 1885, 1895, and 1899 are given below in guilders:—

	1885.	1895.	1899.
Imports .	138,867,785	161,530,294	191,322,270
Exports .	188,071,688	225,087,810	250,923,258

The principal articles of export are sugar, coffee, tea, rice, indigo, cinchona, tobacco, and tin. With the exception of rice, about one-half of which is shipped to Borneo and China, nearly four-fifths of these exports go to the Netherlands.

Shipping.—The following table shows the navigation at the various ports of Netherlands India in 1897 and 1898, and the share of Great Britain in it:—

Year.	Description of Vessel.	Entered.		Whereof, from Great Britain.	
		Number.	Tons.	Number.	Tons.
1895	Steamers .	3418	1,366,077	370	416,607
	Sailing vessels	215	139,223	33	50,177
1899	Steamers .	3661	1,635,689	330	527,209
	Sailing vessels	389	84,452	24	27,915

Communications.—At the end of 1899 the total length of railways (state and private) opened for traffic was about 1300 English miles; the revenues were 17,278,000 guilders. There are about 220 post-offices; the number of letters carried in 1899 for internal intercourse was 10,674,898, while 6,774,534 newspapers, samples, &c., for the interior passed through the various post-offices in the Dutch Indies during the same year. In the same year 1,567,483 letters were carried for foreign postal intercourse. There were 4310 miles of telegraph lines in Dutch India in 1899, with 114 offices; the number of messages was 672,892. In December 1896 Batavia, Samarang, and Surabaya were connected by telephone.

Money and Credit.—The Java Bank, established in 1828, has a capital of 6,000,000 guilders and a reserve of about 1,200,000 guilders. The Government has a control over the administration. Two-fifths of the amount of the notes, assignats, and credits must be covered by specie or bullion. In March 1900 the value of the notes in circulation was 60,591,000 guilders, and of the bank operations 32,623,000. There are two other Dutch banks, besides branches of British banks. In the savings banks, including the postal savings bank, there were in the same year 22,327 depositors, with a deposited amount of £236,499, or £10, 11s. 10d. to the credit of each depositor. (H. O. F.; I. P. A. R.)

Recent Political History.—The chief political events in the Malay Archipelago since 1850 have centred in and been dominated by the *Grondwet* or fundamental law of the Netherlands, passed in 1848. For Netherlands India as for Holland it marked the beginning of a new era. It still recognized, it is true, the king as the sovereign of the colonies, but it also introduced for the first time the principle of the Dutch people's responsibilities towards Holland's dependencies in the Far East. It not only laid upon the Crown the obligation of presenting an annual report on the state of the colonies to the States-General, it likewise conferred upon the Dutch legislature the right to fix the colonial budgets periodically, and to settle the bases of colonial government. It was to carry out these new stipulations of the *Grondwet* that Mr Pahud, the Colonial Minister in the cabinet of Dr van Hall, which came into office after the fall of Thorbecke, in 1854 presented a Bill providing for the administration of the Dutch East Indies. That Bill, the so-called *Règlement*, or Government Rules, became law, and has remained in essence, although modified more than once in some of its provisions, the *Grondwet* or constitution of the Dutch colonies. The *Règlement* was virtually a compromise between two extreme parties, one pleading for the long-neglected rights of the natives and against the continuation of the so-called "culture system," involving the *corvée* on Government and seigniorial lands; the other maintaining the principle that the colonies exist to benefit the mother country, and not the mother country to benefit the colonies. The latter party gained the day, and Pahud had to make considerable concessions to get his Bill through. But although the *Règlement* did not answer the expectations and aspirations of the Reform Party, foremost among whom was Baron van Hoëvell, the lifelong and most capable advocate of native rights, yet it was a most important step on the road of progress and administrative reform in the Dutch East Indies. It substituted statutory regulations for administrative and military despotism. It created the Governor-General the *Tooan-Begar* ("Great Lord") of the natives, who, although possessing viceregal powers, yet, assisted by an Indian Council, is a functionary responsible for his acts to the Minister for the Colonies at The Hague, and bound to carry out the latter's instructions. It also instituted a supreme court at Batavia, which controls the whole judicial machinery of Netherlands India, and constitutes the final court of appeal. It abolished slavery in Java, as from 1st January 1860; it introduced freedom of the press up to a certain point, and elementary education for the natives as well. It provided for the leasing of forest lands to Europeans, made a first attempt to settle the *corvée* question on a reasonable basis, and left the door open for future reforms. Of course the *Règlement* was largely an experiment, and where so much depended upon interpretation the results were not, and could not be, always satisfactory, as all the contradictory policies of diverging Ministers for the Colonies in Holland reflected themselves in conflicting edicts of Liberal or anti-Liberal Governors-General at Batavia. It was perhaps in the vexed question of the *heerendiensten* or *corvée* that those vacillating methods of policy were most manifest and most mischievous. But, upon the whole, their tendency, despite repeated sets-back, has been towards the gradual emancipation of the natives both from the thraldom of the "culture system," of which nothing is left but the Government cultivation of coffee, and from the feudal serfdom of their native rulers. That serfdom existed in many forms all over the archipelago, but among the most curious must be reckoned the *pandelingschap* or "pledgedom," which originated in Borneo, and according to which a man had the power to make his debtors temporarily his serfs until their debts were paid, when they resumed their freedom. This abuse, and many other old abuses, have been permanently swept away, and the election of the heads of *dessas* or *kampongs* (districts or villages) by the population has at last become more of a genuine guarantee to the natives than in the post-Raffles days.

Until 1860 the colonial reform movement in Holland had been somewhat erratic, but it then became much more powerful. The chief cause of this change may be traced to the influence exercised by a remarkable book of Douwes Dekker (*q.v.*), *Max Havelaar*, which he published in 1860, with the help of Jan van Lennep, the novelist, then at the height of his literary fame, under the pseudonym of Multatuli ("I bore much"). In Dutch literature this book created a school which still endures; in the political arena it had the effect of a bombshell. The upholders of the old colonial system denied the truth of its allegations, but the friends of reform as violently hailed Douwes Dekker as a "Daniel come to judgment," and denounced the persecutions to which the author had been exposed as a Government official in Java, whilst endeavouring to palliate or uproot the abuses which *Max Havelaar* describes. The most sober-minded party men soon recognized that the palpable exaggerations of the author could not destroy some of his hardest facts, and thus the colonial reform movement made rapid strides in the decade which preceded the death of Thorbecke, who already in 1849, despite Groen van Prinsterer's opposition, had advocated necessary reforms in the Dutch administration of Insulinde, and insisted upon the duties of the motherland towards its colonies.

One of the great names connected with the Indian reform movement in the 'sixties was that of Mr Fransen Van de Putte, who, formerly a so-called "sugar lord" in Java, early in 1863 became Minister for the Colonies in Thorbecke's second ministry. To him the Dutch East Indies owe the annual introduction of a colonial budget, the most important measure concerning the Dutch colonies after the *Règlement.* It for the first time enabled the States-General effectively to control the ways and means of Holland's possessions over-sea, and it must be considered the precursor of the abolition of the *batig slot* or yearly surplus yielded up to the treasury at The Hague by the Dutch-Indian revenues, although that abolition only came in the year 1876. The same minister, Mr Fransen Van de Putte, in 1865 carried his Bill lessening materially the differentiation of import duties in favour of Dutch goods which existed previously in Netherlands India, whilst Dr Sloet Van de Beele, the then Governor-General at Batavia, introduced various reforms (see JAVA). It is true that his successor, Dr Myer, a reactionary sent out by the Van Zuylen cabinet to reverse Fransen Van de Putte's reform policy, tried to undo a good deal, yet even Dr Myer was compelled to leave many things as he found them, and he was powerless to restore the *corvée* to its former dimensions. In 1870 De Waal, then Minister for the Colonies in a Liberal cabinet, brought about two important colonial reforms. One of the statutes which he passed provided for the restriction of all Government sugar plantations carried on with forced native labour as from 1878, and for their total suppression in 1890, after which year only the Government coffee plantations were to remain, the cultivation of pepper, cochineal, cinnamon, and indigo for Government account having ceased before 1870. The other statute was the so-called Indian Agrarian Law of 1870, which contained many important provisions. It enacted, among other things, that Europeans could lease for 75 years forest lands belonging to the Crown, and that natives could secure proprietary rights in the soil cultivated by them. In 1872 Mr Fransen Van de Putte, once again Colonial Minister in the cabinet which succeeded Thorbecke's last ministry, was able to carry his Bill abolishing all differentiation in a new Dutch-Indian tariff, and establishing a uniform import duty of 6 per cent., with a certain number of free ports all over the Malay Archipelago, rather increasing in latter years than diminishing. That import duty was considered so moderate that, when in 1886 the Dutch-Indian revenues required strengthening, an increase was readily assented to.

These reforms produced the results that had been prognosticated by their advocates. On the one hand, individual enterprise by European capitalists and planters was fostered in the same proportion as the hampering competition of the State was removed. Private plantations and factories arose everywhere, and in 1895 they produced an aggregate of 9,770,000 piculs[1] of sugar, 332,000 piculs of coffee, 3,960,000 kilogrammes of tea, 7,200,000 kilogrammes of tobacco (mainly in Sumatra), 3,570,000 kilogrammes of cinchona bark (grown from Peruvian seedlings by free labour from the beginning in 1852), 475,000 kilogrammes of cacao, and 144,000 kilogrammes of indigo—although it cannot be gainsaid that many of the private planters had a hard struggle, with the low prices ruling for their produce, and a certain number had to succumb. On the other hand, the natives, better protected by the Government against their former oppressors, were undoubtedly benefited to a large extent, as is perhaps best demonstrated by the enormous increase in their numbers. Thus the population of Java and Madura, computed at barely 10,000,000 in 1849, had increased to nearly 27,000,000 by the end of the 19th century.

Dutch power and political authority have immensely grown since 1850, not only in Java (*q.v.*), the principal colony, but also in Sumatra (*q.v.*), Celebes (*q.v.*), where the important districts of Gorontalo have been incorporated (since 1889) with Menado, the residency of the so-called Minahassa, among the earliest and most remarkably successful Dutch settlements in Celebes, the Moluccas (*q.v.*), Borneo (*q.v.*) (where the sultanate of Banjermassin was added to the Dutch direct dominions in the 'sixties, not, however, until after a protracted warfare, and where

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[1] A picul is equal to 133⅓ lb.

Kootany, on the east coast, formerly a semi-independent state, has since 1897 become a rising and prosperous administrative division of Dutch Borneo), the large islands to the east of Java, and New Guinea (*q.v.*). The fact of course remains that both in Borneo and in New Guinea the Dutch have had to divide their sway with the British or the Germans. Naturally, in the course of time, many armed expeditions had to be sent out to various islands to maintain or extend their political influences and connexions, the most important of such expeditions being those to Acheen and to Lombok in 1894, which ended with the almost complete incorporation of that large island within Holland's colonial dominion. Necessarily the Dutch-Indian army and navy, which are both quite distinct from the army and navy at home, and largely consist of native troops, have had to be materially reinforced from time to time to carry on these distant operations. In the Dutch-Indian army the proportion of Europeans to natives has constantly grown, and the number of European troops (now mostly Dutchmen) has been as high as 16,000 on a total of 40,000 men.

The almost endless and very costly warfare in Acheen had a disastrous bearing upon Dutch-Indian finances, coinciding as it did, at the most critical juncture, with the earnest efforts of the Dutch statesmen in the 'seventies to render Holland financially independent of her colonies, and to make the latter self-supporting. A great portion of such war expenses had to be made good by Dutch-Indian loans, guaranteed by the Dutch Government; yet additional taxation,[1] mainly levied upon the European residents in the Malay Archipelago, had to be resorted to from time to time also, to provide for the large and increasing outlay occasioned by the construction of various important public works. In particular, state railways, commenced in Java by virtue of an Act passed in 1875, but virtually though indirectly inaugurated at a much earlier date, through the medium of state-guaranteed private companies, have since that year been extended to other islands. By these means the revenues of the Dutch-Indian colonies, only 76,000,000 guilders in 1849, had been raised fifty years later to nearly double that amount, whereas expenditure, which was but 53,000,000 guilders in 1849, had almost trebled by the year 1899. War expenses and considerable outlays for public works—among which should be mentioned the improvement of harbours, the subsidizing of steamboat lines between Holland and Java, as well as between Java and the adjacent islands, the construction of vast irrigation works, of roads and telegraphs, by land and by sea—were largely but not altogether accountable for that increased expenditure. Civil administration, police, the administration of justice, last yet not least, education, have all had their much extended claims largely satisfied out of revenue. A great deal has also been done in the way of encouraging arts and sciences, the better study of some remarkable antiquities (Boro Boodoor was officially inspected and described in 1863), the Government support of geological and other surveys, also of various scientific expeditions into the unknown parts of Borneo, Sumatra, Timor, &c.

It has to be noted that coffee alone, among the old Government cultures introduced by Governor-General Van den Bosch, contributed in 1898 some 21,000,000 guilders to the revenue of Netherlands India, the other Government crops having been abolished in succession, after yielding 481,000,000 guilders to the Dutch treasury in the years 1849–66, and 139,000,000 guilders more in the years 1867–76. Nor was the Government cultivation of coffee in 1898 to be compared to what it had been fifty years before. The area of the Government coffee districts everywhere had been much restricted (in the Minahassa, the northern district of Celebes, referred to above, the Government coffee monopoly was abolished in 1899), and the scope of private coffee-planting correspondingly extended. The native labourers on the Government coffee plantations were, at the end of the 19th century, very much better treated and paid than they had been in 1849, or, for that matter, in 1889. In 1892 a resolution was carried in the second chamber of the Dutch States-General, directing the Minister for the Colonies to do away with the Government growing of coffee, too, but that resolution remained without effect, the Dutch Government then declaring that the revenue from coffee could not yet be spared. On the other hand, the export duty on coffee (and on indigo) was abolished in 1902; this, it was hoped, might help to tide over the difficulties of the private planters.

For literature concerning the recent history of the Malay Archipelago, consult the works mentioned under HOLLAND and JAVA; also the *Aardrijkskundig en Statistisch Woordenboek van Nederlandsch-Indië* ("Geographical and Statistical Dictionary of Netherlands-India"), Amsterdam, 1869, 3 vols.; the *Staatsalmanak van Nederlandsch-Indië* (Government annual publication, published at Batavia), and the *Encyclopædie van Nederlandsch-Indië* ("Encyclopædia of the Dutch East Indies," Leyden and The Hague, 1895, *et. seq.*), the most comprehensive and most authoritative work existing on the subject, but still incomplete, although several volumes have already been issued, to 1902. Its great drawback is the absence of maps and illustrations. (H. TI.)

Malay Peninsula (called by the Malays *Tânah Mălâyu*, *i.e.*, the Malay Land), a lozenge-shaped strip of land projecting into the China Sea, and forming the most southerly portion of the continent of Asia. Geographically, the peninsula begins at the isthmus of Kra, 7°14′ N., at which point it is only between 60 and 70 miles in width, and the distance from sea to sea is further diminished by a large irregular salt-water inlet. Politically and anthropologically, however, this upper portion must be regarded as a continuation of the kingdom of Siam rather than as a section of Malâya. From the isthmus of Kra the peninsula extends south with a general inclination towards the east, the most southerly point being Tanjong Bûlus in 1° 16½′ N. A line drawn diagonally down the centre from the isthmus of Kra to Cape Romania (Ramûnya) gives the extreme length at about 510 miles. The breadth at the widest point, from Tanjong Pĕn-ûnjut in Trĕnggānu to Tanjong Hantu in the Dindings territory, is about 200 miles. The area is estimated at about 70,000 square miles. The peninsula is bounded on the north by Siam, on the south by the island and strait of Singapore, on the east by the China Sea, and on the west by the strait of Malacca.

Physical characteristics.

A range of granite mountains stretching from the eastern shoulder in 6° 40′ N. to the west coast in 2° 25′ N., irregularly following the parallel 101° 40′ E., forms a backbone which divides the peninsula into two unequal portions, the larger of which lies to the east and the smaller to the west of the chain. Smaller ranges run parallel to the main mountain chain in many places, and there are numerous isolated spurs which have no connexion with either. The country is covered with limestone in many parts, and large isolated bluffs of this formation stand up in the plains both on the eastern and the western slopes. The descent from the summits of the range into the plain is somewhat less abrupt on the western than it is on the eastern side, and between the foot of the mountains and the strait of Malacca the largest known alluvial deposits of tin are situated. On the eastern side of the range, after a steep descent, the granite formation speedily gives place to slates of vast depth, intersected here and there by fissures of quartz containing gold, and in many places covered by limestone which has been superimposed upon the slates. The highest known peak in the main range is that of Gûnong Korbu, 7217 feet above sea-level. The highest mountain is believed to be Gûnong Tâhan, which forms part of an isolated range on the eastern side, between Pahang and Kĕlantan, and is estimated at about 8000 feet. The west coast throughout its whole length is covered to a depth of some miles with mangrove swamps, with only a few isolated stretches of sandy beach, the dim foliage of the mangroves and the hideous mud flats presenting a depressing spectacle. On the east coast the force of the north-east monsoon, which beats upon the shores of the China Sea annually from November to February, has kept the land for the most part free from mangroves, and the sands, broken here and there by rocky headlands thickly wooded, and fringed by *casuarina* trees, stretch for miles without interruption. The islands on each coast present the features of the shores to which they are adjacent. On both the east and the west coast the islands are thickly wooded, but whereas the former are surrounded by beautiful sands and beaches, the latter are fringed by mangrove swamps. The whole peninsula may be described as one vast forest, intersected in every direction by countless streams and rivers which together form the most lavish water-system in the world. Only an insignificant fraction of these forests has ever been visited by human beings, the Malays and even the aboriginal tribe having their homes on the banks of the rivers, and never, even when travelling from one part of the country to another, leaving the banks of a stream except for a short time when passing from one river-system to another. The bulk of the jungle, therefore, which lies between stream and stream, has never been trodden by the foot of man. The principal rivers on the west coast are the Pêrak, the Bĕrnam, and the Mûar. The first-named is far finer than its fellows, and is navigable for steamers for about 40 miles from its mouth, and for native craft for over 250 miles. It is exceedingly shallow, however, and is not of much importance as a waterway. The Bĕrnam runs through flat swampy country for the greater part of its course, and steam-launches can penetrate to a distance of over 100 miles from its mouth, and it is therefore probably the deepest river. The country which it waters, however, is not of any value, and it is not much used. The Mûar waters a very fertile valley, and is navigable for native boats for over 150 miles. On the east coast the principal streams are the Pĕtàni, Tĕlûbin, Kĕlantan, Bĕsut, Trĕnggânu, Dûngun, Kĕmâman, Kuantan, Pahang, Rompin, Endau, and Sĕdĕli, all guarded by difficult bars at their mouths, and dangerous during the continuance of the north-east monsoon. The deepest rivers are the Kuantan and Rompin; the largest are the Kĕlantan and the Pahang, both of which are navigable for native boats for a distance of over 250 miles. The Trĕnggânu river is obstructed by impassable rapids at a distance of about 30 miles from its mouth. The rivers on the east coast are practically the only highways, the Malays always travelling by boat in preference to walking, but they serve their purpose very indifferently, and their great beauty is their chief claim to distinction. Magnificent caves are found on both slopes of the peninsula, those at Bâtu in Sĕlângor being the finest on the west coast, while those of Châdu and Kôto Glanggi in Pahang are the most extensive yet visited by Europeans on the east coast. They are all of limestone formation. The minerals produced are tin, gold, iron, galena, and others in insignificant quantities. Only two tin lodes are being worked, however, and both are situated on the east coast, the one at Kuantan in Pahang, the other at Bandi in Trĕnggânu territory. On the west coast no true lode has yet been discovered, though the vast alluvial deposits of tin found there seem to make such a discovery probable in the future. Since 1890 the tin produced from these alluvial beds has supplied between 50 and 75 per cent. of the tin of the world. Gold is being worked with success in Pahang, and has been exploited from time immemorial by the natives of that state and of Kĕlantan. Small quantities have also been found on the western slope in Pêrak.

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[1] It includes, since 1898, a tax on petroleum, now found in large quantities in Java, Sumatra, and elsewhere; likewise an import duty on foreign matches. Both yield an increasing revenue.

Meteorology, climate, &c.

It was formerly the custom to speak of the Malay Peninsula as an unhealthy climate, and even to compare it with the west coast of Africa. It is now generally admitted, however, that though hot, it compares favourably with that of Burma. The chief complaint which Europeans make concerning it is the extreme humidity, which causes the heat to be more oppressive than is the case where the air is dry. On the other hand, the thermometer, even at Singapore on the southern coast, which is the hottest portion of the peninsula, seldom rises above 98° in the shade, whereas the mean for the year at that place is generally below 80°. On the mainland, and more especially on the eastern slope, the temperature is cooler, the thermometer seldom rising above 93° in the shade, and falling at night below 70°. On an average day in this part of the peninsula the temperature in a European house ranged from 88° to 68°. The number of rainy days throughout the peninsula varies from 160 to over 200 in each year, but violent gusts of wind, called "Sumatras," accompanied by a heavy downpour of short duration, are more common than persistent rain. The rainfall on the west coast varies from 75 to 120 inches per annum, and that of the east coast, where the north-east monsoon breaks with all its fury, is usually about 155 inches per annum. Malarial fevers make their appearance in places where the forest has been recently felled, or where the surface earth has been disturbed. It is noticed that labourers employed in deep mines worked by shafts suffer less from fever than do those who are engaged in stripping the alluvial deposits. This, of course, means that a new station, where clearing, digging, and building are in progress, is often unhealthy for a time, and to this must be attributed the evil reputation which the peninsula formerly enjoyed. To Europeans the climate is found to be relaxing and enervating, but if, in spite of some disinclination for exertion, regular exercise is taken from the beginning, and ordinary precautions against chills, more especially to the stomach, are adopted, a European has almost as good a chance of remaining in good health in the peninsula as in Europe. A change of climate, however, is imperatively necessary every five or six years, and the children of European parents should not be kept in the peninsula after they have attained the age of four or five years. The Chinese immigrants suffer chiefly from fever of a malarial type, from beri-beri, a species of tropical dropsy, and from dysentery. The Malays formerly suffered severely from smallpox epidemics, but in the portion of the peninsula under British rule vaccination has been introduced, and the ravages of the disease no longer assume serious dimensions. Occasional outbreaks of cholera occur from time to time, and in the independent states these cause terrible loss of life, as the natives fly from the disease and spread the infection in every direction. As a whole, the Malays are, however, a remarkably healthy people, and deformity and hereditary disease are rare among them. There is little leprosy in the peninsula, but there is a leper hospital near Penang on Pûla Dĕrâja, and another is about to be formed on an island on the west coast for the reception of lepers from the Federated Malay States.

Flora and fauna.

The soil of the peninsula is remarkably fertile both in the plains and on the mountain slopes. In the vast forests the decay of vegetable matter during countless ages has enriched the soil to the depth of many feet, and from it springs the most marvellous tangle of huge trees, shrubs, bushes, underwood, creepers, climbing plants, and trailing vines, the whole hung with ferns, mosses, and parasitic growths, and bound together by rattans and huge rope-like trailers. In most places the jungle is so dense that it is impossible to force a way through it without the aid of a wood-knife, and even the wild beasts use well-worn game-tracks through the forest. In the interior brakes of bamboos are found, many of which spread for miles along the river banks. Good hard-wood timber is found in plenty, the best being the *mĕrăbau*, *pĕnak*, *rasok*, and *chĕngal*. Orchids of countless varieties abound. The principal fruit trees are the *dûri-an*, mangosteen, custard-apple, pomegranate, *rambut-an*, *pûlas-an*, *langsat*, *rambai*, jack-fruit, cocoanut, areca nut, sugar-palm, and banana. Coffee, tobacco, sugar-cane, rice, pepper, gambier, cotton, and sago are cultivated with success. The principal jungle products are gutta and rubber of several varieties, and many kinds of rattan. The mangrove grows on the shores of the west coast in profusion. Agila-wood, the camphor tree, and ebony are also found in smaller quantities.

The fauna of the peninsula is varied and no less profuse than is the vegetable life. The Asiatic elephant; the *sĕlâdang*, a bison of a larger type than the Indian gaur; two varieties of rhinoceros; the honey bear (*brûang*), the sambhur (*rûsa*); the speckled deer (*kîjang*), three varieties of mouse-deer (*nâpoh*, *plândok*, and *kanchil*); the gibbon (*ûngka* or *wawa'*), the *sîamang*, another species of anthropoid ape, the *brok* or cocoanut monkey, so called because it is trained by the Malays to gather the nuts from the cocoanut trees, the *lôtong*, *kra*, and at least twenty other kinds of monkey; the *bintûrong* (*arctictis binturong*), the lemur; the Asiatic tiger, the black panther, the leopard, the large wild cat (*harîmau âkar*), several varieties of jungle cat; the wild boar, the wild dog; the flying squirrel, the flying fox; the python, the cobra, and many other varieties of snake, including the hamadryad; the alligator, the otter, and the gavial, as well as countless kinds of squirrel, rat, &c., are found throughout the jungles of the peninsula in great numbers. On the east coast peafowl are found, and throughout the interior the argus pheasant, the firebacked pheasant, the blue partridge, the adjutant-bird, several kinds of heron and crane, duck, teal, cotton-teal, snipe, wood-pigeon, green-pigeon of several varieties, swifts, swallows, pied-robins, hornbills, paroquets, flycatchers, nightjars, and many other kinds of bird are met with frequently. A few specimens of solitary goose have been procured, but the bird is rarely met with. The forests literally swarm with insects of all kinds, from *cicadæ* to beautiful butterflies, and from stick- and leaf-insects to endless varieties of ants. The scorpion and the centipede are both common. The study of the insect life of the peninsula opens a splendid field for scientific research, and the profusion and variety of insects found in these forests probably exceed those to be met with anywhere else in the world.

Political divisions and population.

Politically the Malay Peninsula is divided into three sections:—1. The Federated Malay States; 2. The Independent State of Johor, which is within the British sphere of influence; 3. The Independent States of the Peninsula which are actually or nominally under the dominion of Siam. The Federated Malay States, under British protection, are four in number, viz., Pêrak, Sĕlângor, and the Nĕgri Sĕmbilan on the west coast, and Pahang on the east coast.

Johor is the only Malay state in the portion of the peninsula lying within the British sphere of influence which has been allowed to remain under native rule.

The Malay states which either nominally or actually are under the dominion of Siam are as follows:—Palêan, Sâtun, Pâlit, and Kĕdah on the west coast; Pĕtâni, Jĕring, Sai, Lĕgeh, Kĕlantan, and Trĕnggânu on the east coast; and Jâlor and Râman inland. The aggregate area of these states is roughly estimated at about 20,000 square miles, and the population, chiefly Malayan, may be placed at about 200,000. Once in three years the rulers of these states send tribute to Siam in the form of flowers fashioned from gold and silver (*bûnga ămas*), and presents from the king at Bangkok of approximately the same value are returned by the messengers who bear the tribute.

Kĕdah.

Kĕdah is situated on the west coast of the Malay Peninsula, between parallels 5° 2′ and 6° 42′ N. The coast-line is only about 66 miles long, and the greatest distance from north to south is about 115 miles, and the greatest breadth at the widest point is about 47 miles. The area may be estimated at about 5000 square miles, and the population, 75 per cent. of whom are Malays, at about 45,000. According to the native tradition, Kĕdah was at one time a tributary of Malacca, and was subsequently conquered by the Acheenese. Later, the natives of Kĕdah invaded and conquered Pêrak, but they eventually withdrew. In the middle of the 18th century, if not earlier, Kĕdah fell under the dominion of Siam, and has continued from that time to send the *bûnga ămas* (tribute) to Bangkok every three years. Until recently this tribute seems to have formed the only right exercised by Siam with regard to her Malayan dependencies, and it is open to question whether this gift did not partake of the nature of a conciliatory present to a powerful neighbour rather than of that of a direct admission of sovereignty. Be this how it may, it is certain that the cession of Penang to the East India Company in 1785 and of Province Wellesley in 1798 was granted by the then sultan of Kĕdah without the approval of Siam being sought or given. Of late years, however, spurred thereto by the growing influence of the British in the Malay Peninsula, Siam has been at great pains to tighten her hold over the Malayan states which have for so long been nominally under her dominion, and in no part of the peninsula has this been done to greater effect than in Kĕdah. The sultan of that state, nominated and installed by the king of Siam, and granted a Siamese title, is now no better than a governor appointed by Siam to rule the state which is his birthright, and during the visit of the king to the peninsula, in 1890, the sultan was forced to follow his suzerain about as one of the least considered of his nobles. The state is not much better governed than other Malayan countries which are not under European management, the Siamese concerning themselves but little with the details of administration, and displaying in their own land the deplorable lack of political purity and love of justice which seemingly are flaws from which no Oriental government has the power to free itself. A little alluvial tin is worked in Kĕdah, but the chief products are agricultural, the Malays of this state growing a considerable quantity of rice with some success.

Palêan, Sâtun, Pâlit.

Palêan, *Sâtun*, and *Pâlit* are three small states on the west coast, lying to the north of Kĕdah. Like Sĕnggôra on the east coast, they form part of Lower Siam, and can hardly be regarded as an integral portion of the Malayan Peninsula. They are not of any political or commercial importance, and are under the rule of the Siamese governor of Junkseylon. The resident councillor of Penang for the time being is the consul-general for Kĕdah and for these Siamese states on the west coast.

Pĕtâni.

Pĕtâni is the name properly applied to a small state situated on the north-east shoulder of the Malay Peninsula, but it is usually employed to include the small states of Jĕring, Sai, Jâlor, and Râman also. Each of these little states, however, is under its own Malay ruler, and all are directly under the influence and control of Siam. Speaking of Pĕtâni in the wider application of the name, it may be said to be bounded by the China Sea on the N. and E., by Pêrak and Lĕgeh on the S., and by Kĕdah on the W. It is situated between 5° 34′ and 6° 52′ N. and 100° 54′ and 101° 58′ E. Its total area is about 4000 square miles. A portion of Râman is claimed by Pêrak, and has formed the subject of dispute since 1882. The population, which is unusually thick for the peninsula, is estimated at about 20,000, of whom about 5000 are Chinese and Siamese. Pĕtâni is historically important as having been the scene of the first factory established by the East India Company in the peninsula. Pĕtâni is also remarkable as having for an extended period of time been governed by a Malay queen, the only recorded instance of female government in the history of the peninsula. To-day Pĕtâni, under the rule of Siam, is a place of little importance. Its native râjas exert little influence over their people, and the petty jealousies which exist between the rulers of the various tiny states give rise to constant quarrels between them and their adherents. The natives of Pĕtâni are skilled in the art of catching and taming elephants. The chief industry of the country along the coast is the evaporation of salt from sea-water.

Kĕlantan.

Kĕlantan is the name of a large native state on the east coast of the peninsula. It is bounded on the N. and N.E. by the China Sea, on the S. by Pahang, on the E. by Trĕnggânu, and on the W. by Pêrak. It lies between parallels 4° 48′ and 6° 20′ N. and 101° 33′ and 102° 45′ E. The greatest distance from north-east to south-west is 108 miles, and the greatest breadth from east to west is 68 miles. The total area of the state is about 7000 square miles. Next to the Pahang, the Kĕlantan river is the largest on the east coast. It is shallow, and the upper reaches are somewhat obstructed by rapids, but it is navigable for native trading boats for a distance of nearly 200 miles. Its principal tributaries are Gâlas, Nĕnggîri, Pĕrgai, and Lĕbir rivers. The Gâlas valley is rich in alluvial gold, and there is every reason to believe that lodes also exist. A Chinese colony, chiefly composed of Ho-Kien and Te-Chow Chinese, has existed at Pûlai in this valley from time immemorial, the original founders of the settlement having been attracted thither by gold mines. The community is ruled by a Kapitan Chîna, appointed by the sultan. The Lĕbir valley is almost entirely peopled by fugitives from Pahang, who sought refuge from the constant civil wars which raged in that state. The Nĕnggîri valley is largely peopled by aborigines, men of the Mon-Annam stock, who from time to time have carried on a desultory warfare with the Malays. The Pĕrgai is also rich in gold, and forms the principal highway into the state of Lĕgeh.

Kĕlantan is nominally under the control of Siam, and since the death in 1889 of the old sultan, Mûlut Mêrah (The Red-Mouthed), who for more than sixty years ruled the country with great force and cruelty, the strife for the throne which has been carried on by his grandchildren has led to each pretender seeking to strengthen his individual position by enlisting the sympathies of Siam. This has enabled the king to obtain a more definite hold over the country than was possible during the reign of Mûlut Mêrah, and in 1892 an issue of postage stamps was put in circulation in Kĕlantan bearing the portrait of the king of Siam, and a Malay, born in Bangkok, was sent to Kôta Bharu, the capital of the state, to act as postmaster and Siamese representative. Since that time the influence of Siam in Kĕlantan has steadily increased, and now the flag of the white elephant floats at the mouth of the river.

The country in the vicinity of the capital is more open than is usual in the Malayan lands. Broad stretches of grazing-ground are found, and the breed of cattle and sheep which thrives there is the best in the peninsula. Considerable quantities of live stock are exported to Singapore. The whole of the state is very fertile, and the natives, who physically are of a somewhat larger type than most Malays, are more hardworking than those of any other state in the peninsula. Since Pahang was placed under British protection, and the lives of immigrants were rendered safe thereby, a large number of Kĕlantan Malays have made their way into that country, and people of that tribe now supply 70 per cent. of the Malay labour there obtainable. As compared with other Malay states, Kĕlantan has always enjoyed the reputation of being exceedingly populous, and even now, when the population has been diminished by cholera, smallpox, and emigration, it can safely be estimated at 75,000 souls. A round tin coin, with a hole in the centre, like a Chinese "cash," is issued by the sultan, and the old pillar dollar is the standard coin, Mexican dollars being reckoned as being less valuable by one-third. Until quite recently the latter were received with the utmost reluctance. The ruling family of Kĕlantan belongs to a clan bearing the title of *Wan*, and is not regarded by other Malay ruling families as belonging to any royal stock. The title of sultan was assumed only about 1885 for the first time. Kĕlantan, if well governed, would probably be one of the most prosperous states in the peninsula, but under native rule all manner of abuses exist, which cannot but discourage commerce and immigration. The natives of Kĕlantan are addicted to prize-fighting, and also keep rams and buffalo-bulls for similar purposes.

Trĕnggânu.

Trĕnggânu is the name of a large state on the east coast of the peninsula. It is bounded on the N.E. and E. by the China Sea, on the S. by Pahang, and on the W. by Kĕlantan and Pahang. It lies between parallels 4° 4′ and 4° 46′ N. and 102° 30′ and 103° 26′ E. The greatest distance from north to south is 120 miles; the greatest breadth from east to west is 50 miles. It has a coast-line 130 miles in length, and the estimated area of the state is about 6000 square miles. The principal rivers of the state are the Bĕsut, Stîu, Trĕnggânu, Dûngun, and Kĕmâman, each of which waters a district of some importance, the revenues of which are drawn by one or another of the sultan's many relatives. The sultan himself derives his revenues from the district lying immediately around his capital at Kuâla Trĕnggânu, but these represent so small a proportion of the revenues of the state that he is probably the poorest ruler in the peninsula. The Bĕsut district is inhabited entirely by Malays, and was reduced by a war conducted about 1875 by Băginda Umar, the grandfather of the present (1902) sultan. It is chiefly remarkable as having suffered more than any other district on the coast from a typhoon which raged during 1882 and felled the forest for miles. Later the dead timber generated fire, and for some miles inland the traces of this double calamity are still visible. The Stîu river is a long, muddy, and very deep inlet, and is chiefly famous for the number and boldness of the alligators which infest it. The Trĕnggânu district is very thickly inhabited for the first 30 miles of the river's course from its mouth to the impassable falls known as Lâta Kĕlĕmang. Above this point the population only numbers about 500 souls, the falls, which are 5 miles long, presenting a barrier to trade which has effectually prevented the development of the rich interior. Even above the falls the river is difficult, owing to the size of the rapids with which it is beset, and the Trĕnggânu proper, above the point where it is joined by the Kĕrbat, is quite impassable for boats of any kind. The consequence of this is that the whole population of the Trĕnggânu valley is concentrated within the narrow strip of country lying between the sea and the Kĕlĕmang Falls, and almost every inch of the country is cultivated with a thoroughness which is unlike anything to be seen anywhere else in the peninsula. The Dûngun takes its rise in the hills, whence the Tĕmbĕling river flows into Pahang. It is noted for the amount of gutta which is annually exported from the valley. The Kĕmâman river waters a valley bordering on Kuantan in Pahang territory, and has the reputation of being rich in tin. A lode is being worked by a European company at Bandi in this district. The people of Trĕnggânu, owing to the enlightened policy of the late Bâginda Umar, who introduced skilled artisans to teach his people, are the best workers in metal and wood on the coast. They build excellent boats of a European type, weave all manner of native silks and cotton stuffs, make weapons and brass and nickel ware, and are especially famous for their skill in producing spurious articles which so closely resemble the originals that detection is well-nigh impossible.

The Trĕnggânu sultanate is one of the most ancient in the peninsula, and ranks with that of Riau. The country was conquered by Băginda Umar in 1837, the then sultan, the son of the conqueror's elder brother, subsequently dying while flying from his uncle. The present sultan is the grandson of the Băginda. He is very religiously inclined, and the people of this state are more fanatical Mahommedans than are to be found elsewhere in the peninsula.

Lĕgeh is the name of a small state which is more directly under the rule of Siam than Kĕlantan. It is said to contain gold in payable quantities. It is not of much political importance. Its area is about 2000 square miles.

Races of the peninsula.

Excluding the Tai, or Siamese, who are undoubtedly recent intruders from the north, there are three races which for an extended period of time have had their home in the Malay Peninsula. These are the Sĕmang or Pangan, the Sâkai or Jâkun, and the Malays. The Sĕmang, as they are most usually called by the Malays, are Negritos—a small, very dark people, with features of the negroid type, very prognathous, and with short, woolly hair clinging to the scalp in tiny crisp curls. These people belong to the race which would seem to be the true aboriginal stock of southern Asia. Representatives of it are found scattered about the islands from the Andaman group southwards. The state of civilization to which they have attained is very low. They neither plant nor have they any manufactures except their rude bamboo and rattan vessels, and the bows, blow-pipes, and bamboo spears with which they are armed. They are skilful hunters, however, catch fish by ingeniously-constructed traps, and live almost entirely on jungle-roots and the produce of their hunting and fishing. The most civilized tribe of these people is found in Upper Pêrak, and the members of this clan have acquired some knowledge of the art of planting, &c. They cannot, however, be taken as typical of their race, and other specimens of this people are seldom seen even by the Sâkai. From time to time they have been raided by the latter, and many Negritos are to be found in captivity in some of the Malayan villages on the eastern side of the peninsula. The mistake of speaking of the Sâkai tribes as practically identical with the Sĕmang or Pangan has very frequently been made, but as a matter of fact the two races are absolutely distinct from one another. It has also been customary to include the Sâkai in the category of Malayan races, but this too is undoubtedly incorrect. The Sâkai still inhabit in greatest numbers the country which forms the interior of Pahang, the Plus and Kinta districts of Pêrak, and the valley of Nĕnggiri in Kĕlantan. Representatives of their race are also found scattered among the Malayan villages throughout the country, and also along the coast, but these have intermixed so much with the Malays, and have acquired so many customs, &c., from their more civilized neighbours, that they can no longer be regarded as typical of the race to which they belong. The pure Sâkai in the interior have a good knowledge of planting rice, tapioca, &c., fashion pretty vessels from bamboos, which they decorate with patterns traced by the aid of fire, make loin-cloths (their only garment) from the bark of the *trap* and *îpoh* trees; are very musical, using a rude lute of bamboo, and a nose-flute of a very sweet tone, and singing in chorus very melodiously; and altogether have attained in their primitive state to a higher degree of civilization than have the Sĕmang. They are about as tall as the average Malay, are slimly built, light of colour, and have wavy fine hair. In their own language they have only three numerals, viz., *na-nun*, one; *na'*, two; and *ne'*, three; all higher arithmetical ideas being expressed by the word *kĕrpn*, which means "many." Among the more civilized, however, the Malay numerals up to ten are adopted by the Sâkai. An examination of their language seems to indicate that it belongs to the Mon-Annam family of languages, and the anthropological information forthcoming concerning the Sâkai points to the conclusion that they show a greater affinity to the people of the Mon-Annam family of races than to the Malayan stock. Though they now use metal tools imported by the Malays, it is noticeable that the names which they give to those weapons which most closely resemble in character the stone implements which are found in such numbers all over the peninsula are native names wholly unconnected with their Malay equivalents. On account of this, it has been suggested that in a forgotten past the Sâkai were themselves the fashioners of the stone implements, and certain it is that all tools which have no representatives among the stone kelts are known to the Sâkai by obvious corruptions of their Malayan names. The presence of the Sâkai, a people of the Mon-Annam stock, in the interior of the peninsula has also been considered as one of many proofs that the Malays intruded from the south, since had they swept down from the north, being driven thence by the people of a stronger breed, it might be expected that the fringe of country dividing the two contending races would be inhabited by men of the more feeble stock. Instead, we find the Sâkai occupying this position, thus indicating that they have been driven northwards by the Malays, and that the latter people has not been expelled by the Mon-Annam races from the countries now represented by Burma, Siam, and French Indo-China. The Sâkai population is dying out, and must eventually disappear. (With regard to the Malay, see MALAYS.)

Archæology.

The only ancient remains found in the peninsula are the stone implements, of which mention has already been made, and some remarkable ancient mines, which are situated in the Jĕlai valley in Pahang. The stone implements are generally of one or two types: a long rectangular adze or wedge rudely pointed at one end, and used in conjunction with a mallet or flat stone, and a roughly triangular axe-head, which has evidently been fixed in the cleft of a split stick. A few stones, which might perhaps be arrow-heads, have been found, but they are very rare.

The mines, which have been constructed for the purpose of working quartz lodes containing gold, are very extensive, and argue a high stage of civilization possessed by the ancient miners. They consist of a number of circular or rectangular pits sunk from the cap of a hill, and going down to a depth of in some cases as much as 120 feet, until in fact the miners have been stopped by being unable to cope with the quantity of water made when the level of the valley was reached. The shafts are placed so close together that in many instances they are divided by only a couple of feet of solid ground, but at their bases a considerable amount of gallery work has been excavated, though it is possible that this was done by miners who came after the people who originally sank the shafts. Native tradition attributes these mines to the Siamese, but not much importance can be attached to this, as it is very general for the Malays to give this explanation for anything which is obviously not the work of their own ancestors. A theory, which seems to have some probability in its favour, is that these mines were worked by natives of India during the period when the whole of the Malayan Archipelago was more or less overrun by the Hindu races, but the absence of all remains which might aid in the identification of the ancient miners renders it impossible at the present time to give any authoritative opinion on this point.

History.

The Malay Peninsula was known to the ancients as the *Aurea Chersonesus*, and there can be no doubt that from a very early time a constant trade was maintained between the people of the peninsula and archipelago and the natives of Arabia, Persia, and India. Cloves, nutmegs, and other spices are believed to have formed the chief articles of commerce, and to have come almost entirely from Malayan lands, reaching Europe *viâ* Arabia. At one period in its history the archipelago was overrun by Hindus from India, and traces of their presence are found to this day in Java and other islands of the archipelago, the people of Bali, for instance, still professing a kind of Hinduism. There is no evidence to show, however, that the influence of the Hindus ever extended to the peninsula itself. The wave of Mahommedanism which later swept over the peninsula and archipelago was a peaceful, not a warlike invasion. The first Mahommedan missionaries were the traders who, following in the steps of their forebears, acted as the middle-men by whose agency the trade of the East Indies found its way into Europe. The râja of Acheen in Sumatra was the first convert of note. He publicly embraced the new creed in 1206. The sultan of Malacca became a Mahommedan in 1276, but it is probable that long before that date the faith of the Prophet had won a sure foothold among the Malays of his kingdom and of the west coast generally. Vasco da Gama rounded the Cape of Good Hope in 1496, but the peninsula itself does not appear to have been visited until the time of Magellan. Malacca was visited by the Portuguese Sequeira in 1509, and was conquered by Albuquerque in 1511, this being the earliest European settlement on the mainland of the peninsula. Drake was the first Englishman to make a journey to the Malayan Archipèlago, coming from the east of the Moluccas, and calling at Bantam in 1578. Ten years later Cavendish followed the same route. In 1592 Lancaster left Zanzibar in February and called at Penang ("Pulo Pinaom"), where he remained till the end of August. This was the first British trading expedition to the East Indies. The Dutch under Houtman visited Bantam in 1595–96. In 1600 the East India Company was formed in London, principally for the purpose of trading with Malâya, and the first fleet belonging to the company was sent out under Lancaster's command in 1601. During Captain Hippon's voyage in 1612–13 the peninsula was first rounded by a British ship, and in the latter year a factory was established in Pĕtâni, and the first president, Captain Jourdain, was killed in 1620 in a naval engagement with the Dutch in Pĕtâni Roads. It was in the course of various voyages to Malâya that attention was first attracted by the mainland of India, and the commerce which had progressed favourably in Malayan waters ultimately led to the establishment of the Indian Empire. Malacca was wrested from the Portuguese by the Dutch in 1641. The principal stations of the East India Company in Malayan lands were on the island of Sumatra, and it was not until 1795 that Malacca was taken by the British from the Dutch. It was restored to the Dutch by the treaty of 1818, and it did not come finally into British hands until 1824, when it was exchanged for Bencoolen in Sumatra. Penang was purchased from Kĕdah in 1786, and Singapore from the then sultan of Johor in 1819. The native state of Pêrak was placed under British protection in 1874, and between that date and 1888 the other native states which now form the federation were also placed under protection. The Straits Settlements were ruled from India until 1867, when they became a Crown colony.

See *Journal of the Straits Branch of the Royal Asiatic Society*, Singapore; *Journal of the Malay Archipelago*, Singapore.—WELD, MAXWELL, SWETTENHAM, and CLIFFORD, in the *Journal of the Royal Colonial Institute*, London.—CLIFFORD, *Geographical Journal*, London, 1896.—M'NAIR, *Sarong and Kris*, London, 1880.

(H. CL.)

Malays, the name given by Europeans to the people calling themselves *Ôrang Mălâyu, i.e.*, Malayan folk, who are the dominant race of the Malay Peninsula and of the Eastern Archipelago. Broadly speaking, all the brown races which inhabit the portion of Asia south of Siam and Indo-China, and the islands from the Philippines to Java, and from Sumatra to Tîmor, may be described as belonging to the Malayan family, if the aboriginal tribes, such as the Sâkai and Sĕmang in the Malay Peninsula, the Bâtaks in Sumatra, and the Mûruts in Borneo, be excepted. For the purposes of this article, however, only those among these races which bear the name of Ôrang Mălâyu, speak the Malayan language, and represent the dominant people of the land, can be included under the title of Malays. These people inhabit the whole of the Malayan Peninsula to the borders of Lower Siam, the islands in the vicinity of the mainland, the shores of Sumatra and some portions of the interior of that island, Sarâwak and Brûnei in Borneo, and some parts of Dutch Borneo, Batavia, and certain districts in Java, and some of the smaller islands of the archipelago. Though in these lands they have for not less than a thousand years enjoyed the position of the dominant race, they all possess a tradition that they are not indigenous, and that their first rulers "came out of the sea," with a large band of Malayan warriors in their train. In the peninsula especially, where the presence of the Malays is more recent than elsewhere, many traditions exist which point to a comparatively recent occupation of the country. It has been remarked that there is evidence that the Malays had attained to a certain stage of civilization before ever they set foot in Malâya. For instance, the names which they give to certain fruits, such as the *dûri-an*, the *rambut-an*, and the *pûlas-an*, which are indigenous in the Malayan countries, and are not found elsewhere, are all compound words meaning respectively the thorny, the hairy, and the twisted fruit. These words are formed by the addition of the substantial affix "*-an*," the use of which is one of the recognized methods by which the Malays turn primitive words into terms of more complex meaning. This may be taken to indicate that when first the Malays became acquainted with the fruits which are indigenous in Malayan lands, they already possessed a language in which most primary words were represented, and also that their tongue had attained to a stage of development which provided for the formation of compound words by a system sanctioned by custom and the same linguistic instinct which causes a Malay to-day to form similar compounds from European and other foreign roots. For any aboriginal race inhabiting these countries, such important articles of diet as the *dûri-an*, &c., could not fail to be among the first natural objects to receive a name, and thus we find primary terms in use among the Sâkai and Sĕmang, the aborigines of the Peninsula, to describe these fruits. The use by the Malays of artificially constructed terms to denote these things may certainly be taken to strengthen the opinion that the Malays arrived in the lands they now inhabit at a comparatively late period in their history, and at a time when they had developed considerably from the original state of primitive man.

Theories of origin.

Until recently many eminent scientists held the theory that the Malayan peoples were merely an offspring of the Mongol stock, and that their advance into the lands they now inhabit had taken place from the cradle of the Mongolian race—that is to say, from the north. In the fifth edition of his *Malay Archipelago*, p. 591, A. R. Wallace notes the resemblance which he traced between the Malays and the Mongolians, and others have recorded similar observations as to the physical appearance of the two races. To-day, however, fuller data are available than when Wallace wrote, and the more generally accepted theory is that the Malayan race is distinct, and came from the south, until it was stayed by the Mongolian races living on the mainland of southern Asia. The cranial measurements of the Malays and an examination of their hair sections seem to bear out the theory that they are distinct from the Mongolian races. Their language, which is neither monosyllabic nor tonic, has nothing in common with that of the Mon-Annam group. It has, moreover, been pointed out that had the Malays been driven southwards by the stronger races of the mainland of Asia, it might be expected that the peoples inhabiting the country nearest to the border between Siam and Malaya would belong to the Malayan and not to the Mon-Annam stock. As a matter of fact the Sâkai of the interior of the peninsula belong to the latter race. It might also be anticipated, were the theory of a southward immigration to be sustained, that the Malays would be newcomers in the islands of the archipelago, and have their oldest settlements on the Malayan Peninsula. The facts, however, are in exact contradiction to this; and accordingly the theory now most generally held by those who have studied the question is that the Malays form a distinct race, and had their original home in the south. Where this home lay it is not easy to say, but the facts recorded by many writers as to the resemblance between the Polynesian and the Malayan races, and the strong Malayan element found in the languages of the former (see Tregear's *Maori and Comparative Polynesian Dictionary*, London, 1891), have led some students to think that the two races may have had a common origin. John Crawford, in the Dissertation to his *Dictionary of the Malay Language*, published in 1840, noted the prevalence of Malayan terms in the Polynesian languages, and attributed the fact to the casting away of ships manned by Malays upon the islands of the Polynesian Archipelago. The appearance of the same Malayan words in localities so widely separated from each other, however, cannot be satisfactorily accounted for by any such explanation, and the theory is now more generally held that though the two races are ethnologically distinct, they may, at some remote period of history, have shared a common home. It has been suggested that their separation did not take place until after the continent which once existed in the north Pacific had become submerged, and that the Malays wandered northwards, while the Polynesian race spread itself over the islands of the southern archipelago. All this, however, must necessarily be of the nature of the purest speculation, and the only facts which we are able to deduce in the present state of our knowledge of the subject may be summed up as follows: (*a*) That the Malays ethnologically belong to a distinct race; (*b*) that the theory formerly current, to the effect that the Sâkai, Ôrang Bĕnûa, Ôrang Laut, and other similar races of the peninsula and archipelago belonged to the Malayan stock, cannot be maintained, since recent investigations tend to identify them with the Mon-Annam family of races; (*c*) that the Malays are, comparatively speaking, newcomers in the lands which they now inhabit; (*d*) that it is almost certain that their emigration took place from the south; (*e*) and that, at some remote period of their history, they came into close contact with the Polynesian race, probably before its dispersion over the extensive area which it now occupies.

Religion and superstitions.

The Malays to-day are Sunni Mahommedans of the school of Shafi'i, and they habitually use the terms *Ôrang Mălâyu*, *i.e.*, a Malay, and *Ôrang Islâm*, *i.e.*, a Mahommedan, as synonymous expressions. Their conversion from paganism took place during the 13th, 14th, and 15th centuries of our era, the earliest recorded conversion of a Malay ruler being that of the Râja of Acheen in northern Sumatra in 1206, and the latest that of the Bûgis people of Celebes in 1495. The sultan of Malacca, whose conversion occurred in 1276, was the first ruler of the peninsula to embrace the Mahommedan religion. Upon the bulk of the Malayan peoples their religion sits but lightly. Few are found to observe the law concerning the Five Hours of Prayer, and many fail to put in an appearance at the Friday congregational services in the mosques. The Fast of Ramathân, however, is generally observed with some faithfulness. Compared with other Mahommedan peoples, the Malays are not fanatical, though occasionally an outbreak against those of a different creed is glorified by them into a holy war. The reason of such outbreaks, however, is usually to be found in political and social rather than in religious grievances. Prior to their conversion to Mahommedanism, the Malays were subjected to a considerable Hindu influence which reached them by means of the traders who visited the archipelago from India. In the islands of Bâli and Lômbok the people still profess a form of Hinduism, and Hindu remains are to be found in many other parts of the archipelago, though their traces do not extend to the peninsula. Throughout, however, the superstitions of the Malays show indications of this Hindu influence, and many of the demons whom their medicine-men invoke in their magic practices are clearly borrowed from the pantheon of India. For the rest, a substratum of superstitious beliefs which survives from the days when the Malays professed only their natural religion is to be found firmly rooted in the minds of the people, and the influence of Mahommedanism, which regards such things with horror, has been powerless to eradicate this. Mr W. W. Skeat's *Malay Magic* (Macmillan, London, 1900) is a compilation of all the writings on the subject of Malay superstitions by the best authorities.

Mode of life, &c.

The Malays of the coast are a maritime people, and were long famous for the daring character of their acts of piracy. They are now peaceable fisher-folk, who show considerable ingenuity in their calling. Inland the Malays live by preference on the banks of rivers, building houses on piles some feet from the ground, and planting groves of cocoanut, betel-nut, sugar-palm, and fruit-trees around their dwellings. Behind their villages the rice-fields usually spread, and rice, which is the staple food of the people, is the principal article of agriculture among them. Sugar-cane, maize, tapioca, and other similar products are grown, however, in smaller quantities. In planting rice three methods are in use: the cultivation of swamp-rice in irrigated fields; the planting of ploughed areas; and the planting of hill-rice by sowing each grain separately in holes bored for the purpose. In the irrigated fields the rice plants are first grown in nurseries, and are subsequently transplanted when they have reached a certain stage of development. The Malays also work jungle produce, of which the most important are gutta, rattans, agila wood, camphor wood, and the beautiful *kămûning* wood which is used by the natives for the hilts of their weapons. The principal manufactures of the Malays are cotton and silk cloths, earthenware and silver vessels, mats, and native weapons. The best cotton cloths are those manufactured by the Bûgis people in Celebes, and the *bâtek* cloths which come from Java and are stamped with patterns. The best silks are produced by the natives of Pahang, Kĕlantan, and Johor in the Malay Peninsula. Lord Leighton pronounced the silver ware from Malaya to be the most artistic of any exhibited at the Colonial Exhibition held in London in 1886. The pottery of the Malays is rude but curious. When the first Europeans visited the Malay Archipelago the Malays had already acquired the art of manufacturing gunpowder and forging cannon. The art of writing also appears to have been independently invented by the Malayan races, since numerous alphabets are in use among the peoples of the archipelago, although for the writing of Malay itself the Arabic character has been adopted for some hundreds of years. The Malays are excellent boat-builders.

Character, &c.

While the Malays were famous almost exclusively for their piratical expeditions, they naturally bore an evil reputation among Europeans, but now that we have come into closer contact with them, and have learned to understand them better, the old opinions concerning them have been greatly modified. They used to be described as the most cruel and treacherous people in the world, and they certainly are callous of the pain suffered by others, and regard any strategy of which their enemies are the victims with open admiration. In ordinary circumstances, however, the Malay is not treacherous, and there are many instances recorded in which men of this race have risked their own lives on behalf of Europeans who chanced to be their friends. As a race they are exceedingly courteous and self-respecting. Their own code of manners is minute and strict, and they observe its provisions faithfully. Unlike many Orientals, the Malays can be treated with a friendly familiarity without such treatment breeding lack of respect, or leading to liberties being taken with the superior. The Malays are indolent, pleasure-loving, improvident beyond belief, fond of bright clothing, of comfort, of ease, and they dislike toil exceedingly. They have no idea of the value of money, and little notion of honesty where money is concerned. They would always borrow rather than earn money, and they feel no shame in adopting the former course. They will frequently refuse to work for a wage when they most stand in need of cash, and yet at the invitation of one who is their friend they will toil unremittingly without any thought of reward. They are much addicted to gambling, and formerly were much given to fighting, though they never display that passion for war in the abstract which is characteristic of some of the white races, and their courage on the whole is not high if judged by European standards. It is notorious, however, on the coasts that a Malay gang on board a ship invariably gets the better of any fight which may arise between it and the Chinese crew. The sexual morality of the Malays is very lax, but prostitution is not common in consequence. Polygamy, though allowed by their religion, is practised for the most part among the wealthy classes only. The Malays are an intensely aristocratic people, and show a marvellous loyalty to their râjas and chiefs. Their respect for rank is not marred by any vulgarity or snobbery. The ruling classes among them display all the vices of the lower classes, and few of the virtues except that of courtesy. They are for the most part cruel, unjust, selfish, and improvident.

Much has been written concerning the acts of homicidal mania called *âmok*, which word in the vernacular means to attack. It was formerly believed that these outbursts were to be attributed to madness *pur et simple*, and some cases of *âmok* can certainly be traced to this source. These are not, however, in any sense typical, and might equally have been perpetrated by men of another race. The typical *âmok* is usually the result of circumstances which render a Malay desperate. The motive is often inadequate from the point of view of a European, but to the Malay it is sufficient to make him weary of life and anxious to court death. Briefly, where a man of another race might not improbably commit suicide, a Malay runs *âmok*, killing all whom he may meet until he himself is slain.

The nervous affliction called *lâtah*, to which many Malays are subject, is also a curious trait of the people. The victims of this affliction lose for the time all self-control and all sense of their own identity, imitating the actions of any person who chances to rivet their attention. Accounts of these manifestations will be found in Swettenham's *Malay Sketches* (London, 1895, Lane) and Clifford's *Studies in Brown Humanity* (London, 1897, Richards).

The Malays wear a loose coat and trousers, and a cap or head-kerchief, but the characteristic item of their costume is the *sârong*, a silk or cotton cloth about two yards long by a yard and a quarter wide, the ends of which are sewn together, forming a kind of skirt. This is worn round the waist folded in a knot, the women allowing it to fall to the ankle, the men, when properly dressed in accordance with ancient custom, folding it over the hilt of their waist-weapon, and draping it around them so that it reaches nearly to the knee. In the hall of a râja on state occasions a head-kerchief twisted into a peak is worn, and the coat is furnished with a high collar extending round the back of the neck only. This coat is open in front, leaving the chest bare. The trousers are short and of a peculiar cut and material, being coloured many hues in parallel horizontal lines. The *sârong* is of Celebes manufacture and made of cotton, to the surface of which a high polish is imparted by friction with a shell. The typical fighting costume of the Malay is a sleeveless jacket with texts from the Koran written upon it, short tight drawers reaching to the middle of the thigh, and the *sârong* is then bound tightly around the waist, leaving the hilt of the dagger worn in the girdle exposed to view. The principal weapon of the Malays is the *kris*, a short dagger with a small wooden or ivory handle, of which there are many varieties. The blade of a *kris* may either be wavy or straight, but if wavy the number of waves must always be uneven in number. The *kris* most prized by the Malays are those of Bûgis (Celebes) manufacture, and of these the kind called *tuâsek* are of the greatest value. Besides the short *kris* the Malays use long straight *kris* with very narrow blades, shorter straight *kris* of the same form, short broad swords called *sûndang*, long swords of ordinary pattern called *pĕdang*, somewhat shorter swords curved like scimitars with curiously carved handles called *chĕnangkas*, and short stabbing daggers called *tûmbok lâda*. The principal tools of the Malays are the *pârang* or *gôlok*, a heavy knife used in the jungle, without which no peasant ever stirs abroad from his house, the *bĕlîong* or native axe, and the *pîsau raut*, which is used for scraping rattan. Their implements are very primitive, consisting of a plough fashioned from a fork of a tree, and a rude harrow. Reaping is usually performed by the aid of a curious little knife which severs each ear of grain separately. The fisher-folk use many kinds of nets, which they manufacture themselves. Sails, paddles, oars, and punting-poles are all in use.

Costume, weapons, &c.

Language.

The Malayan language is the *lingua franca* used throughout the archipelago, but in its purest forms it is spoken in the native states of the Malay Peninsula and in the Malay districts of Sumatra. It is a wordy language, having a vocabulary estimated at over 15,000 words exclusive of local terms. The grammar is very simple, the formation of the sentence requiring the nominative to precede the verb, the accusative to follow it, and the adjective and demonstrative pronoun to follow the noun they qualify. The possessive is best formed by placing the word indicating the possessor immediately after the word indicating the thing possessed. There are no inflexions of case or number, but when the plural requires to be emphatically expressed the noun is duplicated. Tenses are indicated by the use of auxiliary verbs, and occasionally merely by the context, yet, though this would appear to be a loose mode of expression, there is never any difficulty experienced in conveying the exact shade of meaning. The language is not easy to speak correctly, on account of its extremely idiomatic nature. In many instances slight shades of meaning are indicated by completely different words—*e.g.*, *pîkul*, to carry on the shoulder; *junjong*, to carry on the head; *dûkong*, to carry on the back; *bêban*, to carry on the back as a burden; *kandong*, to carry at the waist or in the womb; *kandar*, to carry suspended from a stick carried over the shoulder; and many other words all indicating to carry. Instances of this kind of minuteness of expression might be multiplied indefinitely. To the educated ear the use of the wrong term is as offensive as a false quantity in Latin. A further difficulty is presented by the number of words to indicate the first person singular, each of which has its complementary pronoun to indicate the second person. Malays attach great importance to the correct use of these terms in polite conversation. In addition to this the idiomatic expressions of the Malays are often somewhat obscure, and cannot be made to bear any meaning if literally translated into a European tongue, though in the vernacular they are exceedingly expressive. Thus it comes to pass that though Malay is a tongue with which it is easy to acquire sufficient familiarity for ordinary conversation, such as is required for simple business transactions and the like, it is found, when a closer knowledge of it is sought, to be a most difficult language for a European to acquire in any perfection. For further information as to the language, see the article MALAYS in the earlier volume of the *Encyclopædia Britannica* (ninth edition).

Literature.

The Malays cannot, strictly speaking, be said to possess a literature, for none of their writings can boast any literary beauty or value. Their most characteristic literature is to be found not in their writings but in the folk-tales which are transmitted orally from generation to generation, and repeated by the wandering minstrels called by the people *Pĕng-lîpor Lâra*, *i.e.*, "Soothers of Care." Some specimens of these are to be found in the *Journal of the Straits Branch of the Asiatic Society* (Singapore). The collections of *Malay Proverbs* made by Klinkert, Maxwell, and Clifford also give a good idea of the literary methods of the Malays. Their verse is of a very primitive description, and is chiefly used for purposes of love-making. There are numerous rhymed fairy tales which are much liked by the people, but they are of no literary merit. The best Malay story is that of *Hang Tûah*.

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Malay States (Federated), the name borne by the native states of the Malay Peninsula which are under the protection of the British Government, though they do not officially form an integral portion of the empire. They are *Pêrak*, *Sĕlângor*, and the confederation of small states known as the *Nĕgri Sĕmbîlan* (nine states) on the west coast of the peninsula, and the state of *Pahang* on the east coast. Each state is under the rule of a sultan, who is assisted in his legislative duties by a state council upon which the Resident has a seat, and which is composed of native chiefs, with Chinese members nominated by the sultan with the advice of the Resident. The administrative work of each state is carried on by the Resident and his staff of European officials, aided by the Malay chiefs and village headmen. The sultan in each case is bound by treaty with the British Government to accept the advice of the Resident, who is therefore practically paramount, though due deference is paid to the wishes of the sultan and his chiefs, and the British officials are pledged not to interfere with the religious affairs of the Mahommedan community. The sultan and his chiefs receive from Government monthly allowances paid from the revenue collected, but all the financial affairs of the country are in the hands of the British officers. The federation of the four states was agreed to by the sultans and chiefs in 1895–96, and the actual federation dates from 1st July 1896, when a Resident-General was appointed to supervise the work of all the Residents, he being responsible to the High Commissioner, who is the Governor of the colony of the Straits Settlements for the time being.

The estimated aggregate area of the Federated Malay States is about 28,000 square miles; the population in 1901 was 517,337, composed as follows:—Europeans, 6589; Eurasians, 7057; Chinese, 227,989; Malays, 213,073; Indians, 58,927; other nationalities, 3702. The actual revenue for the year 1898 amounted to $15,609,807, the total expenditure being $12,728,930. The excess of income over expenditure is all the more remarkable as large sums were expended during the year on railway construction, for which purpose a loan of £500,000 has been sanctioned, but the necessity for drawing upon it has not yet arisen. The trade of the federation for 1900 amounted to the following values:—Imports, $38,402,581; exports, $60,361,045; total, $98,763,626. Since 1883 large alluvial deposits of tin ore have been worked in Pêrak. Sĕlângor, and the Nĕgri Sĕmbîlan with marked success.

Prior to that date tin was also exported from these states in considerable quantities, but lack of facilities for transport, &c., checked the output to a great extent. In 1883 the first railways were constructed, and by 1889 the output of tin from the states averaged half the total production of this metal throughout the world. Since then the increase has been considerable, and at the present time the Federated Malay States produce annually nearly 75 per cent. of the tin of the globe. The total output in 1900 was 713,058 piculs or 42,442 tons, as against 644,205 piculs or 38,226½ tons in 1899.

The whole of the Malay Peninsula is one vast forest, through which countless streams flow forming together the most lavish water system in the world. The rivers, though many of them are imposing in appearance, are uniformly shallow, only a few of them on the west coast being navigable by ships for more than 40 miles from their mouths. (For information on the botany, geology, &c., of the Malay states see MALAY PENINSULA.)

Pêrak.

Pêrak is situated between the parallels 3° 37′ and 6° 05′ N. and 100° 3′ to 101° 51′ E. on the western side of the Malay Peninsula. It is bounded on the N. by the British possession of Province Wellesley and the Malay state of Kĕdah; on the S. by the protected native state of Sĕlângor; on the E. by the protected native state of Pahang and the independent states of Kĕlantan and Pĕtâni; and on the W. by the Straits of Malacca. The coast-line is about 90 miles in length. The extreme distance from the most northerly to the most southerly portions of the state is about 172 miles, and the greatest breadth from east to west is about 100 miles. The total area of the country is estimated at about 10,000 square miles. The Pêrak river, which runs in a southerly direction almost parallel with the coast for nearly 150 miles of its course, is navigable for small steamers for about 40 miles from its mouth, and by native trading boats for nearly 200 miles. The Plus, Bâtang, Pâdang, and Kinta rivers are its principal tributaries, all of them falling into the Pêrak on its left bank. The other principal rivers of the state are the Krian, Kûrau, Lârut, and Brûas to the north of the mouth of the Pêrak, and the Bĕrnam to the south. None of these rivers are of any great importance as waterways, although the Bĕrnam river is navigable for small steamers for nearly 100 miles of its course. The mountain ranges, which cover a considerable area, run from the north-east to the south-west. The highest altitudes attained by them do not exceed 7500 feet, but they average about 2500 feet. They are all thickly covered with jungle. The ranges are two in number, running parallel to one another, with the valley of the Pêrak between them. The larger is a portion of the main chain which runs down the peninsula from north to south. The lesser is situated in the district of Lârut. There are several hill sanatoria in the state at heights which vary from 2500 to 4700 feet above sea-level, but the extreme humidity of the atmosphere renders the coolness thus obtainable the reverse of enjoyable.

Geology.

Mr Leonard Wray, the curator of the Pêrak museum, writes as follows on the subject of the geological formation of the state:—"There are really only four formations represented—firstly, the granitic rock; secondly, a large series of beds of gneiss, quartzite, schist, and sandstone, overlaid in many places by thick beds of crystalline limestone; thirdly, small sheets of trap rock; and fourthly, river-gravels and other Quaternary deposits. The granites are of many varieties, and also, in all probability, of several different geological periods. The series of quartzites, schists, and limestone are of great age, but as no fossils have ever been found in any of them, nothing definite can be stated as to their exact chronological position. Their lithological characteristics and the total absence of all organic remains point to the Archæan period. The failure to discover signs of life in them is, of course, merely negative evidence, and the finding of a single fossil would at once upset it. However, until this happens they may be conveniently classed as Laurentian. It is at present impossible to form anything approaching an accurate estimate of the thickness of this extensive series, but it is probable that it is somewhere between 4000 and 5000 feet. Unconformability has been noticed between the limestones and the beds beneath, but whether this is sufficient to separate them or not is a matter for future investigation. . . . The taller hills are exclusively composed of granite, as also are some of the lower ones. . . . The ores of the following metals have been found in the formations named:—granite—tin, lead, iron, arsenic, tungsten, and titanium; Laurentian—tin, gold, lead, silver, iron, arsenic, copper, zinc, tungsten, manganese, and bismuth; Quaternary—tin, gold, copper, tungsten, iron, and titanium. This is not to be considered a complete list, as small quantities of other metals have also been found."

History.

The early history of Pêrak is obscure, the only information on the subject being obtained from native traditions, which are altogether untrustworthy. According to these authorities, however, a settlement was first made by Malays in Pêrak at Brûas, and the capital was later moved to the banks of the Pêrak river, the site chosen being a little village called Tĕmong, which lies some miles up stream from Kuâla Kangsar, the present residence of the sultan. When the Malacca sultanate fell owing to the invasion of the Portuguese in 1511, a member of that royal house is said to have migrated to Pêrak, and the present dynasty claims to have been descended from him. As this boast is also made by almost every ruling family in the peninsula, the tradition is not worthy of any special attention. What is more certain is the tradition that Pêrak was twice invaded by the Acheenese, and its rulers carried off into captivity, one of them, Sultan Mansur Shah, subsequently becoming the ruler of Acheen. The first European settlement in Pêrak was made by the Dutch in 1650, under a treaty entered into with the Acheenese, but the natives of the country rose against the Dutch again and again, and it was abandoned in 1783, though it was afterwards reoccupied, the Dutch being finally ejected by the British in 1795. In 1818 the Siamese conquered Pêrak, but its independence was secured by a treaty between the British and Siamese Governments in 1824. From that date until 1874 Pêrak was ruled by its own sultans, but in that year, owing to internal strife, Sultan Abdullah applied to the then Governor of the Straits Settlements, Sir Andrew Clarke, for the assistance of a British Resident. The treaty of Pangkor was concluded on 20th January 1874, and the first Resident, Mr J. W. W. Birch, was murdered on 2nd November 1875. A punitive expedition became necessary; Sultan Abdullah and the other chiefs concerned in the murder were banished, the actual murderers were hanged, and Râja Mûda Jusuf was declared regent. Sir Hugh Low was appointed Resident, a position which he held until 1889, when he was succeeded by Sir Frank Swettenham. Since then the history of Pêrak has been one of continuous peace and growing prosperity and wealth.

Population.

By the census taken on 5th April 1891 the population of Pêrak was shown to be as follows:—Europeans, 366; Eurasians, Jews, and Armenians, 293; Malays, 96,719; Chinese, 94,345; Tamils, 13,086; aborigines, 5779; other nationalities, 3666; thus making a grand total of 214,254, of whom 156,408 were males and 57,846 were females. The estimated population in 1898 was 277,461, but owing to the disparity of the proportions between the sexes the deaths in each year largely outnumber the births, and the increase in the population is accounted for solely by the number of immigrants, chiefly from the mainland of China, and to a lesser extent from India also.

Finance, trade, &c.

The revenue of Pêrak in 1874 amounted to only $226,333. That for 1900 amounted to $7,636,126. Of this latter sum $3,570,631 was derived from duty on tin exported, $1,017,618 from railway receipts, $351,451 from land revenue, and $89,857 from postal and telegraphic revenue. The balance is mainly derived from the revenue farms which are leased to Chinese capitalists for a term of years, being for the right to collect import duties on opium and spirits, and to keep licensed gambling and pawnbroking shops. The expenditure for 1900 amounted to $6,144,774. Of this sum $2,417,990 was expended upon railway upkeep and construction, and $1,229,295 on public works. The value of the imports during 1900 was $14,741,148; that of the exports, $29,190,663; total, $43,931,811. Tin is the principal export from the state. The following table shows the amount exported between 1896 and 1900, with the Singapore price of refined tin at the time of export, and the value of each year's output:—

Year.	Tons.	Price per Picul.	Value.
1896	22,811	$32·20	$12,339,909
1897	20,949	36·09	12,701,695
1898	19,703	42·96	14,177,101
1899	18,960	72·52	23,099,506
1900	21,166	74·15	26,032,000

The diminished output is stated not to be due to the exhaustion of the tin resources of the state—that will not come for many years yet—but to the scanty labor supply. The latter is ascribed to increased demand for Chinese labour in China and French Indo-China, and the Dutch colonies, and also to the low price which has ruled for some years. In 1900 the price of tin rose higher than in any year of the decade 1891–1900. The sugar exported from Pêrak in 1898 was valued at $1,214,701, and the coffee at $48,664.

General.

Although so much has been done to develop the resources of Pêrak, by far the greater portion of the state is still covered by dense forest. In 1898 it was calculated that only 330,249 acres of land were occupied or cultivated out of a total acreage of 6,400,000. A line of railway connects the port of

Tĕluk Anson with the great mining district of Kinta, whence the line runs on to Kuâla Kangsar, the residence of the sultan; and an extension thence to Lârut and from Lârut to Province Wellesley, opposite Penang, is in course of construction. There are also several hundred miles of excellent metalled roads. For administrative purposes the state is divided into six districts:—Upper Pêrak, Kuâla Kangsar, and Lower Pêrak, on the Pêrak river; Kinta; Lârut, and Krian. Of these, Lârut and Kinta are the principal mining centres, while Krian is the most prosperous agricultural district. The districts on the Pêrak river are mostly peopled by Malays. The administrative capital is Taiping, the chief town of Lârut. Kuâla Kangsar is chiefly memorable as having been the scene of the first federal meeting of native chiefs, who, with the British Residents from each state, met together in 1897 for friendly discussion of their common interests for the first time in history, under the auspices of the High Commissioner, Sir Charles H. B. Mitchell. This, in the eyes of those who are acquainted with the character of the Malays and of the relations which formerly subsisted between the rulers of the various states, is perhaps the most signal token of the changes which British influence has wrought in the peninsula.

Sĕlângor.

Sĕlângor is situated between the parallels 2° 32′ and 3° 37′ N. and 100° 38′ and 102° E., on the western side of the Malay Peninsula. It is bounded on the N. by the protected native state of Pêrak, on the S. by the protected states of the Nĕgri Sĕmbilan, on the E. by Pahang and the Nĕgri Sĕmbilan, and on the W. by the Straits of Malacca. The coast-line is about 100 miles in length, greatest length about 104 miles, and greatest breadth about 48 miles, total area estimated at about 3000 square miles. The state consists of a narrow strip of land between the mountain range which forms the backbone of the peninsula and the Straits of Malacca. Compared with other states in the peninsula, Sĕlângor is poorly watered. The principal rivers are the Sĕlângor, the Klang, and the Lângat. The principal port of the state is situated at the mouth of the Klang river, and is connected with the capital, Kuâla Lûmpor, by a railway. The geology of the state closely resembles that of Pêrak. The state is possessed of most valuable deposits of alluvial tin, and mining for this metal is the chief industry of the population.

History.

According to native tradition, the ruling house of Sĕlângor is descended from a Bûgis râja, who, with two of his brothers, settled in the state in 1718, the son of the youngest brother eventually becoming ruler of the country. In 1783 the then sultan of Sĕlângor joined with the Iang-di-pĕr-Tûan Mûda of Riouw in an unsuccessful attack upon the Dutch who then held Malacca. In retaliation the Dutch, under Admiral Van Braam, invaded Sĕlângor and drove the sultan out of his country. In 1785, aided by the Bĕndăhâra of Pahang, Sultan Ibraḥim of Sĕlângor reconquered his state; but the Dutch blockaded his ports, and eventually forced him to enter into a treaty whereby he consented to acknowledge their sovereignty. The earliest British political communication with Sĕlângor began in 1818, when a commercial treaty was concluded with the Governor of Penang. In 1867 Sultan Abdul Samad of Sĕlângor appointed his son-in-law, Tûngku Kudin, to be viceroy; and this gave rise to a civil war which lasted almost without intermission till 1873, when the enemies of Tûngku Kudin were finally vanquished, largely by the agency of the Bĕndăhâra of Pahang, who, at the invitation of the Governor of the Straits Settlements, sent a warlike expedition to the assistance of the viceroy. In 1874 the occurrence of an atrocious act of piracy off the mouth of the Lângat river led to the Governor, Sir Andrew Clarke, appointing, at the request of the sultan, a British Resident to aid him in the administration of his kingdom. Since that date there has been no further breach of the peace, and the prosperity of Sĕlângor has increased annually.

Population.

By the census taken on 5th April 1891 the population of Sĕlângor was shown to be as follows:—Europeans, 190; Eurasians, 167; Malays, 23,750; Chinese, 50,844; aborigines, 1224; Tamils, 3082; other nationalities, 2335, thus making a total of 81,592, of whom 67,051 were males and 14,541 were females. It will be noted that the population of this once Malayan state is now Chinese to the extent of more than 60 per cent. of the whole. The estimated population in 1898 amounted to 150,000, and of this probably 75 per cent. at the least was Chinese, the increase of the population being due entirely to the influx of labourers from the mainland of China attracted by the richness of the alluvial tin mines. Here, as elsewhere in the Malay Peninsula, the deaths annually far outnumber the births recorded, the disproportion of the female to the male sections of the population being greater in Sĕlângor than in other parts of the colony and Federated States. The development of planting enterprise in Sĕlângor, and more especially the cultivation of coffee, has led to a certain immigration of Tamil coolies, but the number of Tamils is still insignificant if compared with that of the Chinese population.

Finance, trade, &c.

The revenue of Sĕlângor in 1875 amounted to only $115,656; in 1900 it had increased to $6,303,165. Of this latter sum $2,695,828 was derived from duty on tin exported, $1,072,378 from railway receipts, $255,899 from land revenue, and $67,937 from postal and telegraphic revenue. The balance is chiefly derived from the revenue farms, which include the right to collect import duty on opium and spirits. The expenditure for 1900 amounted to $4,944,160, of which sum $2,276,510 was expended upon railways and $833,722 on public works. The value of the imports in 1900 was $18,406,570, and that of the exports was $21,798,444, making a total of £40,205,014. Tin is the principal export. The amount exported in 1898 was 16,301 tons, but in 1900 it was 16,041 tons. The decrease is attributed by the Resident to scarcity of labour rather than to any deficiency of good mining ground. The total area of alienated mining land at the end of 1898 amounted to 39,532 acres, and it was estimated that 50,000 Chinese were employed in the mines. Coffee, rice, pepper, and gambier are all grown with success in Sĕlângor, but the state practically exists at the present time only as a mining country. Had it to depend upon its agricultural products for its revenue, it would speedily become bankrupt. Every effort is being made, however, to stimulate planting enterprise against the day, probably far distant still, when the alluvial tin deposits will become exhausted. No true lode has hitherto been discovered in Sĕlângor.

General.

The total length of railway line open to traffic at the end of 1898 was 77½ miles, and on 1st January 1899 a further section of 5½ miles was declared open. There is now railway communication not only between the port of Klang and the capital, Kuâla Lûmpor, but between that place and Ulu Sĕlângor, a distance of 36 miles, and Ulu Lângat, a distance of nearly 20 miles. Railways are also in course of construction which will eventually join the Sĕlângor system to that of Pêrak on the north and that of the Nĕgri Sĕmbilan on the south. Frequent communication is maintained by steamer between Klang and Singapore, and by coasting vessels between the former port and those on the coast of the peninsula.

For administrative purposes Sĕlângor is divided into six districts—Kuâla Lûmpor, in which the capital and the principal tin-fields are situated; Ulu Sĕlângor, which is also a prosperous mining district; Kuâla Sĕlângor, which is agricultural, and poorly populated by Malays; Ulu Lângat, mining and agricultural; Kuâla Lângat, the residence of the late sultan Abdul Samad, agricultural; and Klang, the only prosperous port of the state. Much money has been expended upon the capital, Kuâla Lûmpor, which possesses some fine public buildings, water-works, &c., and where the principal residence of the Resident-General is situated. In some sort Kuâla Lûmpor is the capital not only of Sĕlângor, but also of the whole federation. Its scenery is very attractive.

Nĕgri Sĕmbilan.

Nĕgri Sĕmbilan (the Nine States) is a federation of small native states which is now treated as a single entity, being under the control of a British Resident, and is situated between parallels 2° 28′ and 3° 18′ N. and 101° 45′ and 102° 45′ E., on the western side of the Malay Peninsula. It is bounded on the N. by the protected state of Pahang, on the S. by the territory of Malacca, on the E. by Pahang and the independent state of Johor, and on the W. by the Straits of Malacca. The coast-line is about 28 miles in length, and the extreme distance from north to south is 55 miles, and that from east to west about 65 miles. The estimated area is about 3000 square miles. Arang-Arang, or Port Dickson, is the only port on the coast. It is connected with the capital, Sĕrĕmban, by a railway 24 miles in length. Most of the states comprising the federation depend largely for their prosperity upon agriculture, but in some of the districts tin is being worked in considerable quantities, with good results.

History.

As is the case with the history of most Malayan states, much rests upon no surer ground than tradition, in so far as the records of the Nĕgri Sĕmbilan are concerned. At the same time the native story that the states which now form the federation of the Nĕgri Sĕmbilan were originally peopled by tribes of Sâkai, or aborigines of the peninsula, who descended from the mountains of the interior and peopled the valleys, is supported by much corroborative evidence. Not only does the Malay's contempt for the Sâkai make it exceedingly unlikely that the tradition, which is hardly a matter for pride, should have been preserved if it were not true, but also many of the laws and customs in force in these states are wholly foreign to those of the Malays, and can plainly be traced to the aborigines. As an instance, the custom of inheriting rank and property through the mother instead of through the father may be mentioned. Tradition further relates that towards the end of the 18th century a râja of the royal house of Mĕnangkâbu came from Sumatra to rule over the federation of small states, each of which continued to be governed in all its local affairs by its own chief and by the village and other councils sanctioned by ancient custom. The Sumatran râja took the title of Iang-di-pĕr-Tûan of Sri Mĕnanti. Although they bore the name of the "Nine States," only six seem to have belonged to the federation during the time of which history speaks. These are

Sri Měnanti, Johol, Tampin, Rĕmbau, Jĕlĕbu, and Sûngei Ujong. Later the two latter separated themselves from the confederation. Ancient tradition says that the names of the nine states were originally Klang, Jĕlĕbu, Sûngei Ujong, Johol, Sĕgâmat, Pâsir Bĕsar, Nâning, Rĕmbau, and Jĕlai. Of these Klang was annexed by Sĕlângor, Sĕgâmat and Pâsir Bĕsar by Johor, and Nâning by Malacca. During the last years of the 18th century the Iang-di-pĕr-Tûan appointed an Iang-di-pĕr-Tûan Mûda to rule Rĕmbau, and the state of Tampin was created to provide for the family of the new chief. In 1887 the Governor of the Straits Settlements sent Mr Martin Lister to the Nĕgri Sĕmbîlan, which had become disintegrated, and by his influence the ancient federal system was revived under the control of a Resident appointed by the Governor. The states which formed this new confederation were Johol, Ulu Mûar, Jĕmpol, Tĕrâchi, Inas, Gûnong Pâsir, Rĕmbau, Tampin, and Gĕmĕncheh. Prior to this, in 1873, owing to a civil war in Sûngei Ujong, Sir Andrew Clarke sent a military force to that state, put an end to the disturbances, and placed the country under the control of a British Resident. Jĕlĕbu was taken under British protection in 1886, and was thenceforth managed by a magistrate under the orders of the Resident of Sûngei Ujong. In 1896, when the federation of all the Malayan states under British control was effected, Sûngei Ujong and Jĕlĕbu were reunited to the confederation of small states from which they had so long been separated, and the whole, under the old name of the Nĕgri Sĕmbîlan, or Nine States, was placed under one Resident.

Population.

The population of the Nĕgri Sĕmbîlan, according to the census taken in April 1891, amounted to 70,730. It is now estimated that the population has increased to 85,000, but no trustworthy figures on the subject are obtainable. In 1898, however, the number of arrivals at the ports of the state exceeded the departures by 3646. The births registered slightly exceed the deaths, there being a large Malayan population in these states, among whom there is a fair proportion of women to men, a condition of things which is not found in the states most visited by Chinese immigrants.

Finance and trade.

The revenue of the Nĕgri Sĕmbîlan amounted to only $223,435 in 1888. In 1898 it had increased to $701,334, and in 1900 amounted to $1,251,366. The revenue of 1900 was derived mainly as follows—land revenue, $125,168; railway receipts, $83,180; duty on tin, $692,519; the balance being chiefly due to the revenue farms. The expenditure in 1900 amounted to $1,009,318. The trade returns for 1900 show a total value of $11,330,000. Of this sum two-fifths is represented by the value of the exports, $4,281,457 being the value of the tin exported, and $1,065,000 the value of agricultural produce exported. The latter is chiefly coffee, jungle produce, pepper, and gambier. The output of tin in 1900 amounted to 74,300 piculs. At the end of that year there were 15,000 persons working in the tin mines.

General.

The only line of railway open to traffic at the end of 1898 was that from Port Dickson to Sĕrĕmban, which is 24½ miles in length. During the year 223 miles of cart-road and 174 miles of bridle-paths were open to traffic. A railway is now in course of construction which, when completed, will join Sĕrĕmban to Malacca on the south and to Kuâla Lûmpor on the north. Frequent communication with the ports of the colony and of the native states on the Straits of Malacca by coasting vessels is maintained.

For administrative purposes the Nĕgri Sĕmbîlan is divided into five districts, viz., the Sĕrĕmban District, the Coast District, Jĕlĕbu, Kuâla Pilah, and Tampin. Each of these is under the charge of a European district officer, who is responsible to the Resident. The Iang-di-pĕr-Tûan lives at Kuâla Pilah, but the capital of the federation is at Sĕrĕmban in Sûngei Ujong, where the Resident is stationed. The hereditary chiefs of the various states aid in the government of their districts, and have seats upon the state council, over which the Iang-di-pĕr-Tûan presides. The watering-place of Magnolia Bay, where excellent sea-bathing is obtainable, is one of the pleasure resorts of this part of the peninsula.

Pahang.

Pahang, on the east coast of the peninsula, is situated between parallels 2° 28′ and 3° 45′ N. and 101° 30′ and 103° 30′ E. It is bounded on the N. by the independent native states of Kĕlantan and Trĕnggânu; on the S. by the Nĕgri Sĕmbîlan and Johor; on the E. by the China Sea; and on the W. by the protected states of Pêrak and Sĕlângor. The coast-line is about 112 miles in length; the greatest length is about 210 miles, and greatest breadth about 130 miles. The state is the largest in the peninsula, its area being estimated at 15,000 square miles. The ports on the coast are the mouths of the Endau, Rompin, Pahang, and Kuantan rivers, but during the north-east monsoon the coast is not easy of approach, and the rivers, all of which are guarded by difficult bars, are impossible of access except at high tides. The principal river of the state is the Pahang, from which it takes its name. At a distance of 180 miles from the coast this river is formed by two others named respectively the Jĕlai and the Tĕmbĕling. The former is joined 20 miles farther up stream by the Lĭpis, which has its rise in the mountains which form the boundary with Pêrak. The Jĕlai itself has its rise also in a more northerly portion of this range, while its two principal tributaries above the mouth of the Lĭpis, the Tĕlom and the Sĕrau, rise, the one in the plateau which divides Pêrak from Pahang, the other in the hills which separate Pahang from Kĕlantan. The Tĕmbĕling has its rise in the hills which divide Pahang from Kĕlantan, but some of its tributaries rise on the Trĕnggânu frontier, while the largest of its confluents comes from the hills in which the Kuantan river takes its rise. The Pahang is navigable for large boats as far as Kuâla Lĭpis, 200 miles from the mouth, and light-draught launches can also get up to that point. Smaller boats can be taken some 80 miles higher up the Jĕlai and Tĕlom. The river, however, as a waterway is of little use, since it is uniformly shallow. The Rompin and Kuantan rivers are somewhat more easily navigated for the first 30 miles of their course, but taken as a whole the waterways of Pahang are of little value. The interior of Pahang is chiefly noted for its auriferous deposits. Gûnong Tâhan is situated on the boundary between Pahang and Kĕlantan. Its height is estimated at 8000 feet above sea-level, but it has never yet been ascended. Pahang, like the states on the west coast, is covered almost entirely by one vast forest, but in the Lĭpis valley, which formerly was thickly populated, there is a considerable expanse of open grass plain unlike anything to be seen on the western sea-board. The coast is for the most part a sandy beach fringed with *casuarina* trees, and there are only a few patches of mangrove-swamp throughout its entire length.

History.

The ancient name of Pahang was Indrapûra. It is mentioned in the history of *Hang Tûah*, the great Malacca brave, who flourished in the 16th century, and who succeeded in abducting a daughter of the then ruling house of Pahang for his master, the sûltan of Malacca. Prior to this, Pahang had been ruled by the Siamese. When Malacca fell into the hands of the Portuguese in 1511 the sultan, Muhammad Shah, fled to Pahang, and the present ruling house claims to have been descended from him. The title of the ruler of Pahang was Bĕndăhâra until 1882, when the present (1902) ruler, Wan Ahmad, assumed the title of sultan, taking the name of Sultan Ahmad Maatham Shah. Up to that time the Bĕndăhâra had been installed on his accession by the sultan of Riau, and held his office by virtue of that chief's letter of authority. About 1855 the father of the present sultan died at Pĕkan, and his son Bĕndăhâra Korish, who succeeded him, drove Wan Ahmad from the country. After making three unsuccessful attempts to conquer the land and to dethrone his elder brother, Wan Ahmad at last succeeded in 1865 in invading the state and wresting the throne from his nephew, who had succeeded his father some years earlier. From that time, in spite of two attempts to shake his power by invasions from Sĕlângor which were undertaken by his nephews Wan Aman and Wan Da, Bĕndăhâra Ahmad ruled his country with a rod of iron. In 1887 he consented to enter into a treaty with the Governor of the Straits, by which he accepted a Consular Agent at his court. This treaty was finally signed on 8th October 1887. In February of the following year a Chinese British subject was murdered at Pĕkan in circumstances which pointed to the responsibility of the sultan for the crime, and in October 1888 a Resident was appointed to assist the sultan in the administration of his country, that being, in the opinion of the British Government, the only guarantee for the safety of the life and property of British subjects which it could accept. In December 1891 disturbances broke out in Pahang, the nominal leaders of which were certain of the sultan's most trusted chiefs. The sultan himself took no part in the outbreak, but it undoubtedly had his sympathy, even if it was not caused by his direct commands. The rebels were driven to seek safety in flight in November 1892, but in June 1894 they gathered strength for a second disturbance, and raided Pahang from Kĕlantan, in which state they had been given shelter by the Mahommedan rulers. This event, added to the occurrence of other raids from across the border, led to an irregular expedition being led into Trĕnggânu and Kĕlantan by the Resident of Pahang (Mr Hugh Clifford) in 1895, and this had the desired result. The rebel chiefs were banished to Siam, and no further breach of the peace has troubled the tranquillity of Pahang since that time. Pahang joined the Federated Malay States by a treaty signed in 1895, and the sultan and his principal chiefs were present at the federal durbar held at Kuâla Kangsar in Pĕrak in 1897.

Population.

The census taken in Pahang in April 1891 was neither complete nor trustworthy, the country being at that time newly acquired territory, and the machinery for taking such statistics by no means efficient. The figures then obtained gave the total population of the state as 57,642, of whom 50,527 were Malays, 3241 Chinese, and 2032 Sâkai, or aboriginal tribes. Of the latter it is estimated that several thousands escaped enumeration, and at least 3000 Malays also escaped the census. It is estimated that the population at the present time, which has been augmented since 1891 by the influx of both Chinese and foreign

Malays, exceeds 80,000. In former days Pahang was far more thickly populated than in modern times, but the long succession of civil wars which racked the land after the death of Bĕndăhâra Ali caused thousands of Pahang Malays to fly the country. To-day the valley of the Lĕbir river in Kĕlantan and the upper portions of several rivers on the Pêrak and Sĕlângor boundaries are inhabited by Pahang Malays, the descendants of these fugitives. The Pahang natives are almost all engaged in agriculture. The work of the mines, &c., is performed by Chinese and foreign Malays. In the Lĭpis valley the descendants of the Râwa Malays, who at one time possessed the whole of the interior in defiance of the Pahang râjas, still outnumber the people of the land.

Finance and trade.

The revenue of Pahang in 1889 amounted to only $62,077; in 1899 it was $300,000, and in 1900 had increased to $419,150. The expenditure in 1900 amounted to $630,678. Pahang is still a source of expense to the federation, its progress having been retarded by the disturbances which lasted from December 1891 until 1895, with short intervals of peace; but the revenue is now steadily increasing, and the ultimate financial success of the state is considered to be secure. Pahang owes something over $3,500,000 to Sĕlângor, which has financed it now for some years out of surplus revenue. The value of the imports in 1900 was $973,405, that of the exports was $2,322,950, thus making a total trade value of $3,295,355. The most valuable export was gold, worth $680,000. The tin ore exported amounted to 15,728 piculs.

General.

The geological formation of the states lying to the eastward of the main range of mountains which splits the peninsula in twain differs materially from that of the western states. At a distance of about a dozen miles from the summits of the mountains the granite formation is replaced by slates, which in many places are intersected by fissures of quartz, and in others are overlaid by vast thicknesses of limestone. Those of the quartz fissures which have been exploited are found to be auriferous, and several European mining companies are now working these deposits of gold with some success. The Raub mine, near the foot of the mountains, is said to be likely to take rank as a fine gold-mine, and there is every reason to believe that Pahang possesses other gold-mines of equal value. These mines are now being worked by electric power generated by water-power, and transmitted by overhead wires for a distance of 7 miles. A magnificent road over the mountains, with a ruling grade of 1 in 30, joins Kuâla Lĭpis, the administrative capital of Pahang, to Kuâla Kûbu, the nearest railway station in Sĕlângor. The road measures 82 miles in length. Pĕkan, where the sultan has his residence, was the capital of Pahang until the middle of 1898, when the administrative headquarters were transferred to the interior as being more central. None of these towns is of any size or importance. In the Kuantan valley, which lies parallel to the Pahang river, a European company is working tin lodes with considerable success. These lodes are the only mines of the kind being worked in the Federated Malay States. Pahang is fertile and well suited for agriculture of many kinds. The rainfall is heavy and regular. The climate is cooler than that of the west coast, and the full force of the monsoon is felt from October to February in each year. For administrative purposes Pahang is divided into four districts—Ulu Pahang, in which the present capital is situated; Tĕmĕrloh, which includes 80 odd miles of the Pahang valley and the Sĕmantan river; Pĕkan, which includes the coast rivers down to Endau; and Kuantan. Each of these is under the charge of a district officer, who is responsible to the Resident. The boundary with Johor and the Nĕgri Sĕmbilan was rectified by a commission which sat in London in 1897–98.

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(H. CL.)

Maláyir, a small province of Persia, situated between Hamadan and Burújird. It has a population of about 70,000, and, together with the district Túsirkán, pays a yearly revenue of about £13,000. Its capital and seat of government is Doletábád (Dowletábád), a thriving and prosperous little city, with a population of about 5000, situated, at an elevation of 5680 feet, 38 miles from Hamadan and 32 miles from Burújird. It has post and telegraph offices.

Malchin, a town of Germany, grand-duchy of Mecklenburg-Schwerin, on the river Peene, between Lakes Malchin and Kummerow, 28 miles by rail north-west of Neu-Brandenburg. It is, alternately with Sternberg, the place of assembly of the Mecklenburg Diet. Here are the châteaux of Remplin, Basedow, and Schlitz; a 4th-century church, and a large town hall. Population (1900), 7449.

Malda, a district of British India, in the Bhagalpur division of Bengal. The administrative headquarters are at English Bazar, near the town of Old Malda.

Area, 1902 square miles; population (1881), 711,487; (1891), 814,919; (1901), 884,443, showing an increase of 15 per cent. between 1881 and 1891, and of 8·5 between 1891 and 1901; average density, 464 persons per square mile. Classified according to religion, Hindus in 1891 numbered 409,136; Mahommedans, 384,651; Christians, 72, of whom 23 were Europeans; "others," 21,060. The land revenue and rates in 1897–98 were Rs.4,66,863; number of police, 278; number of boys at school (1896–97), 13,181, being 22 per cent. of the male population of school-going age; registered death-rate (1897), 33·6 per thousand. The two principal industries are indigo and silk, but both are declining. There are two indigo concerns, and four factories, employing about 3000 persons, with an out-turn of 1600 maunds, valued at Rs.2,00,000; and two silk filatures, employing 1000 persons, with an out-turn of 50,000 ℔, valued at Rs.3,00,000. No railway touches the district, but the communications by water are good.

Malden, a city of Middlesex county, Massachusetts, U.S.A., in the eastern part of the state. It is 5 miles north of Boston, of which it is a suburb. Its plan is irregular, it is divided into seven wards, it derives its water supply from Spot Pond, and few of its streets are paved. It is on the Boston and Maine railroad. It is largely a residential city, and its manufactures are not extensive. In 1900 its manufacturing establishments numbered 242, with a capital of $5,906,279. They employed an average number of 3082 hands, and their product had a value of $7,959,292. The assessed valuation of real and personal property in 1900 was $27,287,540, the net debt of the city was $1,522,944, and the rate of taxation was $16·70 per $1000. Population (1880), 12,017; (1890), 23,031; (1900), 33,664, of whom 9513 were foreign-born and 446 were negroes. The death-rate in 1900 was 14·4.

Maldive Islands, an archipelago in the Indian Ocean, lying between 7° 6′ N. and 0° 42′ S. and 72° 33′ and 73° 44′ E. The group was again visited and surveyed in 1899–1900 by Mr J. Stanley Gardiner and Mr C. Forster Cooper, who found that as many as 300 of the atolls were at that time inhabited. The natives, who are estimated at about 30,000 Mahommedans, are classed by these observers in four ethnological divisions. 1. Those of the northern atolls, which are separated from the rest by the Kardiva channel, 35 miles broad and exposed to strong cross-currents during the monsoons. Here the reefs are less perfect, seldom forming complete central lagoons, and as they were formerly exposed to the constant attacks of the Mopillah pirates from India, the people are hardier and more vigorous than their less warlike southern neighbours. They annually visited the coasts of India or Ceylon, concluded treaties with the rajahs against the corsairs, and often married Indian wives, thus acquiring distinct racial characters of an approximately Dravidian type. 2. Those of the central division, comprising ten atolls crowded together between North Male and Haddumati, who are under the direct rule of the sultan, and have been more exposed to Arab influences. They formerly traded with Arabia and Malaysia, and many Arabs settled amongst them, so that they betray a strong strain of Semitic blood in their features. 3 and 4. The natives of Suvadiva, Addu, Mulaku, and the other southern clusters, who have had little communication with the Central Male people, and probably preserve more of the primitive type, approximating in appearance to the Singhalese villagers of Ceylon. They are an intelligent and industrious people, growing their own crops, manufacturing their own cloth and mats, and building their own boats, while many read Arabic more or less fluently, although still believers in magic and witchcraft. Mr Gardiner also visited the hitherto little known MINIKOI atoll, which lies in 8° 15′ N. and 73° E., 110 miles from the Laccadives, 71 miles from the Maldives, and 215 miles from the nearest point on the coast of India. The atoll, which is pear-shaped and disposed in the direction from south-west to north-east, is 5 miles long, with an extreme breadth of nearly three miles, with a large but shallow lagoon approached from the north by a passage 2 fathoms deep. At present the atoll is growing outwards on every side, and at one place rises 19 feet above sea-level. The population, which numbered a little over 3000 in 1899, is sharply divided into five castes, of which the highest three are pure Maldivan, the lower two the same as the rest of the Laccadives. All are centred in a small village opposite Mou Rambu Point on the west or lagoon side; but most of the men are generally absent, many being employed with the Lascar crews on board the large liners plying in the Eastern seas. The numerous wrecks on its reefs, its lighthouse, and its position on the track of all eastward-bound vessels make Minikoi a familiar sight to seafarers in those waters.

See *Proceedings of the Cambridge Philosophical Society*, vol. xi. Pt. 1. (1900). (A. H. K.)

Maler Kotla, a native state of India, within the Punjab. It ranks as one of the cis-Sutlej states, which came under British influence in 1809. The territory lies south of Ludhiana. Area, 162 square miles; population (1891), 75,755; average density, 467 persons per square mile. In 1901 the population was 77,506, showing an increase of 2 per cent. The estimated gross revenue is Rs.3,02,000; the military force numbers 280 men; and there is no tribute. The chief, whose title is nawab, is an Afghan. In consequence of his insanity, the administration is conducted by the nawab of Loharu. It is proposed to construct a railway through the state, and partly out of its revenues, from Ludhiana to Jhakhal on the Southern Punjab line. In 1896–97 the number of schools was 22, attended by 837 pupils, of whom 60 were girls; the proportion of boys at school was as high as one in 48 of the total male population. The town of MALER KOTLA is 30 miles south of Ludhiana. Population (1891), 21,754.

Mallarmé, Stéphane (1842–1898), French poet and theorist, was born at Paris, 18th March 1842. His life was simple and without event. His small income as professor of English in a French college was sufficient for his needs, and, with his wife and daughter, he divided the year between a fourth-floor flat in Paris and a cottage on the banks of the Seine. His Tuesday evening receptions, which did so much to form the thought of the more interesting of the younger French men of letters, were almost as important a part of his career as the few carefully elaborated books which he produced at long intervals. *L'Après-midi d'un Faune* (1876) and other fragments of his verse and prose had been known to a few people long before the publication of the *Poésies complètes* of 1887, in a facsimile of his clear and elegant hand-writing, and of the *Pages* of 1891 and the *Vers et Prose* of 1892. His remarkable translation of the poems of Poe appeared in 1888, the "Raven" having been published as early as 1875, with illustrations by Manet. *Divagations*, his own final edition of his prose, was published in 1897, and a more or less complete edition of the *Poésies*, posthumously, in 1899. He died at Valvins, Fontainebleau, 9th September 1898. All his life Mallarmé was in search of a new æsthetics, and his discoveries by the way were often admirable. But he was too critical ever to create freely, and too limited ever to create abundantly. His great achievement remains unfinished, and all that he left towards it is not of equal value. There are a few poems and a few pieces of imaginative prose which have the haunting quality of Gustave Moreau's pictures, with the same jewelled magnificence, mysterious and yet definite. His later work became more and more obscure, as he seemed to himself to have abolished limit after limit which holds back speech from the expression of the absolute. Finally, he abandoned punctuation in verse, and invented a new punctuation, along with a new construction, for prose. Patience in the study of so difficult an author has its reward. No one in our time has vindicated with more pride the self-sufficiency of the artist in his struggle with the material world. To those who knew him only by his writings, his conversation was startling in its clearness; it was always, like all his work, at the service of a few dignified and misunderstood ideas. (A. SY.)

Malleco, a province of Southern Chile, situated between 37° 46′ and 38° 30′ S. and 71° 40′ and 73° 10′ W., and bounded by the province of Bio-Bio on the N. and E., by that of Cautin on the S., and by the province of Arauco on the W. It has an area of 2857 square miles, and had a population in 1895 of 98,032. It is divided into four departments—Angol, Traiguen, Mariluan, and Collipulli. Its capital is Angol (7056).

Mallorca. See BALEARIC ISLANDS.

Mallow, a town in the county of Cork, Ireland, on the river Blackwater, 150 miles south-west of Dublin by rail. It ceased to be a parliamentary borough in 1885. It is governed by town commissioners, but under the Local Government (Ireland) Act, 1898, can apply to be constituted an urban sanitary district. Population (1881), 4437; (1901), 4549.

Malmesbury, James Howard Harris, 3rd EARL of (1807–1889), English statesman, son of the 2nd Earl, was born 25th March 1807, and educated at Eton and Oriel College, Oxford. He led a life of travel for several years, making acquaintance with famous people; and in 1841 he had only just been elected to the House of Commons as a Conservative, when his father died and he succeeded to the peerage. His political career, though not one which made any permanent impression on history, attracted a good deal of contemporary attention, partly from his being Foreign Secretary in 1852 and again in 1858–59 (he was also Lord Privy Seal in 1866–68 and in 1874–76), and partly from his influential position as an active Tory of the old school in the House of Lords at a time when Lord Derby and Mr Disraeli were, in their different ways, moulding the Conservatism of the period. Moreover his long life—he survived till 18th May 1889,—and the publication of his *Memoirs of an Ex-Minister* in 1884, contributed to the reputation he enjoyed. These *Memoirs*, charmingly written, full of anecdote, and containing much interesting material for the history of the time, remain his chief title to remembrance. Lord Malmesbury also edited his grandfather's *Diaries and Correspondence* (1844), and in 1870 published *The First Lord Malmesbury and His Friends: Letters from 1745 to 1820.*

Malmö, a seaport town and important industrial centre of Sweden, on a small bay of the Sound, 384 miles by rail south-south-west of Stockholm. It is the terminus of more than half a dozen railways, and since October 1895 has been connected with Copenhagen ($17\frac{1}{4}$ miles west by north) by steam-ferry, the Sound being kept free from ice in winter by an ice-breaker. Moreover, since the summer of 1899 it has been the first important station in Sweden on the Sassnitz (island of Rügen)-Trelleborg express route (opened 30th April 1897) between Stockholm and Berlin. In 1895 the total imports (in great part coal) amounted to £1,917,000, and the exports (9 per cent. of the exports of the kingdom) to £1,572,250. The latter consisted principally of bacon and beef, butter, chalk, flour, live-stock, and matches. The shipping, which is mostly under the Swedish and Danish flags, averaged 3943 vessels of 817,500 tons cleared annually in the period 1886–96; but in 1897 it jumped up to 5093 vessels of 1,421,590 tons, and in 1900 reached 5582 vessels of 1,712,191 tons. The harbour consists of two inner basins, admitting vessels of 21 feet draught, and an outer harbour of 22 feet depth; and in 1896 a further scheme of improvement was agreed upon. There are also a dry dock, 236 feet long, and a patent slip, 400 feet long. The port owns a merchant fleet of over 50 vessels of 20,000 tons aggregate. Here Charles XV. died in 1872. St Peter's Church (1319–46) was restored in 1847–53, and again in 1889–90. There are, further, the 1t5h-century house of the burgomaster Jörgen Kock, a small museum, a prison (single-cell system), a technical school, new barracks (1897), and a colossal statue of Charles X. (1896). Population (1880), 38,054; (1890), 48,504; (1900), 60,857.

Malone, a village of New York, U.S.A., capital of Franklin county, in the northern part of the state, at an altitude of 756 feet. It is at the intersection of three railways, the New York Central and Hudson River, the Ogdensburg and Lake Champlain, and the St Lawrence and Adirondack. The adjacent region contains iron ore and lumber. Population (1890), 4986; (1900), 5935, of whom 910 were foreign-born.

Malstatt-Burbach, a town of Prussia, in the Rhine province, on the right bank of the Saar, nearly opposite to Saarbrücken. It has large ironworks, brickworks, breweries, and manufactures of cement, machinery, and railway carriages; also iron mining. Population (1885), 14,950; (1895), 23,677; (1900), 31,200.

Malta, an important naval and military station belonging to Great Britain, situated in the Mediterranean Sea, about 60 miles south of Sicily. The area, including the islands of Gozo and Comino, is 117,117 square miles. Malta is a Crown colony, administered by a governor, who is generally a soldier, an executive council, and a legislative council, termed "the Council of Government." The executive council consists of the governor, the senior military officer, of six other official members, and such other persons as the Crown may select. So far as possible, however, the old practice is maintained of giving seats on the council to elected members of the council of government. This body consists of the governor, the vice-president, six official members, and thirteen elected members. Of these ten are elected by the general electors, who require a small property qualification, and three by the "special electors." These "special electors" are the nobility and landed proprietors, the university graduates, and the members of the exchange. The fourth body of special electors, the ecclesiastical, is no longer represented, and has therefore ceased to be. The votes of eight elected members are necessary for the rejection of any vote in connexion with finance, and the rule forbidding officials to vote on such questions has been abrogated. In spite, however, of these provisions, the practice of the elected members to refuse supplies, and generally to obstruct the Government, led to the free use of what was termed "the safety valve" of the 1887 Constitution, viz., the power of the Imperial authorities to legislate over the heads of the elected members by means of Orders in Council. When the elected members have refused to vote supplies, the rule has been, where purely local interests were concerned, to allow their constituents to suffer for such refusal. But where imperial questions, or local questions of such importance as to become imperial, were concerned, to impose the taxation required by Orders in Council. By this means alone was it found possible, up to 1902, to continue some form of popular government, in an island which, from the point of view of British interests, is solely a fortress, essential to the British position in the Mediterranean, without neglecting the warning contained in the duke of Wellington's well-known saying that to give a constitution to Malta was like giving a constitution to a man-of-war. At the same time it should be noted that the electorate consists of only one-eighteenth of the total population, and that of this restricted number only a small proportion takes the trouble to vote.

The local laws are based on the Roman law and Continental codes. Considerable difficulty has arisen from the uniform use of the Italian language in the law courts. It had been substituted for Latin as the official language in 1815, with the general consent, but circumstances had greatly altered. At the last census, the number of Maltese natives speaking English was almost equal to the number of those speaking Italian, while the increase in the British garrison and of visitors rendered more apparent the inconvenience of the sole use of Italian in the courts. Matters were brought to a head in February 1898 by the case of a British officer, who was at first sentenced to three days' imprisonment for contempt of court, because he had refused to sign the translation in Italian of his evidence given in English, not being satisfied that it was correct. To meet this state of things, an Order in Council (1899) was passed, under which in future, in criminal cases, when the accused was British the trial should be conducted in English. In civil cases, when either party was British, an option was given to such party, or to any person appearing in the case in any capacity, to use English. A further Order in Council (1899) was issued, declaring the intention of the Government to make English in fifteen years (*i.e.*, in 1914) the official language of the courts. This period of time was subsequently extended to twenty years. In deference, however, to the feeling aroused in Italy, this proclamation was withdrawn in 1902.

The question of the language of the law courts was closely connected with the question of education. Educational experts generally recognized that it was impossible to teach a child more than one foreign language; and Italian being a foreign language in Malta as well as English, it followed that, if Italian were to be generally taught, it must be at the expense of English. But the practical convenience of a knowledge of English to the Maltese was obvious. In this state of things an Order in Council was passed in 1899 giving parents and guardians the power to choose which language shall be taught their children in addition to Maltese. At first no less than 98 per cent. chose English, and though, under the pressure of agitation, the proportion sank to 75 per cent., it again increased. Although undoubtedly the provisions of this law aroused the fierce opposition of those who wished to maintain the Italian characteristics of Maltese civilization and culture, there can be no question but that they represented the fixed determination of the British Government. In fact, this freedom of choice was to be extended to the parents of students in the Lyceum and University, except in the case of the faculty of theology, where the supremacy of Italian is preserved.

In deference to the religious feelings of the population, the institution of civil marriages has not been established. Difficulties have sometimes arisen from the mixed marriages of Roman Catholics and Protestants, and, in certain cases, from the inability to obtain legitimate marriage.

The following are the figures of the revenue and expenditure:—

	Revenue.	Expenditure.
1881	£185,957	£188,039
1891	275,125	281,870
1900	356,758	365,943

There is no public debt. There is no direct taxation, and the main sources of revenue are the Customs duties. Taxation is about £1 7s. 6d. per head, as against about £4 13s. in the United Kingdom in 1901.

The trade tends to decrease, owing to the competition of other Mediterranean ports. The number of steamers entering the port and the amount of their tonnage was in—

	Steamers.	Tonnage.
1881	3885	3,673,753
1891	3286	3,988,397
1900	2549	3,473,576

The imports in 1900 were £7,434,289, and the exports £6,471,567. The civil population was (1881), 149,782; (1891), 165,037; (1900), 183,679. The population of the capital, Valetta, is almost stationary, nearly 24,000, but the neighbouring suburbs have increased greatly. In 1891 Floriana had a population of 6575. Of the several cities and suburbs forming, on the borders of the two harbours, an almost uninterrupted line of inhabited localities, the most populous are "The Three Cities," namely, Vittoriosa (6902), Conspicua (12,065), and Senglea (7770). In 1891, 73,876 persons resided in the urban districts and 72,608 in the rural, which include the old city of Notabile. The average density of the population was 1570 to a square mile in 1901, as compared with 1487 in 1891 and 1332 in 1881.

Malta is an example of *la petite culture*. There were, at the time of the census of 1891, about 10,000 holdings, the average extent of which was 4·4 acres. About 30 per cent. of the whole cultivated area is under corn crops. Vegetables are grown on irrigated land throughout the year. The rent of irrigated land is from £3 per acre. Potatoes and onions are largely grown for exportation. The area under potatoes is about 5000 acres. Oranges are also grown for export. The average rainfall for the 15 years ending 1898 was 19·7 inches. The rainfall for 1900 was 16·3. The climate, although very hot in summer, appears on the whole healthy. The death-rate, which is about 27 per thousand, is increased by the neglect of proper sanitary measures.

Besides a university (77 students in 1900) and a lyceum, there are two secondary schools, one in Malta for girls and one in Gozo for boys; a technical and manual school; 38 elementary day schools for boys, 40 for girls, 20 for infants, 17 miscellaneous, and 34 night elementary schools; the elementary schools being attended by about 11,500 children. In addition there are about 130 private schools and colleges with more than 4200 scholars. Maltese only is taught in the inferior standards. In the next two standards either English or Italian is taught. The general prosperity of the islanders is indicated by the fact that at the end of 1900 there were 6960 depositors in the Maltese savings bank, with £535,571 standing to their credit, or an average of £76 19s. for each depositor. The main importance of Malta to Great Britain lies in its harbour and fortifications, which have been of late years greatly strengthened and adapted to new conditions. Besides a permanent garrison of six companies of Royal Artillery and six battalions of infantry, there are the local corps, supported in part by the imperial Government. A railway 8 miles long was opened in 1892, and has proved financially very successful.

The tradition may be accepted which regards the cathedral as occupying the site of Publius's palace. A public church appears to have been erected, after the general peace in the 4th century, on the spot where private worship had been carried on. This church survived the period of Mahommedan dominion, and was extensively repaired by Roger the Norman. The exploration and survey of St Paul's catacombs in 1894 has thrown light on the question of early Christian burial in Malta. It is true that direct evidence from documents or epitaphs is lacking, but the representation of a scene of martyrdom is still clearly discernible in the basement of an arched tomb, and the palm-leaf, the ordinary emblem of martyrdom, is engraved on several tombs in the same capel. Moreover, the analogy of the Roman catacombs is altogether convincing. Malta, as an allied city, not far removed from the seat of empire, must have felt the effect of the imperial decree of A.D. 64, "*non licet esse Christianos*," while "as a matter of evidence, from the similar mode of construction and economy of place, internal arrangement of details, and distribution of graves analogous to the Roman catacombs, from the same devices contrived for concealment, it is clearly apparent that our Christian forefathers had then to follow the same recondite cemeterial system, sunk under ground, as in Rome." The same authority adds, "The topographical situation of the ancient burial grounds, *extra urbem*, along the high roads, was strictly Roman, and the individual areas, both of our ancient pagan tombs and of our Christian cemeteries, defined by determinate boundaries conformably to the provisions of the then common law, were private properties of the natives."

The manner in which successive civilizations have occupied the same site at Notabile accounts for Greek and Roman remains being now found only in excavations. As late as 1647 relics of old buildings could still be seen in the streets, but the work of destruction has gone on. The remains of the temple of Apollo were discovered in 1747.

See *Ancient Pagan Tombs and Christian Cemeteries in the Island of Malta, Explored and Surveyed from 1881 to 1897*, by Dr A. A. CARRUANA. Malta, 1898.—For the language question, see Mr Chamberlain's speech, in House of Commons, 28th January 1902.

(H. E. EG.)

Malton, a market town in the Thirsk and Malton parliamentary division (since 1885) of Yorkshire, England, on the river Derwent, 22 miles north-east of York. In 1894 Old and New Malton were formed into one civil parish (an urban district). Population (1901), 4758.

Malvern, a health resort of England, 10 miles south-west from Worcester, in the Bewdley parliamentary division of Worcestershire. It consists of a string of little towns and villages, situated partly at the eastern foot of the Malvern Hills (1000–1440 feet), partly on their slopes, overlooking the valley of the Severn and the Vale of Evesham. At the foot of the hill are Great Malvern, Malvern Link, Malvern Wells, and Little Malvern, and higher up North Malvern and West Malvern. Owing to their pure and invigorating air, they enjoy great repute as places of residence and as health-resorts, latterly for the "open-air cure" for consumptive patients. The water, so noted for its purity, is now collected and stored for public use in waterworks. In addition there are mineral springs (two at Great Malvern, one above Malvern Wells, and one near West Malvern). Malvern College and other schools make the place of some importance as an educational centre. Population (1801), 819; (1901), 16,448.

Mamiani della Rovere, Terenzio, COUNT (1799–1885), Italian writer and statesman, was born at Pesaro in 1799. Taking part at Bologna in the outbreaks arising out of the accession of Pope Gregory XVI., he was exiled and went to France; but he returned after the amnesty of 1846, and in 1848 was made president of the council by Pius IX. This post, however, he only held for a few months, his political views being the reverse of papal. He retired to Genoa and there worked for Italian unity, and in 1860 became minister of education under Cavour. In 1861 he was made ambassador to Greece, and in 1865 to Switzerland. Meanwhile, he had founded at Genoa in 1849 the Academy of Philosophy, and in 1855 had become professor of the history of philosophy at Turin; and he published several volumes, not only on philosophical and social subjects, but of poetry, among them *Rinnovamento della filosophia antica italiana* (1836), *Teoria della Religione e dello stato* (1869), *Kant e l' Ontologia* (1879), *Religione dell' avenir* (1880), *Poems* (1843, 1857). He died at Rome, 21st May 1885.

MAMMALIA.

In few branches of zoology have greater advances been made than in the Mammalia since the date of the appearance of the article in the earlier volumes (ninth edition) of the *Encyclopædia Britannica.* These advances, noticeable alike in the morphological, palæontological, and taxonomic aspects of the subject, are, in fact, so great as to have altered our whole conception of the relations of the group. Moreover, what may be regarded as practically a revolution in nomenclature has taken place, including the introduction of the principle of trinomialism.

In regard to the dental system (vol. xv. p. 352), it has been found that when only a single series of teeth is developed, they may belong to the milk or deciduous, and not to the permanent series; this is the case with the Cetacea and the Marsupialia (with the exception of the single replacing tooth in each jaw). Again, the statement (vol. xv. p. 354) that the cheek-teeth of Marsupials do not correspond serially with those of Placentals has not been found to hold good, and it now appears that in both groups the typical number of premolars (whether permanent or deciduous[1]) is four, behind which there are three (occasionally more) molars. The section of the earlier article devoted to the placenta (vol. xv. pp. 368, 369) requires considerable modification, owing to the discovery by Caldwell in 1884 that the Monotremata are oviparous, and to Hill's announcement in 1897 of the existence of a true placenta in the Marsupial genus *Perameles.* These and other discoveries have had an important bearing on the general scheme of classification of the Mammalia, and it has been suggested that, instead of dividing the class into the equivalent subclasses Prototheria, Metatheria, and Eutheria, the division should be into two subclasses only, viz., *Prototheria* and *Eutheria,* the latter of which is divisible into the sections Marsupialia and Placentalia. Palæontological discoveries in the early Secondary rocks of South Africa and North America have had an important bearing on the question of the origin of the Mammalia, and it is now generally conceded that the class is derived from the Labyrinthodontia, or Stegocephalia, of the Permian and Carboniferous, which were Amphibian-like creatures with completely roofed skulls. Between the Stegocephalia and the Mammalia may probably be intercalated the group of Triassic and Permian Reptiles known as the Anomodontia, certain members of which present remarkable mammalian resemblances in their skeletons and teeth, while others come very close to the Stegocephalia. It is true that no small forms (ancestral mammals must necessarily have been diminutive) have hitherto been discovered which can be regarded as ancestral types of the Mammalia (Hypotheria or Promammalia), but the probability is that such were included among the Anomodontia. The question whether the Prototheria and Eutheria had a single or dual (diphyletic) origin from the Anomodontia (or Hypotheria) must for the present remain in abeyance, although there are good grounds for thinking that the latter alternative may prove the true solution of the problem. Much depends upon future investigations in regard to the structure of the Eutherian ovum; and if this proves to be amphibian in character the argument for a dual origin will be overwhelming, since the Monotreme (Prototherian) egg is certainly of a reptilian type.[2]

Prototheria.—Turning to the extent and characters of the subclass Prototheria (vol. xv. pp. 371, 377), this is now generally taken to include not only the existing order Monotremata (as represented by the *Ornithorhynchidæ* and *Echidnidæ*), but also an extinct group—the Multituberculata—of which the genus *Plagiaulax* (vol. xv. p. 376, Figs. 20, 21) and probably *Stereognathus* (*ibid.* Fig. 17) are representatives. These Multituberculata, which were abundant in the Jurassic and Cretaceous rocks and survived till the Eocene Tertiary, appear to have been intimately connected with certain Anomodont Reptiles, such as the South African *Tritylodon* (long regarded as a mammal); and this relationship, in spite of a theory as to the splitting-up of the multituberculate molar, speaks strongly in favour of the dual origin of the Prototheria and Eutheria, since it seems certain that the primitive carnivorous and insectivorous forms of the latter group cannot be derived from animals with a dentition of the type of *Tritylodon* and the Multituberculata. The Triassic *Microlestes* (vol. xv. p. 375) is probably a relative of *Tritylodon.*

As already mentioned, it has been ascertained that the females of the Monotremata lay eggs, which develop in the same manner as those of Birds and Reptiles, a portion only of the yoke segmenting to form the embryo, while the remainder serves for the nutriment of the latter. In the case of *Ornithorhynchus* it has been said that two eggs are laid in the chamber at the end of the burrow,[3] but those of the *Echidnidæ* are carried about in the pouch on the abdomen of the female, which becomes enlarged during the time of incubation. The temperature of the Monotremata has also been found to be lower than that of other mammals. The existence of true teeth in *Ornithorhynchus* is another discovery made since 1883. Three pairs of these teeth are developed in the upper, and three in the lower jaw; after being for some time in use, they gradually become worn away, and are finally shed. Under and around the teeth are developed the horny plates, or cornules, which gradually grow round them and assume their function, the hollows on the surface of the cornules indicating the positions of the teeth. In form these teeth make a distant approximation to the molars of some of the extinct Multituberculata.

Marsupialia.—The discovery of a rudimentary placenta in *Perameles,* together with that of vestiges of a second series of teeth, suggests that the Marsupialia are a degenerate rather than a primitive type, although probably one of great antiquity. Instead of the one deciduous tooth developed in certain living genera (vol. xv. p. 378, Fig. 23) being the only one corresponding to the milk-series of the Placentalia, it is its successor which alone represents the permanent premolar of the latter; this successional tooth being the third permanent premolar of the typical series of four premolars, and the one immediately behind it the fourth milk-premolar. Hence only the three last teeth, in cases when there are seven in the cheek-series, are the molars. Accordingly, in all cases where the dental formula of the Marsupialia is given in the original article as $p\,\frac{3}{3}$, $m\,\frac{4}{4}$, it should be amended to $mp+pp\,\frac{4}{4}$, $m\,\frac{3}{3}$. (See *Proc. Zool. Soc. Lond.* 1899, p. 922.)

Mr B. A. Bensley (*American Naturalist,* 1901), starting with the well-known fact that the group simulates most of the placental orders, states that its evolution, or "radiation," has taken place within its present habitat. Reasons are given for regarding the Banded Anteater (*Myrmecobius*) as a degraded type; and if this view be accepted, all the other types can be derived, both as regards their dentition and their feet, from the American Opossums, the ancestors of which are regarded as the proximate progenitors of the group. All the Australian Marsupials thus appear to have had an arboreal ancestry; and when, in spite of the specialization of certain forms, the primitive character of the whole group is borne in mind, it seems evident that the date of the "radiation" is comparatively recent. Hence the author is inclined to side with those who consider that Marsupials first entered Australia during the Tertiary period, although he thinks their arrival was later than has previously been considered possible. As to whether their immigration was from the north or from the south he is undecided, although he states that "there is at least some justification for the view that it was from the northward," *i.e.*, by way of Asia.

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[1] It has been found convenient to speak of the milk-molars as "milk-premolars."

[2] See a paper on the Origin of Mammals, by Prof. H. F. Osborn, in the *Proceedings* of the International Congress of Zoology, 1898.

[3] There does not appear to be authentic evidence that the eggs in this genus are actually laid.

Of all the palæontological discoveries, few are more interesting than the occurrence of extinct Marsupials in the Miocene of South America allied to the Australian *Dasyuridæ*. Two of the best-known genera are *Prothylacinus* and *Amphiproviverra*, the former being an animal agreeing closely in size and dentition with the Thylacine, but having two pairs of milk-premolars in each jaw replaced by permanent premolars. In this respect the extinct form departs one step less from the placental type than does its existing analogue, and these and other fossil forms, such as *Borhyæna*, seem to indicate an intimate relationship between the Polyprotodont Marsupials and the Creodont Carnivora, as represented by *Hyænodon* (vol. xv. p. 442, Fig. 122); the dental formula of the two, according to the new method of notation, being, so far as the cheek-teeth are concerned, identical, save for the fact that all the premolars of the Creodontia belong to the second or permanent series. On this view the Creodontia have retained a tooth-change which is lost in the modern Marsupials; and both may be descended from Mesozoic forms like *Triconodon* and *Amphitherium*, in the former of which all four premolars were replaced.

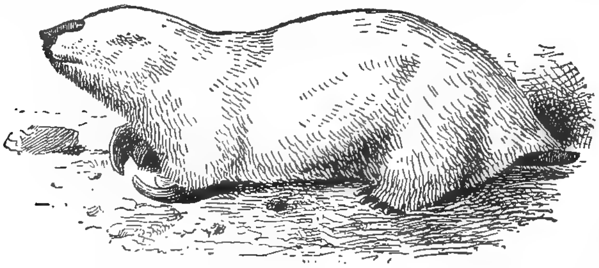


Fig. 1.—Marsupial Mole (*Notoryctes typhlops*).

An additional family (*Notoryctidæ*) of Polyprotodont Marsupials is represented by the Marsupial Mole (*Notoryctes typhlops*), from the deserts of central South Australia (Fig. 1). This is a small burrowing animal, of a pale golden-yellow colour, with long silky hair, a horny shield on the nose, and a stumpy leathery tail. The feet are five-toed, and the third and fourth toes of the front pair armed with enormous claws adapted for digging. Neither ear-conchs nor eyes are visible externally. There are but three pairs of incisor teeth in each jaw, and the upper molars are tricuspid. This animal spends most of its time burrowing in the sand in search of insects and their larvæ, but occasionally makes its appearance on the surface.

Of even greater interest than *Notoryctes* is the discovery of a family (*Epanorthidæ*) of Diprotodont Marsupials in South America, the majority of the members of which are extinct, their remains being found in the Miocene of Patagonia, although one existing genus (*Cænolestes*) survives in Ecuador and Colombia. One of the two living species was, indeed, described so long ago as the year 1863, under the preoccupied name of *Hyracodon*, but attracted little or no attention, as its affinities were not fully recognized. Externally *Cænolestes* has a shrew-like appearance. The elongated skull (Fig. 2) has four pairs of upper incisors and long upper canines, while in the lower jaw there is a single pair of procumbent incisors, followed by several small teeth representing the canine and earlier premolars. The three pairs of molars in each jaw are, like the last premolar, quadritubercular oblong teeth. The five-toed feet are of normal structure, and the rat-like tail is prehensile towards the tip. The female has a small pouch. The extinct members of the family are represented by the genera *Epanorthus*, *Acdestis*, *Garzonia*, &c. In a second family—*Abderitidæ*—also from the Patagonian Miocene, the penultimate premolar is developed into an enormous tooth, with a tall, secant, and grooved crown, somewhat after the fashion of the enlarged premolar of *Plagiaulax*. From the structure of the skull it is thought probable that *Abderites* had an elongated snout, like that of many Insectivora.

As regards other discoveries in connexion with the Marsupialia, it must suffice to say that complete skeletons of the extinct Australian *Diprotodon* (vol. xv. p. 383) have been disinterred and described by Dr Stirling, from which it has been ascertained that in the structure of the feet this genus shows resemblances both to the *Phalangeridæ* and the *Phascolomyidæ*, but comes nearer to the former. *Phascolonus* (*Sceparnodon*), from the same deposits, was a giant Wombat. It may be added that a large mammal (*Pyrotherium*), with cheek-teeth like *Diprotodon*, from the Miocene of Patagonia, may possibly prove to be a Diprotodont Marsupial, although this is not very likely.

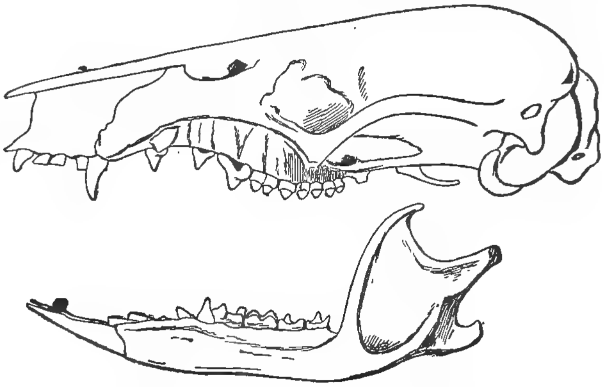


Fig. 2.—Skull of *Cænolestes obscurus*.

Edentata.—The result of recent discoveries has been to discount the supposed isolation of the Edentata (vol. xv. p. 383), and to bring them more into line with other Placentals. The connecting forms are a group of Eocene mammals termed Ganodontia, as represented by the genera *Psittacotherium*, *Calamodon*, *Hemiganus*, *Stylinodon*, &c., all of which are typically North American. In this group front teeth were present, and the cheek-teeth of the earlier types were rooted and invested to a considerable extent with enamel, their unworn crowns being tricuspid. An approximation to the true Edentata is revealed in the later types by the gradual abortion of the incisors, and of the roots of the cheek-teeth; the latter grow from persistent pulps, and have their enamel restricted to vertical bands. Among the Edentata of the family *Mega*[*lo*]*theriidæ*, especial interest attaches to the discovery in a cave in South Patagonia of remains of the genus *Glossotherium*, or *Grypotherium* (vol. xv. p. 385), a near relative of *Mylodon*, which include a considerable portion of the skin with the hair attached. Ossicles somewhat resembling large coffee-berries had been previously found in association with the bones of *Mylodon*, and in *Glossotherium* nearly similar ossicles occur embedded on the inner side of the thick hide. The coarse and shaggy hair is somewhat like that of the Sloths. The remains, which include not only the skeleton and skin, but likewise the droppings, were found buried in grass which appears to have been chopped up by man, and it thus seems not only evident that these Ground-Sloths dwelt in the cave, but that there is a considerable probability of their having been kept there in a semi-domesticated state by the early human inhabitants of Patagonia. The extremely fresh condition of the remains has given rise to the idea that *Glossotherium* may still be living in the wilds of Patagonia, but this is improbable.

Although a few of the Pleistocene Ground-Sloths, such as *Nothropus* and *Nothrotherium* (= *Cœlodon*, vol. xv. p. 385) were of comparatively small size, in the Miocene of Patagonia few of the representatives of the family much exceeded the modern Sloth in size. The best-known generic types are *Eucholœops* (*Hapalops*) and *Pseudahalops*, of which considerable portions of the skeleton have been disinterred. In these diminutive Ground-Sloths the crowns of the cheek-teeth approached the prismatic form characteristic of *Mega[lo]therium*, as distinct from the subcylindrical type occurring in *Mylodon*, *Glossotherium*, &c. It should be added that the North American Tertiary forms described as Edentates under the name of *Moropus* and *Morotherium* (vol. xv. p. 385) are now ascertained to be aberrant Ungulates allied to *Chalicotherium*.

In addition to the discovery of certain new types of Pleistocene Armadillos (*Dasypodidæ*), one of which is far larger than any species previously known, important advances have of late years been made in our knowledge of the allied extinct South American family *Glyptodontidæ* (vol. xv. p. 388, where it is termed *Hoplophoridæ*), now ascertained to date at least from the Miocene. Here it has to be mentioned that the restoration of *Glyptodon* copied from Owen (vol. xv. p. 387, Fig. 39) is quite incorrect, that which is made to do duty for the entire tail being the terminal portion of the tail-sheath of a totally different genus. In *Glyptodon* (with which *Schistopleurum* is identical) the tail-sheath consists of a series of coronet-like rings, gradually diminishing in diameter from base to tip. *Dœdicurus*, in which the tail-sheath is in the form of a huge solid club, is the largest member of the family; in *Panochthus* and *Lomaphorus* (*Hoplophorus*) the tail-sheath consists basally of a small number of smooth rings, and terminally of a tube. In some specimens of these genera the horny shields covering the bony scutes of the carapace have been preserved, and since the foramina, which often pierce the latter, stop short of the former, it is evident that these were for the passage of blood-vessels and not receptacles for bristles. All the above are of Pleistocene and perhaps Pliocene age, but in the Miocene of Patagonia there occur the two curious genera *Propalæohoplophorus* and *Peltephilus*, the former of which is a primitive and generalized type of Glyptodont, while the latter seems to come nearer to the Armadillos. Both are represented by species of comparatively small size. In *Propalæohoplophorus* the scutes of the carapace, which are less deeply sculptured than in the larger Glyptodonts, are arranged in distinct transverse rows, in three of which they partially overlap near the border of the carapace after the fashion of the Armadillos. The skull and limb-bones exhibit several features met with in the latter, and the vertebræ of the back are not welded into a continuous tube. There are eight pairs of teeth, the first four of which are simpler than the rest, and may perhaps therefore be regarded as premolars. More remarkable is *Peltephilus*, on account of the fact that the teeth, which are simple, with a chevron-shaped section, form a continuous series from the front of the jaw backwards, the number of pairs being seven. Accordingly, a modification of the character, even of the true Edentata, as given in the earlier article, is rendered necessary. The head bears a pair of horn-like scutes, and the scutes of the carapace and tail, which are loosely opposed or slightly overlapping, form a number of transverse rows.

The so-called Old-World Edentata—the families *Manidæ* and *Orycteropodidæ* (vol. xv. p. 388)—have been assigned to an order apart, under the name of Effodientia. *Orycteropus* has been ascertained to possess milk-teeth, and fossil representatives of the genus have been obtained from the Pliocene of Persia, Greece, and Samos. The presumed extinct Edentata of the Old World mentioned on p. 388 of the earlier article have proved to be Ungulata, and are referred to below.

Sirenia and Cetacea.—As regards the former order, it will suffice to say that in the Manatee the number of teeth has been proved to be at least twenty pairs in each jaw, and may possibly be as many as thirty; and that *Trichechus* is now taken as the name of the genus, the Walrus being termed *Odobœnus*. In the palæontological history of the Cetacea some important items have been furnished by the Tertiary strata of Patagonia. In the first place, a small Sperm Whale, tentatively assigned to the extinct European genus *Physodon*, has a full series of enamelled teeth in the upper jaw, and therefore, unless it be made the type of a separate family, entails a modification in the definition of the *Physeteridæ* (vol. xv. p. 395). Even more interesting is *Argyrocetus*, also from the Miocene of Chubut, on account of the fact that the occipital condyles, instead of being adpressed to the skull, are as prominent as in any ordinary mammal, and that the nasals are squared bones covering the hinder part of the nose-chamber. The latter feature was previously unknown among the Toothed Whales, and its occurrence in the Patagonian genus removes one of the objections which have been urged against the possibility of the Whalebone Whales tracing their descent to the aforesaid group. Yet another Chubut Cetacean—*Prosqualodon*—indicates a distinct type of *Squalodontidæ*, characterized by the shortness of the skull, the nasal bones in this genus also roofing over the chamber of the nose to a small extent. Recent researches tend to show that the extinct *Zeuglodon* was furnished with bony armour.

Rodentia.—Since no very remarkable discoveries of new forms—either living or extinct—have been made in the orders Insectivora and Chiroptera, these may be passed over with the observation that considerable modifications have been made in the taxonomy and nomenclature of the latter group. Among the Rodentia, on the other hand, not only are the taxonomic and nomenclatural changes greater, but many interesting new forms have been discovered. The Tillodontia (vol. xv. p. 432), as typified by *Tillotherium*, but including *Esthonyx* and other forms, all of which occur in the Eocene of North America, are now generally regarded as a primitive section of the order, to which in taxonomic series the Dulplicidenta will come next. In these Tillodonts the skull, although to a great extent Rodent-like, exhibits archaic features in the form and size of the brain-cavity, as it does in the retention of small

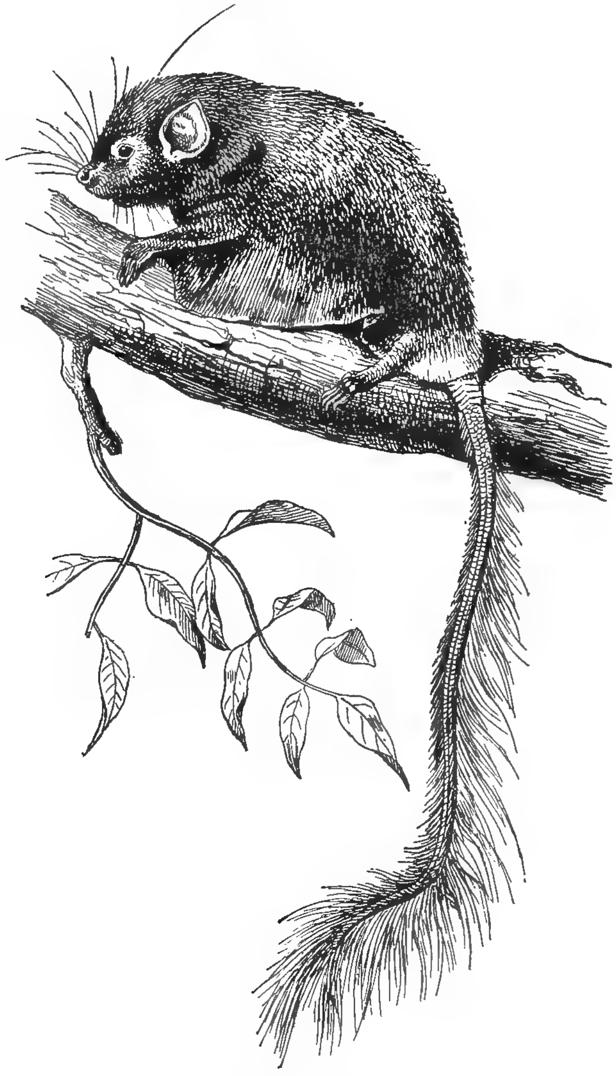


Fig. 3.—*Idiurus Zenkeri.*

canines and the anterior premolars. On the other hand, the incisors—especially one pair—exhibit an approximation to the scalpriform character of those of modern Rodents, this being less apparent in the earlier *Esthonyx* than in the later *Tillotherium.*

For the modifications in the taxonomy of the true Rodents, the reader may consult a paper by O. Thomas in the *Proc. Zool. Soc. London* for 1896, and a monograph of the order by T. Tullberg, published at Upsala in 1899; the views of these writers are by no means altogether in accord. All are now agreed that the *Anomaluridæ* (vol. xv. p. 417) are markedly different from the Squirrels. Two new West African representatives of the group—*Idiurus* (Fig. 3) and *Zenkerella* (Fig. 4)—have been discovered, the second of these being devoid of a flying membrane. From the Miocene of North America has been described the extinct family *Mylagaulidæ*, allied to the *Castoridæ*. In the *Muridæ* a host of new existing forms have been found, among the more interesting being *Xeromys*, *Leptomys*, and *Chrotomys*, allied to the previously isolated Australian genus *Hydromys*, which is restricted to the Philippines and Australia. Other peculiar Philippine Murines are *Batomys*, *Carpomys*, *Rhynchomys*, and *Crateromys*, all being confined to the mountains of Luzon; the third is remarkable for its Shrew-like muzzle, and the fourth for its huge size and long hair. The *Bathyergidæ* (vol. xv. p. 419) have been separated as a family from the *Spalacidæ*, and the *Heteromyidæ* from the *Geomyidæ*. From a distributional point of view the discovery of a Jumping Mouse (*Zapus*) in north-eastern Asia is important. The Cape Jumping Hare (*Pedetes*, vol. xv. p. 420) is now removed to the Hystricomorpha, where it forms a family by itself, in the neighbourhood of which some consider the *Anomaluridæ* should find a place. From the Old-World *Hystricidæ* the American Porcupines have been separated as a distinct family, under the name of *Erethizontidæ*. The Hystricomorpha have always been strongly represented in South America, and a number of extinct types more or less intimately related to the existing representatives of the group have been recorded from the Miocene of Patagonia. None of these demand, however, special mention, with the exception of *Megamys*, which was a huge Rodent allied to the Capybara, estimated to have rivalled an ox in bulk.

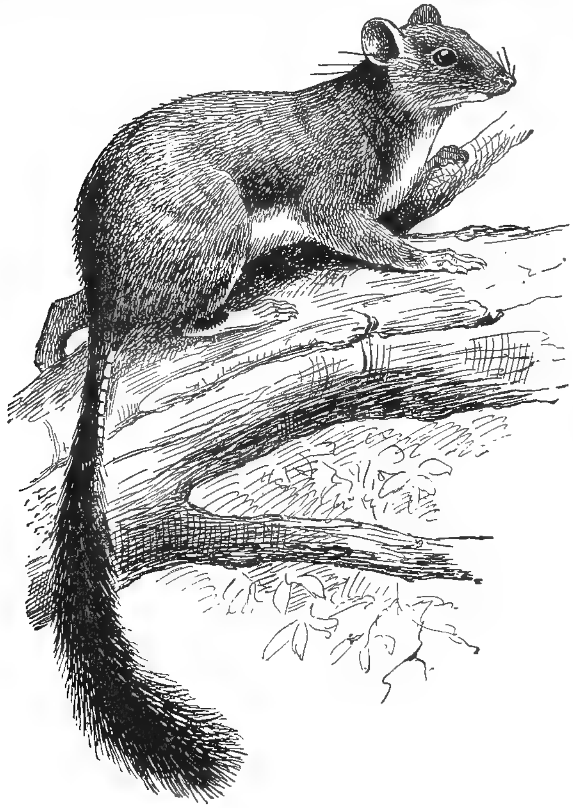


Fig. 4.—*Zenkerella insignis.*

Ungulata.—Very great has been the advance in our knowledge of the past history of this order since 1883, more especially as regards the South American Miocene forms, and it is now no longer practicable to subdivide the order into the two groups of Ungulata Vera and Subungulata (vol. xv. p. 422). The most primitive representatives of the group are the Eocene forms constituting the suborder Condylarthra, of which the North American *Phenacodus* and *Hyracops* are the best known. In these small and generalized Ungulata, which are but little differentiated from the ancestral Carnivora, the brain is small and smooth, the cheek-teeth are short-crowned and tuberculated, with the premolars less complicated than the molars, the number of the teeth being usually the typical forty-four. The articular heads of the bodies of the vertebræ are flat, the lower end of the humerus is perforated on the inner side, and the feet, which are more or less plantigrade, are five-toed, with the median digit the largest of the series. In the carpus the bones of the upper and lower row are arranged in vertical lines, without being alternated (vol. xv. p. 422, Fig. 100). Teeth resembling those of *Phenacodus* occur in the Swiss Eocene bone-beds.

Hyracoidea.—All the existing representatives of this suborder are now termed *Procavia,* instead of being classed in two genera as *Hyrax* and *Dendrohyrax.* More important is the occurrence of an extinct genus—*Pliohyrax*—in the Pliocene of Greece and Samos, its lower jaw having long ago been described under the preoccupied name *Leptodon.* A skull from the Miocene of Patagonia has been named *Archæohyrax*, and, if really referable to the present group, is of much interest, especially if, as seems probable, some of the under-mentioned Toxodonts are related to the Hyracoidea.

Toxodontia.—As the description of the suborder Amblypoda requires but little amendment, it must suffice to say that the proper title of its typical family is *Uintatheriidæ.* At the conclusion of the notice of the Amblypoda in the earlier article (vol. xv. pp. 426, 427) mention is, however, made of several extinct South American Ungulates whose position was left uncertain. Later discoveries have done much towards elucidating the true relationships of these and other forms, which are now assigned to several distinct suborders of Ungulata, showing more or less marked signs of affinity with the Perissodactyla. It may eventually become a question whether it will not be advisable to extend the limits of the latter suborder to include all these extinct groups, together with the existing Hyraces.

Under the suborder Toxodontia may be included not only the typical *Toxodon*, but the more aberrant *Typotherium* (or *Mesotherium*) (vol. xv. p. 427, Fig. 106) of the Pleistocene of Buenos Aires, and the smaller *Pachyrucus* and *Hegetotherium* of the Patagonian Miocene. All the members of the suborder have tall-crowned and curved cheek-teeth, some or all of which have persistent pulps, while at least one pair of incisors are rootless. The bodies of the cervical vertebræ have flat articular surfaces, the bones of the two rows of the carpus alternate, and in the tarsus the navicular articulates with the calcaneum, which, as in the Artiodactyla, is articulated to the fibula, while the astragalus, which is slightly grooved above, is formed on the Perissodactyle plan. The number of toes varies between three and five, of which the middle one is the largest, and the femur may or may not have a third trochanter. The *Typotheriidæ* and *Pachyrucidæ* are remarkable among the Ungulates for the retention of clavicles, and for their curious approximation in dentition and certain characters of the skeleton to the Rodentia. The dental formula of *Typotherium* is given in vol. xv. p. 427; that of the smaller Patagonian forms differs by the larger number ($\frac{3}{3}$) of premolars. The toes were unguiculate rather than ungulate. Certain allied Patagonian forms appear to show distinct affinity to the Hyraces.

The *Toxodontidæ* differ from the preceding family by the loss of the clavicles, and the reduction of the digits to three in each foot. The typical genus *Toxodon* is represented by animals the size of a Rhinoceros, of which the entire skeleton is now known. The teeth, of which the approximate formula is given in vol. xv. p. 427, all grow from persistent pulps; those of the cheek-series are very tall, highly curved, and with a simplified crown-structure. In the Miocene *Nesodon*, on the other hand, the cheek-teeth are shorter-crowned, and depart less widely from a generalized Perissodactyle type, the total number of teeth being forty-four, and there being scarcely any gap in the series. Very remarkable changes occur in the dentition as age advances, most of the teeth eventually developing roots. Although the complete skeleton is not yet known, it is ascertained that the femur differs from that of *Toxodon* in the retention of a third trochanter.

Astrapotheria.—Another group of Ungulates confined to the Miocene of Patagonia is typified by the genus *Astrapotherium,* represented by huge animals with cheek-teeth singularly like those of a Rhinoceros, and an enormous pair of tusk-like upper incisors, recalling the upper canines of *Machœrodus* on an enlarged scale. In the lower jaw are two large tusk-like canines, between which are three pairs of curiously-formed spatulate incisors, and in both jaws there is a long diastema. The dental formula appears to be $i\,\frac{1}{3}$, $c\,\frac{0}{1}$, $p\,\frac{2}{1}$, $m\,\frac{3}{3}$.

Here may be provisionally placed the genus *Homalodontotherium,* of which the imperfect skull was alone known in 1883 (vol. xv. p. 427). The teeth have much lower crowns, and are of a less decidedly Rhinocerotic type than in *Astrapotherium,* and the whole dentition forms an even and unbroken series. The bodies of the cervical vertebræ are short, with flattened articular surfaces, the humerus has an enormous deltoid crest, suggestive of fossorial powers, and the femur is flattened, with a third trochanter. According to the Argentine palæontologists, the carpus is of the alternating type, and the terminal phalanges of the pentedactyle feet are bifid, and very like those of Edentata. Indeed, this type of foot shows many Edentate resemblances. The astragalus is square and flattened, articulating directly with the navicular, although not with the cuboid, and having a slightly convex facet for the tibia. From the structure of the above-mentioned type of foot, which is stated to have been found in association with the skull, it has been suggested that *Homalodontotherium* should be placed in the Perissodactyle family *Chalicotheriidæ;* but, to say nothing of the different form of the cheek-teeth, all the other South American Miocene Ungulates are so distinct from those of other countries that this seems unlikely. It may be suggested that we have rather to deal with an instance of parallelism—a view supported by the parallelism to the *Equidæ* presented by certain members of the next group.

Litopterna.—A fuller study of the remains of the South American Pleistocene genus *Macrauchenia* (vol. xv. p. 428) shows that it can no longer be included in the Perissodactyla, as at present understood, and that it typifies a suborder containing a number of Miocene forms. All were digitigrade forms, recalling in general build the Llamas and Horses; they have small brains, and a facet on the calcaneum for the fibula. The cheek-dentition approximates more or less to the Perissodactyle type. Both the terminal faces of the cervical vertebræ are flat, the femur carries a third trochanter, the bones of both the carpus and tarsus are arranged in linear series, and the number of toes, although commonly three, is stated to vary between one and five, the third or middle digit being invariably the largest. Of the two families, the first is the *Proterotheriidæ,* which exhibits, in respect of the reduction of the digits, a curious parallelism to the equine line among the Perissodactyla; in this feature, as well as in the reduction of the teeth, it is more specialized than the second family.

The molar teeth approximate to the *Palæotherium* type, but have a more or less strongly developed median longitudinal cleft. The three-toed type is represented by *Diadiaphorus,* in which the dental formula is $i\,\frac{1}{2}$, $c\,\frac{0}{1}$, $p\,\frac{4}{4}$, $m\,\frac{3}{3}$, and the feet are very like those of *Hipparion.* The cervical vertebræ are of normal form, the orbit (as in the second family) is encircled by bone, the last molar has a-third lobe, the single pair of upper incisors are somewhat elongated, and have a gap between and behind them, while the outer lower incisors are larger than the inner pair, the canines being small. The skull has a short muzzle, with elongated nasals. Remains of this and the other representatives of the group are found in the Patagonian Miocene. In *Proterotherium,* which includes smaller forms having the same, or nearly the same, dental formula, the molar teeth differ from those of *Diadiaphorus* by the deeper median longitudinal cleft, which completely divides the crown into an inner and an outer moiety, the two cones of the inner half being united. According to the description given by Argentine palæontologists, this genus is also three-toed, the single-toed representative of the family being separated as *Thoatherium,* but further information with regard to this point is desirable. It is, however, certain that there is a monodactylate representative of the family, in which the lateral metapodials, or splint-bones, are even more reduced than in the *Equidæ.*

In the second family—*Macraucheniidæ*—the dentition is complete (forty-four) and without a gap, the crowns of nearly all the teeth being of nearly uniform height, while the upper molars are distinguished from those of the *Proterotheriidæ* by a peculiar arrangement of their two inner cones, and the elevation of the antero-posterior portion of the cingulum so as to form an extra pit on the crown. To describe this arrangement in detail is impossible here, but it may be stated that the two inner cones are closely approximated, and separated by a narrow V-shaped notch on the inner side of the crown. The elongated cervical vertebræ are peculiar in that the arch is perforated by the artery in the same manner as in the Llamas. In the Miocene of Patagonia the family is represented by the generalized genus *Oxyodontotherium* (in which *Theosodon* may apparently be included). It includes animals ranging up to the size of a Tapir, in which the nostrils were more or less in the normal anterior position, and the cheek-teeth were short-crowned with the inner cones of the upper molars well developed and separated by a notch, and the pits of moderate depth. The last upper premolar is simpler than the molars, and the canine, which may be double-rooted, is like the earlier premolars. The radius and ulna, like the tibia and fibula, are distinct, and the metapodials are rudimentary. On the other hand, in *Macrauchenia,* which was a much larger Llama-like animal, the skull is elongated and narrow, with rudimentary nasals, and the aperture of the nose placed nearly on the line of the eyes and directed upwards, the muzzle not improbably having terminated in a short trunk. Deep pits on the forehead probably served for the attachment of special muscles connected with the latter. Very curious is the structure of the cheek-teeth, which are high-crowned, with the two inner cones reduced to mere points, and the pits on the crown-surface large and funnel-shaped. In fact, the Perissodactyle type is almost lost by the specialization. The cervical vertebræ and limb-bones are very long, the radius and ulna being completely and the tibia and fibula partially united. The typical *M. patagonica* is a Pleistocene form as large as a Camel, ranging from Patagonia to Brazil, but remains of smaller species have been found in the Pliocene (?) of Bolivia and Argentina. It remains to add that the imperfectly known *Scalabrinia* of the Argentine Pliocene appears to occupy a position intermediate between *Oxyodontotherium* and *Macrauchenia,* having the nasal aperture situated in the middle of the length of the skull, and the crowns of the cheek-teeth nearly as tall as in the latter, but with the lower molars furnished with a projecting process in the hinder valley, similar to one occurring in those of the former.

Perissodactyla.—Since 1883 it has been discovered that the teeth described from the Upper Tertiary deposits of Europe, India, and North America as *Chalicotherium* (vol. xv. p. 429) belong to the same group of animals as the Edentate-like limb-bones to which the names *Macrotherium, Ancylotherium, Moropus,* and *Morotherium* have been assigned. In spite of the Edentate-like feet, the teeth are so like those of *Titanotherium,* while the cervical vertebræ and upper limb-bones are so essentially Perissodactyle in character, that it seems best to regard the *Chalicotheriidæ* as a branch of the Perissodactyla, in which the feet have acquired (or ? retained) an unguiculate character. Some palæontologists prefer, however, to regard them as a distinct suborder, under the name of Ancylopoda. In this connexion it is important to observe that remains of *Titanotherium* (vol. xv. p. 429) have been recorded from the Balkans, and that the North American Tertiary genera *Palæosyops*, *Limnosyops*, and *Limnotherium* indicate a family (*Limnotheriidæ*) closely allied in dental character to the *Titanotheriidæ*, but with a less complex fourth upper premolar, and no horn-like protuberances on the skull. Great advances have been made in our knowledge of the extinct Perissodactyla forming the ancestral stocks from which the existing representatives of the suborder have originated.

Artiodactyla.—Somewhat similar observations apply in the case of the Artiodactyla, the working out by American palæontologists of the complete descent of the Camels, from materials supplied by the Tertiary deposits of their own country, being one of the most important discoveries. Remains of true Camels (*Camelus*), it may be mentioned, have been obtained from the Pliocene of North Africa, Russia, and Rumania. *Agriochoerus*, an ally of the Oreodonts, from the North American Miocene, is now known to have had claws like phalanges, the limbs having been described as *Artionyx* and *Mesonyx*. The Giraffe family, for which the name *Giraffidæ* is now adopted in place of *Camelopardalidæ* (vol. xv. p. 432), is now known to include the living African Okapi (*Ocapia*), together with a number of extinct types. The Okapi (see coloured Plate), discovered by Sir H. Johnston in the Semliki forest, between Lakes Albert and Albert Edward, is known by two skins, two skulls, and a slightly incomplete skeleton. The skull and dentition (only partially described at the date of writing) are distinctly Giraffe-like, the former being much more depressed than in the Giraffe. The general form of the animal is also Giraffe-like, but the neck and limbs are proportionately much shorter, and the ears are very large and broad. The immature specimen in the British Museum stands about 5 feet at the withers. Very remarkable is the coloration. Most of the upper parts are chocolate-brown, with a purplish tinge; but the sides of the face are pale puce, the forehead and ears reddish, and the nose and muzzle blackish, while the upper portion of the fore-limbs, and the buttocks, thighs, and upper part of the hind-legs are marked with wavy horizontal black stripes on a buff ground. Except for a black ring on the fetlocks, the hind-legs below the hocks are uniformly buff, but the fore-legs below the knees have in addition a longitudinal black stripe in front. The only reason that can be suggested for this strange type of coloration is that the forest is clear of foliage up to about the height of the animal's thighs. In the British Museum specimen rudiments of a pair of horns are visible on the forehead, and other specimens show that in the adult state both sexes are horned. *Ocapia* is allied to *Palæotragus* (from which *Samotherium* is probably inseparable), of the Pliocene of Greece, Samos, and Persia, in which the males were horned and the females hornless. *Helladotherium*, from the Grecian Pliocene, is an apparently hornless type. *Sivatherium*, *Hydaspitherium*, and *Bramatherium* from the Indian, and *Libytherium* from the North African Pliocene, are now known to be gigantic giraffoids, in the males of which one pair of horns at least were branched. In *Sivatherium* a simple pair of nasal horns stand in advance of the large branched, while in *Bramatherium* an occipital pair are placed behind the branched frontal horns.

Proboscidea.—The origin and birthplace of the Proboscidea have long been a puzzle to students of evolution and distribution, the Mastodons suddenly making their appearance in the middle part of the Miocene, without our having hitherto had the slightest clue as to their connexion with more generalized types. The puzzle has, in a great degree, been solved by Dr C. W. Andrews, who, while travelling in the Fayum district of Egypt with Mr H. J. L. Beadnell, came across two Tertiary deposits which have yielded a previously unknown vertebrate fauna, a part of which is described in the *Geological Magazine* (September 1901). From the upper beds, provisionally regarded as Lower Oligocene, were obtained remains of a small Mastodon-like animal (*Palæomastodon*), differing from *Mastodon* by the simpler last molar and by having five pairs of cheek-teeth simultaneously in use. The other remains are from a lower horizon, perhaps Upper Eocene, but possibly newer. Most remarkable is a primitive proboscidean (*Mœritherium*), with a nearly full series of front- and cheek-teeth, the latter being of a generalized Ungulate type. That this animal is an ancestor of the mastodons and elephants may be inferred from the enlargement of the second pair of incisors in both jaws and the small upper canines (Fig. 5). All the six pairs of cheek-teeth were in use at the same time. More problematical are the affinities of a huge Ungulate described as *Barytherium*, which in many respects resembles *Dinotherium*, but in others seems to approach the gigantic *Uintatherium* of the North American Tertiaries.

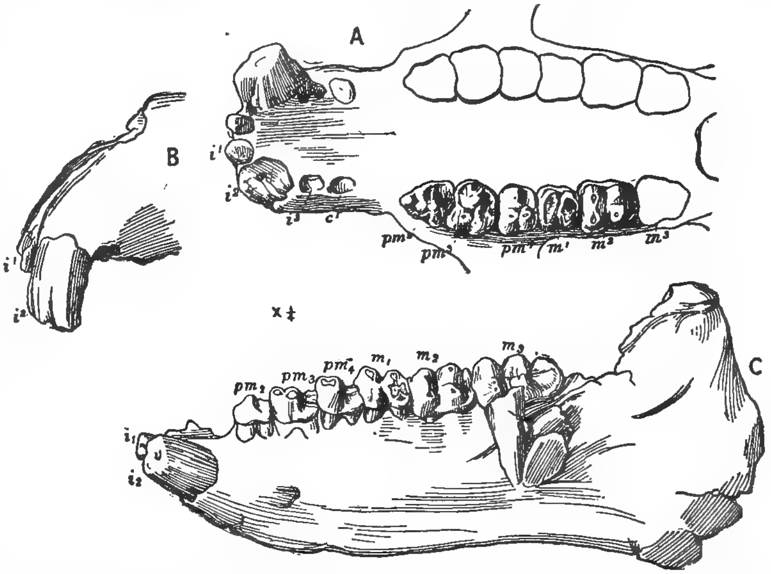
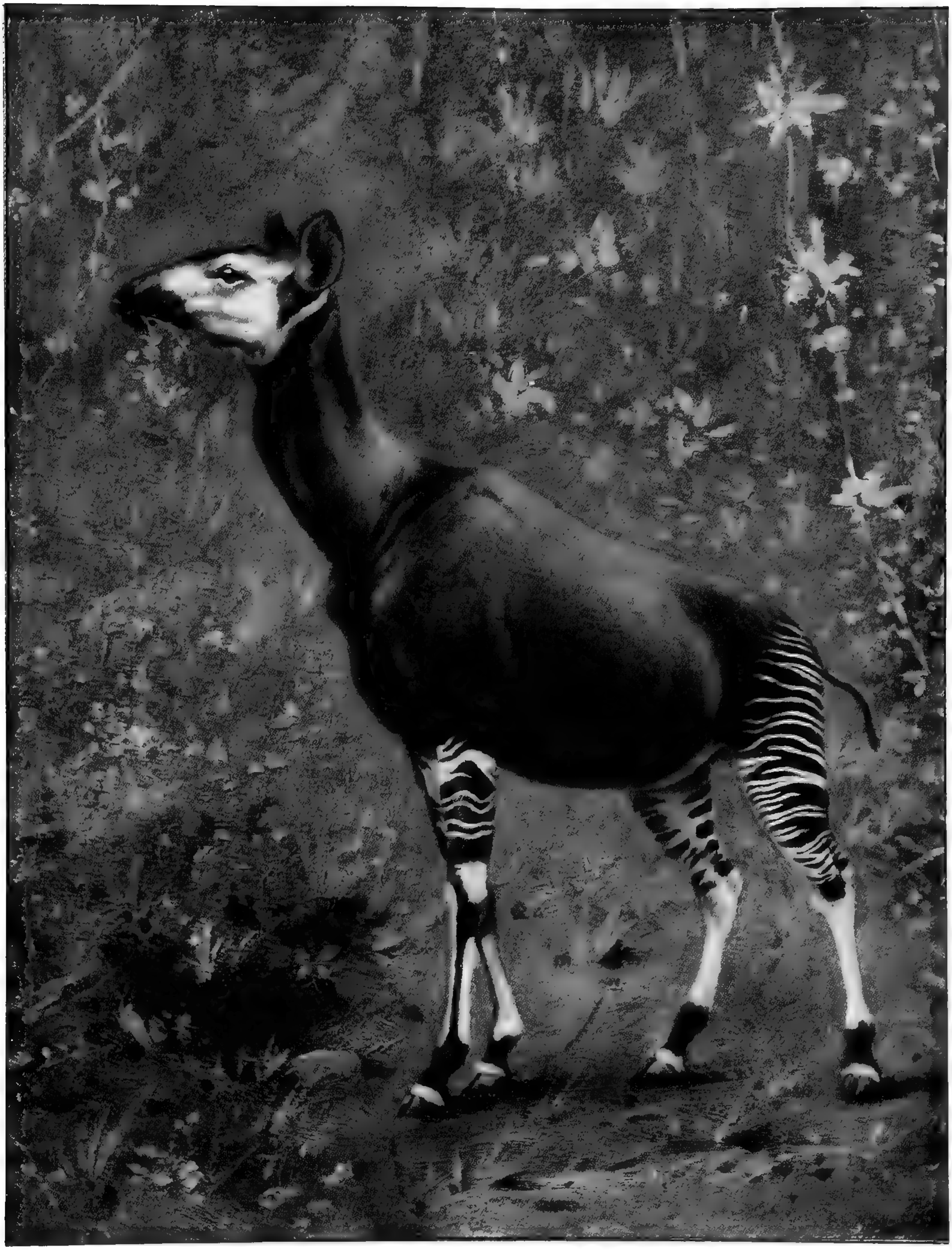


Fig. 5.—Dentition of *Mœritherium lyonsi*. One-fourth natural size. (A) Upper teeth; (B) front of snout, showing the tusk-like second incisors; (C) left ramus of mandible from outer side. (From the *Geological Magazine*).

Carnivora.—The palæontological history of the Carnivora Vera (vol. xv. p. 433) shows that the triple division of the order into the sections Æluroidea, Cynoidea, and Arctoidea is no longer tenable. The *Canidæ*, which is one of the most primitive families of the group, passes imperceptibly into the *Ursidæ*, while the *Mustelidæ* are just as intimately connected with the *Viverridæ*. The *Æluridæ* (*Ailuridæ*, vol. xv. p. 441) are now generally included in the *Procyonidæ*; and remains of a large species of the typical genus *Ælurus* have been discovered in the Pliocene of England and the Continent. Moreover, from the study of the skeleton, Professor Ray Lankester (*Trans. Linn. Soc.—Zool.* 1901) has shown that, instead of being a bear, *Æluropus* (vol. xv. p. 441, Fig. 121) is nearly allied to *Ælurus*.

Primates.—Two very remarkable extinct lemuroids of large size have been discovered in the superficial deposits of Madagascar, in one of which (*Megaladapis*) the upper



The Okapi (Immature).

cheek-teeth are of a tritubercular type (Fig. 6), while in the second and smaller form (*Nesopithecus*) the dentition makes a notable approximation to that of the *Cercopithecidæ*. Possibly these gigantic lemuroids were living in the times of the early voyagers. Dr F. Major has also discovered a remarkable similarity in the structure of the internal ear between the existing Malagasy lemurs and *Adapis* of the European Oligocene. From the Miocene of Patagonia have been obtained remains of a genus (*Homunculus*) nearly allied to the existing *Cebidæ*. Much interest has been attracted by the discovery in a bed of volcanic ash in Java of the imperfect roof of a skull, together with two molar teeth and a thigh-bone, supposed to indicate a very low type of man-like creature, for which the name *Pithecanthropus erectus* has been suggested. The forehead is extremely low, with beetling brow-ridges, and the whole calvarium presents a curiously gibbon-like aspect. Although the capacity of the brain-case is estimated to have equalled but two-thirds that of an average modern man, the creature still appears to have been a member of the family *Hominidæ*—assuming that all the remains are associated. (R. L*.)

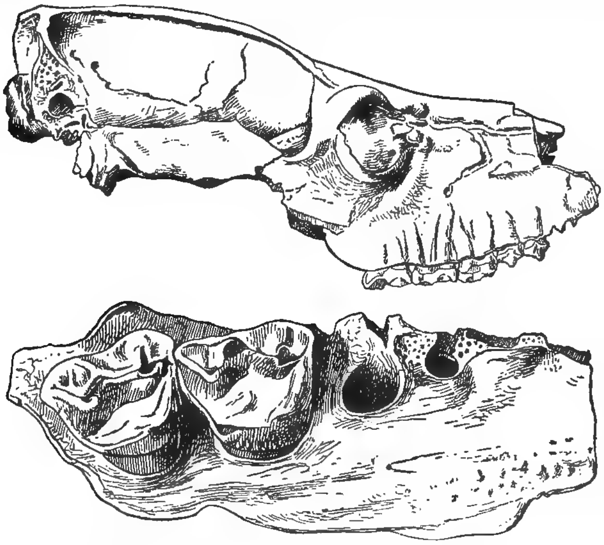


Fig. 6.—Skull and hinder upper cheek-teeth of Megaladapis.

Man, Isle of, the ancient *Mona*, an island in the Irish Sea, 33 miles west of England, 30 miles east of Ireland, 16 miles south of Scotland, and 56 miles north of Wales; greatest breadth 12 miles; length, north-east to south-west, 33 miles.

Climate.—Recent observations enable us to give more accurate and detailed climatic statistics than were possible in 1882. The mean annual temperature of the 70 years between 1828 and 1897 was 49·0°, that of the summer being 57·2° and of the winter 42·0°. The mean variation between the warmest month (August), 58·5°, and the coldest (January), 41·4°, was 17°. The annual rainfall varies greatly in the different districts, the calculated mean of 70 years (1828–97) giving 61 inches on the summit of Snaefell, 47 inches at Ramsey, 46 inches at Douglas, 38 inches at Peel, 34 inches at Castletown, 28 inches at the Point of Ayre, and 25 inches at the Calf of Man. Observations of bright sunshine show the Isle of Man to be one of the sunniest places in the British Isles.

Minerals.—In 1899 the value of the lead obtained was £59,210; of the zinc, £24,701; and of the silver, £8236. The value of the granite quarried was £2445.

Agriculture.—In 1900 the total acreage under all kinds of crops, bare fallow, and grass was 92,184, of which 21,890 acres were under corn crops (oats, 13,393; barley, 7382; wheat, 814; rye, beans, and peas, 301), 10,938 acres under green crops, 39,238 acres under rotation grasses, and 20,118 acres under permanent grass, &c. There were also 25,781 acres of mountain pasture and 1026 acres of orchards, woods, and market-gardens. Horses, 3399 of which were used solely for agriculture, numbered 5139; cows, 21,988; sheep, 75,047; and pigs, 2679.

Trade.—In 1900 the tonnage of vessels cleared for coastwise traffic was 717,150, and for foreign and colonial traffic, 668. The number of vessels (other than fishing-boats) registered as belonging to the Isle of Man in 1900 was 91, and their tonnage was 13,233. In the same year there were 308 fishing-boats aggregating 5103 tons, which employed 1470 men and 212 boys.

Internal communication has been much facilitated by the provision of tramways along Douglas Bay[1] (1883), between Douglas and Laxey[2] (1895), between Laxey and the summit of Snaefell[2] (1896), in Douglas[3] (1897), and between Laxey and Ramsey[2] (1898).

Population has remained almost stationary since 1881. Total (1891), 55,608; (1901), 54,758. In 1901 the population of Douglas was 19,149; of Ramsey, 4672; of Peel, 3306; and of Castletown, 1963.

Births, Marriages, and Deaths.—The following are the rates per thousand of the population for five-year periods between 1884 and 1898:—

	Births.	Marriages.	Deaths.
1884–88	28·1	6·97	20·6
1889–93	26·4	6·81	19·8
1894–98	25·6	7·10	19·4

Language.—The Manx language still lingers, the census of 1901 showing that there were still about 4400 people who understood something of it. There is now no one who does not speak English.

Elementary Education.—Total number of schools 53, 42 being Board and 11 denominational (6 Church of England, 3 Wesleyan, 2 Roman Catholic). Percentage of attendance, 85·41; average attendance, 8206. Amount of Government grant per child, 19s. 8·4d. Receipts from rates, £8794; total expenditure, £30,222.

Rateable Value.—The rateable annual value of the parishes, towns, and villages was £392,528 in 1900.

Revenue for the year ending 31st March 1902 was £78,382, and the expenditure £75,542. The present debt is £160,224. The largest revenue raised was £91,339 in 1901, and the debt reached its maximum amount, £219,531, in 1894.

Poor Relief.—The total number of persons in receipt of poor relief in 1900 was 934, and its cost was £4842.

Lunatics numbered 206 in 1901; their cost was £4168.

History.

Constitutional.—On the departure of the duke of Atholl in 1829 the Tynwald Court had no control over the surplus revenue, and this continued to be the case till 1866, when it gained, if not the sole control of this revenue,[4] at least a substantial share in the disposal of it. Since 1866 it has also obtained a real instead of a nominal voice in fixing the customs duties, subject to the veto of Parliament or the Treasury; and of late years it has become the practice for this court to elect a committee of its members to advise the Governor in financial matters.

The change of the House of Keys in 1866 from a self-elected to a representative body has already been referred to (vol. xv. p. 452). In 1880 it established its right to regulate its own sittings, which had been disputed. The property qualification of the members of the House of Keys was abolished in 1892. In 1881 the franchise was lowered and extended to women, being conferred upon every person who (1), being a male, or a spinster or widow, is the owner of real estate of the annual value of not less than £4; or (2), being a male, is the occupier of real estate of the annual value of not less than £4; or (3), being a male, occupies lodgings of the annual rental of not less than £10. In 1892 women who were occupiers of real estate worth not less than £4 annually were also given a vote.

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[1] Horse. [2] Electric. [3] Cable traction.

[4] In the article in vol. xv. it was stated in error that the Keys gained the control of the surplus revenue in 1866.

In 1883 the whole Manx judicial system was transformed. Law and equity were fused, and the whole legal and equitable jurisdiction of the various courts was transferred to the High Court of Justice. The effect of this and other changes has been virtually to assimilate, with very few exceptions, the Manx practice in the administration of justice to the English. The office of Water-Bailiff was done away with in 1885.

Ecclesiastical.—In 1878 a Sodor and Man Theological School was established for the training of candidates for holy orders. This school has been affiliated to Durham University. In 1880 four rural deaneries were established, and commissioners were constituted as trustees of endowments for Church purposes. In 1895 a cathedral chapter, with four canons, was constituted under the name of the "Dean and Chapter of Man," the bishop being the dean of the cathedral church. A Church Sustentation Fund was established by Bishop Straton in 1894, with a view to supplementing the incomes of the clergy, which had been greatly reduced on account of the low price of corn. Since 1884 the jurisdiction of the Church courts has almost disappeared, all that now remains having reference to affiliation questions, the swearing in of churchwardens, and the granting of faculties. There have been several Acts giving Nonconformists equal rights with Churchmen. Among these are the Burial Acts of 1881 and 1895, which permit burials to take place in churchyards without the rites of the Church of England, and allow any burial service, provided it be Christian, in mortuary chapels.

Social and Economic.—It was not till 1872, when the insular Legislature passed the Public Elementary Education Act, that the Manx State undertook any direct responsibility for education. This Act differed from the English Act of 1870 in three important particulars: (1) It at once constituted every town and parish a school district under a school board; (2) the attendance of children was made compulsory; and (3) every elementary school, those in connexion with the Church of Rome excepted, was obliged to provide for non-sectarian instruction in religious subjects, and for the reading of the Bible accompanied by suitable explanation. Since the date of this Act education has made extraordinary strides. It became free in 1892, and a higher-grade school was established in Douglas in 1894. In 1876 vaccination was made compulsory, as also was the registration of births, marriages, and deaths in 1878. It was not till 1884 that the sanitation of the towns was seriously taken in hand, but ten years more elapsed before the sanitary condition of the island was dealt with by the passing of an Act which constituted parish and village districts, with commissioners elected by the people, who had, in conjunction with a board elected by the Tynwald Court and an inspector appointed by it, to attend to all questions relating to sanitation and infectious diseases. As a result of these measures the death-rate has been greatly reduced. In 1888 a permissive poor law was established; it has been adopted by all the towns except Peel and by six of the seventeen country parishes. Prior to this date the poor had been dependent on voluntary relief, which broke down owing to the growth of a temporarily employed class occupied in administering to the wants of the summer visitors. In 1829 the insular harbours were practically unprotected from inshore winds, there was no low-water landing accommodation, and no regular communication with England by steamer. But since 1860 extensive harbour works have been constructed which give great, though still inadequate, protection, and nearly all the landing accommodation required; and steamers run to and from England on every week-day during the year. Since 1844 numberless absurd and complicated regulations, which hampered trade, have been revoked, and, while the duties on spirits have been increased, those on articles of beneficial and universal consumption have either disappeared or have been greatly reduced. In 1853 the infamous licence system, by which only limited quantities of such articles as spirits, tea, coffee, tobacco, and salt could be imported, and then only by a few merchants, who, having obtained a licence, combined and charged what prices they pleased to the unfortunate consumers, was abolished.

Manx textile industries have, generally speaking, declined since 1880, being unable to compete with the larger and more completely organized manufactories elsewhere. Agriculture has, on the whole, improved since 1882, and its average condition in 1902 was not much inferior to what it was in England and Scotland. In 1900 commissioners appointed to inquire into the condition of local industries noted that there was need for better and more complete cultivation of the land, and that, as regards the crops, "neither Manx wheat nor barley is as good on an average as English; but that oats, the largest crop, is on the whole fully equal to what is grown on the mainland." They stated that the Government premiums for stallions and bulls, which had been established in 1889, had been beneficial in improving the breed of horses and cattle, but that dairying was in a very unsatisfactory condition and butter "very unequal in quality." The fishing industry is a declining one. Efforts to deal with this state of affairs have been confined to the making of bye-laws regulating the sea-fisheries in 1894, and to the erection of a hatchery for lobsters and flatfish at Port Erin in 1902. Mining, on account of the low price of metals, is also on the wane. The discovery of an excellent quarry of granite at the Dhoon has led to the production of paving setts on a large scale. But there is one industry, for so it may really be called, that of providing for summer visitors, which has greatly prospered, and the Isle of Man has become the most popular holiday resort in the north of England. On the whole, it may fairly be said that the Manx people in 1902 formed a prosperous and contented community.

During the ten years 1891–1901 a considerable number of books relating to the history, law, antiquities, language, folklore, and philology of the Isle of Man have been issued. The chief of them are mentioned in the list given below The most popular literary associations of the island, however, are those which centre round the novels of Mr Hall Caine, who, in his *Deemster*, *Manxman*, &c., has exploited the "local colouring" of the island in a way which has undoubtedly added to its general interest.

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Folklore: P. M. C. Kermode, F.S.A. *A Catalogue of the Manx Crosses with Runic Inscriptions, &c.* Ramsey, *Courier* office, 1892. —A. W. Moore, M.A. *The Folklore of the Isle of Man.* London, D. Nutt, 1891. **Language and Philology**: *The Book of Common Prayer in Manx Gaelic.* Being translations made by Bishop Phillips in 1610 and by the Manx clergy in 1765. Edited by A. W. Moore, M.A., and John Rhys, M.A., LL.D. Together with the *Outlines of the Phonology of Manx Gaelic*, by John Rhys. Oxford, University Press, 2 vols., 1893–94.—*Manx National Songs*, with English words, from the MS. collection of the Deemster Gill, Dr J. Clague, and W. H. Gill, and arranged by W. H. Gill. London, Boosey and Co., 1896.—*Manx Ballads and Music*, edited by A. W. Moore, M.A. Douglas, G. and R. Johnson, 1896. —A. W. Moore, M.A. *The Surnames and Place Names of the Isle of Man.* London, Elliot Stock, 1890. (A. W. M.)

Manacor, a town in the island of Majorca, 11 miles from its eastern shore, and connected with Palma by rail. Its population was 16,461 in 1887, and 11,579 in 1897. A suburb of some importance has sprung up by the sea, styled Colonia del Carmen, with good modern houses.

Managua, the capital of Nicaragua, Central America, situated 1 mile from the foot of Lake Managua, 32 miles south-east of Granada, with which it is connected by rail. There is communication with Momotombo at the head of the lake by small steamers, and thence by rail 58 miles to the port of Corinto. It was chosen as the capital of Nicaragua in 1855, and on account of the improved railway communication with Corinto and with the interior its commercial importance has considerably increased, its chief trade being in coffee, of which the plantations in this district have almost superseded those of cotton. The principal building is the Palacio National, in the Corinthian style. A modern addition is the national, industrial, and scientific museum. Population about 18,000.

Manahiki. See Polynesia.

Manaoag, a town in the north central portion of the province of Pangasinan, Luzon, Philippine Islands. There is rich agricultural land in its vicinity, which is level for the most part, and its inhabitants devote themselves almost exclusively to rice-culture. The principal language is Pangasinan. Population, 17,000.

Manaos, a town in Brazil, at the mouth of the Rio Negro, and capital of the province of Amazonas, with a population estimated at between 30,000 and 50,000. It is an important commercial mart, especially for the fine Upper Amazon rubber, large quantities coming from Bolivia. Some 8200 tons of this commodity were exported in 1899–1900. It is connected with Pará by a cable down the Amazon, and a railway is projected up the Rio Madeira, which will greatly increase the business of Manaos. Though the town is of recent origin, it already possesses electric tramways, waterworks, electric street-lighting, and a fine opera-house.

Manbhum, a district of British India, in the Chota Nagpur division of Bengal. The administrative headquarters are at Purulia.

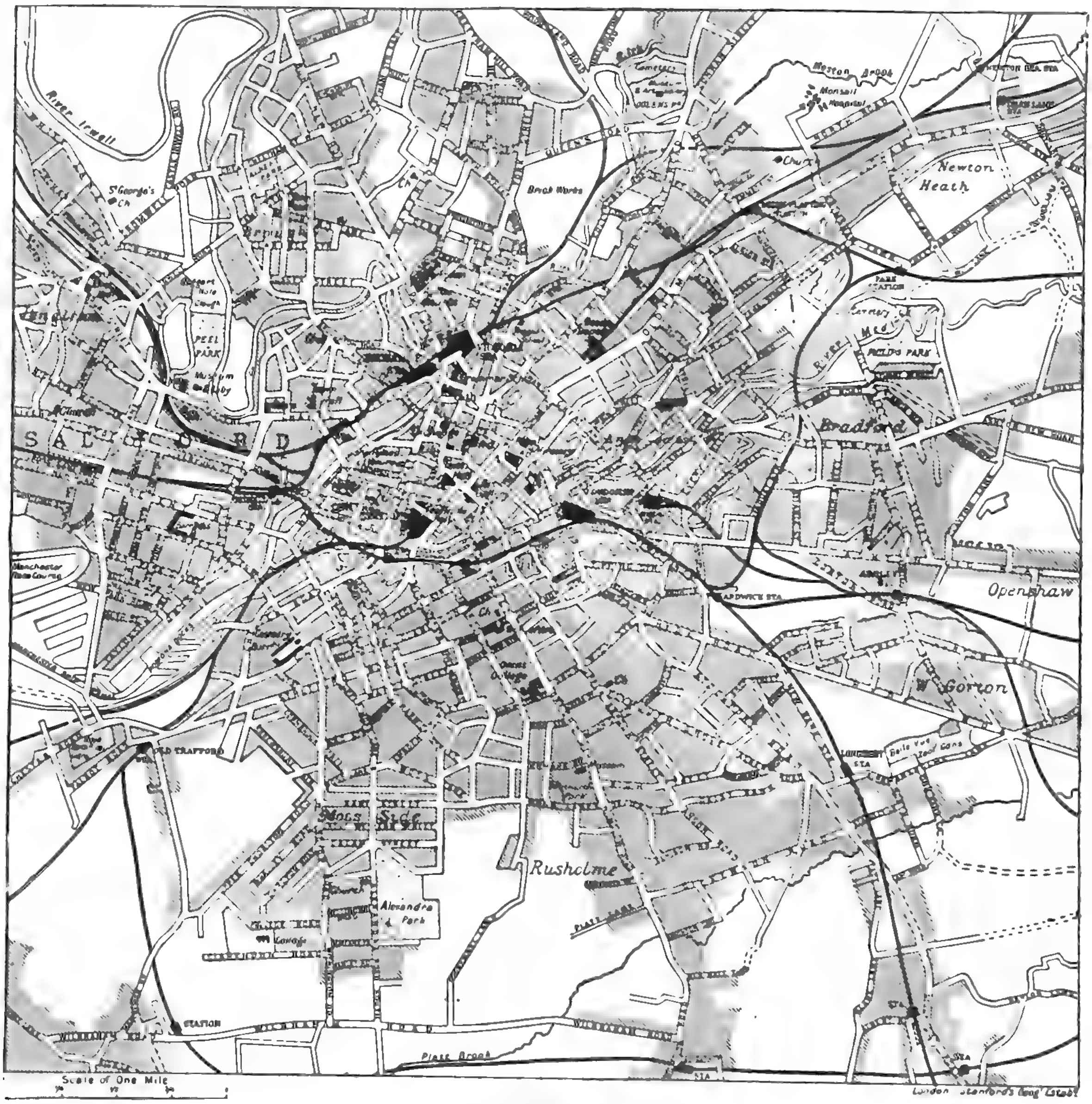
Area, 4147 square miles; population (1881), 1,058,228; (1891), 1,193,325; (1901), 1,303,583, showing an increase of 13 per cent. between 1881 and 1891, and of 9·24 per cent. between 1891 and 1901; average density, 314 persons per square mile. Classified according to religion, Hindus numbered 972,509 in 1891; Mahommedans, 53,255; Christians, 1532, including 78 Europeans; aborigines, 166,029. The land revenue and rates in 1897–98 were Rs.1,47,403; number of police, 353; number of boys at school (1896–97), 17,283, being 19·4 per cent. of the male population of school-going age; registered death-rate (1897), 32·74 per thousand. Manbhum contains the Jherriah coalfield, in the Damodar valley, where a large number of mines have been opened since 1894. Some of these are very small; but three employ more than 1000 persons each, with an output of more than 100,000 tons. The United Free Church of Scotland has a mission at Pakheria, with a printing-press that issues a monthly journal in Sonthali. The district is traversed by the Bengal-Nagpur railway, with another line to the coalfield.

Manche, a department of the north-west of France, forming the peninsula of Cotentin, washed by the English Channel.

Area, 2475 square miles. The population, 520,865 in 1886, decreased to 488,631 in 1901. Births in 1899, 10,867, of which 790 were illegitimate; deaths, 10,695; marriages, 3620. The schools numbered in 1896, 1233, with 71,000 pupils, and the illiterate constituted 3 per cent. of the population. Out of 1,284,994 acres of cultivated land in 1896, 778,409 acres were plough-land and 420,094 acres natural pastures and grass lands. The wheat of 1899 yielded the value of £718,000; barley, £312,000; buckwheat, £348,000; oats, £188,000. Its chief wealth, however, consists in its vast natural pastures and grass lands, which in 1899 returned a value of £2,080,000, and in respect of which Manche holds a front rank among the departments of France. Apples rendered in 1898 the value of £837,000. The live stock of 1899 included 81,780 horses, 316,750 cattle, 179,350 sheep, and 112,870 pigs. The total value of the milk of the department was in 1899 £2,600,000. Manche has, however, no industries of importance, with the exception of paper factories and some spinning mills. Saint Lô, the capital, had 11,604 inhabitants in 1901; but Cherbourg (42,952 in 1901) is the largest town.

Manchester, a county of itself, city, parliamentary and municipal borough and parish, in the south-east of the county of Lancashire, England, the commercial centre of the English cotton district. With the borough of Salford, with which it is continuous, Manchester is about 180 miles north-east of London, in 53° 29′ N. and 2° 14′ 23″ W. They stand on a level plain and on the rising ground to the north. The rivers are the Irwell, Medlock, Irk, and Tib. There are stations on the London and North-Western, the Midland, Great Northern, and Great Central railways. There are about fifty passenger stations in the two boroughs, which are connected by rail with every part of the kingdom. The parliamentary and municipal boroughs of Manchester are not conterminous. The city boundaries were enlarged in 1885 from 4294 acres to 5933 by the inclusion of Bradford and Rusholme. In 1890 the addition of Blackley, Kirkmanshulme, Moston, Newton Heath, Openshaw, and West Gorton, with some minor readjustments in 1894, made the municipal area 12,911 acres. The population of the city was 505,368 in 1891, and 543,969 in 1901. The parliamentary borough contains 7945 acres, and had a population of 454,509 in 1891 and 475,455 in 1901, divided amongst six divisions. The parliamentary and municipal boundaries of Salford are identical, the area being 5170 acres, and the population 198,139 in 1891 and 220,956 in 1901. Both boroughs have as neighbours populous towns and urban districts. Tramways, as well as railways, run from Manchester to Oldham, Ashton, Eccles, Stockport, &c., with which places the city is connected by continuous lines of street. The length of the streets in the city of Manchester is 694 miles, and in the same area there are 78 miles of tramways.

Parks and Statues.—There are in Manchester thirty-nine parks and open spaces. Some of these are small, and the total area is 1103 acres. Boggart Hole Clough, where great efforts have been made to preserve the natural features, is 76 acres in extent, and was the largest until 1902, when Heaton Park, containing 692 acres, was purchased at a cost of £230,000. It was formerly the seat of the earls of Wilton, and includes Heaton House, one of Wyatt's structures. In the Queen's Park there is a museum, and periodical exhibitions of works of art are held. There, too, is a statue of Benjamin Brierley, a well-known writer in the Lancashire dialect. The Salford parks have an area of about 130 acres. The largest is Peel Park, in which there is a museum, library, and art gallery. The last-named, built from the bequest of Mr E. R. Langworthy, contains some notable paintings. The statues are not numerous. There are several in the Manchester town hall. In Piccadilly are statues of Sir Robert Peel, Dr Dalton, and the Duke of Wellington. In Albert Square are statues of the Prince Consort, Bishop Fraser, John Bright, Gladstone, and Oliver Heywood. In St Ann's Square is a statue of Cobden. A statue of Dr J. P. Joule in the town hall should also be named. The Whitworth Park occupies an exceptional position, as it is not the property of the Manchester corporation, but of the Whitworth Institute, a corporate body originating from the liberal bequests of Sir Joseph Whitworth. The Institute contains a valuable collection of works of art, and stands in the centre of the park, which is maintained as a woodland park and pleasure-ground. In the park is a sculpture group of Christ and the Children by George Tinworth from the designs of Mr R. D. Darbishire, by whom it was presented. A Diamond Jubilee statue of Queen Victoria stands in Piccadilly, and another statue of her Majesty by Princess Louise, Duchess of Argyll, is placed on the new porch of the Cathedral.



PLAN OF MANCHESTER.

Public Buildings.—The chief public buildings are the Royal Infirmary, which occupies a central position in Piccadilly, and the Town Hall, erected at a cost, including interest, of £1,062,565. Around the great hall are a series of twelve mural paintings by Mr Ford Madox Brown. The organ cost £5269, and the bells and clock £6985. The town hall was opened in 1877, and contains 314 rooms. There are also eleven district town halls and public rooms belonging to Manchester. Salford, Pendleton, and Broughton have each a town hall. The Manchester post office, Brown Street, is a handsome building, completed in 1887. It suffers, like many other fine structures in the city, from being hemmed in by streets, which prevent the proportions from being seen to advantage. Other public buildings are the Free Trade Hall, the Royal Exchange (1869), the Assize Courts (1864), and the city police courts (1871). The Royal Institution was transferred to the corporation in 1882, and the permanent collection of works of art then existing has been considerably increased by purchases, to which purpose £2000 is yearly devoted. It is known as the City Art Gallery.

Manchester Ship Canal.—The most important event in the modern history of the district is the creation of the ship canal, by which Manchester and Salford have a direct communication with the sea at Eastham, near Liverpool. The idea of making Manchester a port was an old one. After various schemes had been proposed, and after a long and costly parliamentary struggle, the work of construction was begun in November 1887 under the superintendence of Mr (afterwards Sir) Edward Leader Williams, as engineer. Mr T. A. Walker, who was the contractor, died in 1889, and the completion of the work was taken over from his executors by the company and finished under contracts. The canal was opened for traffic in January 1894. The official opening ceremony was on 21st May 1894, when Queen Victoria visited Manchester. The total expenditure on capital account has been £15,173,402, including £1,224,451 paid for land and compensation and £1,786,313 for the Bridgewater canal, now absorbed in the greater undertaking. The original share capital of £8,000,000 and £1,812,000 raised by debentures having been exhausted, the corporation of Manchester advanced on loan a further sum of £5,000,000. (For the engineering features see CANALS: *Ship Canals*.) The Manchester canal is a remarkable example of constructive skill; and whilst the original shareholders have not received the anticipated returns from these investments, the canal has had a beneficial influence on the trade and the district. Since the opening for traffic the yearly tonnage has been :—

	1894. Tons.	1895. Tons.	1896. Tons.	1897. Tons.
Sea-borne traffic	686,158	1,087,443	1,509,658	1,700,479
Barge traffic .	239,501	271,432	316,579	365,336
Total . .	925,659	1,358,875	1,826,237	2,065,815
	1898.	1899.	1900.	1901.
Sea-borne traffic	2,218,005	2,429,168	2,784,843	2,684,833
Barge traffic .	377,580	348,940	275,673	257,560
Total . .	2,595,585	2,778,108	3,060,516	2,942,393

Water-supply.—The water-supply is controlled by the corporation. The works at Longdendale, begun in 1848, were completed, with extensions in 1884, at a cost of £3,147,893. The area supplied by Manchester waterworks was about 85 square miles, inhabited by a million people. The increase of trade and population led to the obtaining of a further supply from Lake Thirlmere, at the foot of Helvellyn and 96 miles from Manchester. The watershed is about 11,000 acres. The engineering difficulties of the alteration of the level of the lake and the conveyance of the water so great a distance were skilfully overcome. The daily consumption is over 32 million gallons. Manchester supplies in bulk many local authorities in the district between Thirlmere and the city. The Manchester corporation have also established works for the supply of hydraulic power for various trade purposes.

Lighting.—The gas lighting of Manchester has been in the hands of the corporation for many years. Salford has separate gasworks, also under municipal control. It is possible that the value and excellence of the gasworks may have retarded the introduction of the electric light. Powers were sought in 1882; but differences arose between the corporation and the Board of Trade, and a provisional order was not obtained until 1890. Electricity works have been erected, the light is supplied in the central area of the city, and large extensions are in progress for the remainder of Manchester and the adjoining urban districts.

Sanitary Condition.—Although continuous efforts have been made, and the social condition of the mass of the people has very greatly improved, Manchester and Salford have high death-rates. Dr John Tatham has constructed a Manchester life-table based on the vital statistics of the decennium 1881–90; and from this it appears that while in England and Wales of 1000 men aged 25 nearly 800 survive to be 45, and of 1000 aged 45, 569 survive to be 65, in the city of Manchester the survivors are only 732 and 414 respectively. The expectation of life, at 25, is for England and Wales 36·12 years, and for Manchester 30·69 years. The city death-rate in 1891 was 26·0 per thousand living; in 1894 it was 19·8; in 1898, 21·2. For the 10 years ending 1900 the average death-rate was 23·4, that of Salford 24·1. The reports of the medical officers show that whilst the density of the population, the impurity of the atmosphere, and the pollution of the streams are difficult elements in the sanitary problem, great efforts have been made towards improving the health of the people.

Churches.—Manchester Cathedral, which was built as a parish and collegiate church and dates from the 15th century, with traces of much older work, has been extensively restored, under Mr Champneys. The old churchyard has again been encroached upon to allow of the widening of Victoria Street. A new porch has been built in harmony with the rest of the structure. The Gordon memorial window and the recumbent statues of Bishop Fraser and Mr Hugh Birley, M.P., should be named. In 1847 Manchester was created a bishopric. The wardens and fellows were converted into deans and canons, and the parish church became the cathedral. The first bishop, James Prince Lee, died in 1870; the second, James Fraser, died in 1885. He was succeeded by Dr James Moorhouse, formerly bishop of Melbourne. Including the cathedral, there are more than 100 Anglican churches in Manchester and Salford. Salford is a Roman Catholic see. With Salford Cathedral there are, in the two boroughs, about 40 places of worship belonging to the Church of Rome. The other religious denominations include the Armenian Church, Baptist, Bible Christian, Catholic Apostolic Church, Christadelphian Ecclesia, United Friends, Congregationalists, German Protestant, Greek, Independent Methodists, Jews, Labour Church, Methodist New Connection, New Jerusalem Church, Presbyterians, Primitive Methodist, Salvation Army, Society of Friends, Unitarians, United Methodist Free Church, Welsh Calvinistic Methodists, and Wesleyan Methodists. The Secularists and the Positivists have also congregations.

Philanthropic Institutions.—In addition to the Royal Infirmary, the Salford Hospital, St Mary's Hospital, and other institutions of that type, mention may be made of the Boys' and Girls' Refuges, and the Charter Street Ragged School and Working Girls' Home—both of which are large and important.

Literature, Science, and Art.—Numerous societies and institutions exist for the cultivation of learning. The Literary and Philosophical Society is one of the oldest in the kingdom, and has a high reputation. The Lancashire and Chester Antiquarian Society, the Record Society, and the Chetham Society, have their headquarters in the city. There are nine daily papers, and many weekly papers and periodicals. The *Manchester Quarterly* is issued by the Manchester Literary Club. The success of the Art Treasures Exhibition in 1857 was repeated in the Jubilee Exhibition of 1887. In 165 days there were 4,765,137 admissions. The Manchester Academy of Fine Arts is a society of artists, and holds an annual exhibition in the city art gallery.

University and Schools.—The educational arrangements of the city are on an extensive scale. There are 74 board schools, 55 belonging to the Church of England, 25 Roman Catholic, 5 British, and 5 Wesleyan. In Salford there are 24 board schools, 1 British, 29 Church of England, 11 Roman Catholic, and 3 Wesleyan. The Moss Side School Board has two schools. The two corporations have taken an active interest in secondary education. The Manchester Municipal School of Technology is large and well equipped. The School of Art forms one department, and in connexion with this there is an Arts and Crafts Museum. The Salford Technical School adjoins Peel Park, and is a handsome building, erected at a cost of £84,000. The Manchester Grammar School, founded in 1515, has earned a high reputation. It is connected by scholarships with Oxford University and the Victoria University. The foundation of William Hulme maintains a grammar school at Alexandra Park. There are also four high schools for girls. The Victoria University received its charter in 1880, and in 1883 a supplementary charter conferring the power of granting degrees in medicine as well as in science and arts. Owens College, which was at first the only one in the university, has since been joined by University College, Liverpool, and the Yorkshire College of Science, Leeds. A new educational type —that of a federal teaching university—was thus created; but in consequence of the application of Liverpool for a separate charter, there is a probability that the Victoria University will develop into three civic universities of Manchester, Liverpool, and Leeds. The original endowment of Owens College, founded under the bequest of John Owens, was about £100,000, but this has been greatly increased by other benefactors. Mr Thomas Ashton's gifts are estimated at £80,000. Dr Richard Copley Christie, formerly a professor, gave the building known as the Christie Library, which cost £21,000, and devoted £50,000 of the funds at his disposal as a legatee of Sir Joseph Whitworth to the erection of the Whitworth Hall. These, with the building containing the Manchester Museum (an admirably arranged collection illustrating geology, biology, and anthropology), complete the quadrangle of the main college buildings. There are various large denominational colleges in the district, and many of those preparing for the ministry receive their arts training at Owens College. The Royal College of Music is another educational institution which should not be overlooked. The various authorities have a working agreement for the coordination of the educational work of the district.

Libraries and Museums.—The district has many libraries. Chetham's Hospital contains a blue-coat school for 100 boys and a public library. The Salford Museum and Library was founded in 1849. This includes reference library, 5 lending libraries, and 2 reading-rooms. The central building contains also the museum and art gallery. The Manchester Free Library was opened in 1852. There is now a large reference library, containing probably the best working collection of books in the North of England, 13 lending libraries, and 5 reading-rooms. The stock of books amounts to 292,000. By the generosity of Mrs Enriqueta Rylands the city received in 1899 an endowed library of a remarkable character—the John Rylands Library, which has been erected by his widow to the memory of a well-known Manchester worthy. The building is a noble and beautiful structure, and the library is large and important. It includes the famous Althorp collection, which was bought from Earl Spencer and incorporated by Mrs Rylands into her scheme. The regulations for use of the Rylands Library are similar to those in force at the British Museum. Moss Side, which is in the parliamentary limits, but has its own urban council, has a municipal library, and also a small park and recreation ground.

Recreation.—The recreation of the population is provided for in many ways. There are eleven theatres, mostly large in size. The concerts of classical music and other musical entertainments have more than local celebrity. The Bellevue Zoological Gardens is a favourite holiday place for working people. The Ancoats Recreation Committee have since 1882 had Sunday lectures, and occasional exhibitions of pictures, window gardening, &c. The Ancoats Art Museum was founded to carry out the educational influences of art and culture generally. In addition to works of art, there are concerts, lectures, reading circles, &c. The museum is worked in connexion with a university settlement.

Manufactures and Commerce.—Manchester, whilst the centre of the cotton industry, is also the seat of large engineering and chemical trades. The central area is more and more occupied by offices and warehouses, and the works and factories are grouped outside. This process has been carried out so largely that the real Manchester is difficult of definition. From one point of view the whole of south-east Lancashire, and some portions even of Cheshire and Derbyshire, may be regarded as one vast urban district, having many interests and characteristics in common, although split up into separate areas of local government. The annual value of the city of Manchester increased from £2,943,545 in 1896 to £3,394,879 in 1901; that of Salford from £835,455 to £967,727. In the districts where there was more room for expansion the increase is also striking. Thus the annual value of Stretford has risen from £143,956 to £194,366 within the years named; the corresponding figures for similar urban districts adjoining Manchester are equally demonstrative of the increase of trade and population. The amount passing through the Manchester bankers' clearing-house in 1890 was £162,849,544; in 1899, £222,563,348; in 1900, £247,206,000; in 1901, £235,487,000. Manchester is the headquarters of the Wholesale Co-operative Society.

Municipality.—Manchester received a municipal charter in 1838, received the title of city in 1853, and became a county borough in 1889. The city is divided into 25 wards, and the corporation consists of 26 aldermen and 78 councillors. The mayor received the title of Lord Mayor in 1893. The municipal charter of Salford was granted in 1844. There are 16 wards. Sixteen aldermen and 48 councillors constitute the Town Council. Salford became a county borough in 1889.

By the Reform Bill of 1832 Manchester received two and Salford one representative. In 1868 this was increased to three for Manchester (each voter, however, having only two votes) and two for Salford. At present Manchester sends six and Salford three members to the House of Commons.

AUTHORITIES.—W. A. SHAW. *Manchester, Old and New*, 1894.—W. E. A. AXON. *Annals of Manchester*, 1885.—HARRY RAWSON. *Historical Record of some Recent Enterprises of the Corporation of Manchester*, 1894; *Official Manual of Manchester and Salford*, 1902.—J. P. EARWAKER. *Court List Records of Manchester, 1552–1686, 1731–1846* (1884–90), 12 vols.; *Constable's Accounts, 1612–47, 1743–76* (1891–92), 3 vols.; *Manchester Municipal Code*, 1894–99, 5 vols.—GEORGE SAINTSBURY. *Manchester*, 1887.—*Handbook and Guide to Manchester.* Edited by J. HOWSON RAY, F.R.C.S. 1902. (W. E. A. A.)

Manchester, a township of Hartford county, Connecticut, U.S.A., north-east of the centre of the state, a few miles east of Hartford, containing an area of 21 square miles and including the villages of Manchester, South Manchester, Manchester Green, and Buckland. Its manufactories include silk, paper, cotton, and needle mills, and factories of electric machinery and appliances. The total capital invested in manufacturing in 1900 was $7,330,806, and the various establishments employed 3118 wage-earners, and had products valued at $5,939,943. Population (1890), 8222; (1900), 10,601, of whom 3771 were foreign-born.

Manchester, a city of New Hampshire, U.S.A., capital of Hillsboro county. It is on the Merrimac river, at Amoskeag Falls, which furnish water-power for its manufactures. Its manufacturing establishments had in 1900 a capital of $22,426,125, employed an average number of 19,032 wage-earners, and produced goods valued at $26,607,600. Of this total product, cotton goods were valued at $11,723,508, boots and shoes at $4,052,204, hosiery and knitted goods at $834,343, and foundry and machine-shop products at $511,208. Manchester is the seat of St Anselm's College, a Roman Catholic institution founded in 1893. In 1899 this had 19 instructors, and was attended by 61 students. The assessed valuation of real and personal property in 1900, on a basis of about 70 per cent. of the full value, was $32,706,794, the net debt of the city $1,627,025, and the rate of taxation $19.50 per $1000. Population (1890), 44,126; (1900), 56,987, of whom 24,257 were foreign-born and only 28 were negroes. The death-rate in 1900 was 19·2, the same as in 1890.

Manchester, a city of Virginia, U.S.A., on the south bank of the James river, opposite Richmond, with which it is connected by bridges. Though within the limits of Chesterfield county, it is independent of county government. It is on the Atlantic Coast Line, the Seaboard Air Line, and the Southern railways. It is a manufacturing city of some importance, using the water-power from the falls of James river at this point. Population (1880), 5729; (1890), 9246; (1900), 9715, of whom 138 were foreign-born and 3338 were negroes.

Manchuria.—The three provinces of China lying outside the Great Wall, generically known as Manchuria, were described in the earlier volumes (xv. 465) of this Encyclopædia (ninth edition). Since 1883 the country has made considerable progress. Immigrants from the older and over-populated parts of China have been flocking thither in great numbers, and much new land has been brought under cultivation. The general progress is exemplified in the returns of trade passing through the treaty-port of Newchwang. The total value of the trade in 1880 was H. taels 6,725,000, and in 1899 it had risen to H. taels 48,357,000; but in 1900, owing to the disturbed state of the country, it fell to £1,023,260, or H. taels 38,116,450. The population is estimated as follows for each of the three divisions:—

Province of Shengking (Feng Tien) . .	4,000,000
,, ,, Kirin	6,500,000
,, ,, Hei lung chiang . . .	2,000,000
Total	12,500,000

The original population was entirely Manchu, but they are rapidly being elbowed out by the more industrious Chinese. Their number is estimated at from 2 to 3 millions, or about 25 per cent. of the whole population. Nearly all of them are officials or hangers-on at the various civil and military establishments, and but for the official support they receive in the shape of pay or perquisites, they would rapidly be squeezed out. Gold mines are worked at several places in the northern part of Manchuria, of which the principal are on the Muho river, an affluent of the Amur, and near the Russian frontier. Mines are also worked at Kwanyin-shan, opposite the Russian frontier town of Radevska, and at Chia-pi-kou, on an affluent of the upper Sungari. Manchuria has been claimed by Russia as her particular sphere of interest, and in the course of the disturbances of 1900, Russian troops occupied various parts of the country (see CHINA). Eventually a Manchurian Convention was arranged between China and Russia, by which Russia was to evacuate the province; but various difficulties arose, and no actual ratification of this convention had been made by Russia up to June 1902. The Anglo-German agreement of October 1900, to which Japan also became a party, and by which it was agreed to "maintain undiminished the territorial condition of the Chinese empire," was considered by Great Britain and Japan not to exclude Manchuria; but Germany, on the other hand, declared that Manchuria was of no interest to her. The Anglo-Japanese treaty of 1902, however, was ostensibly directed towards the preservation of Manchuria in Chinese hands. Railways are in course of construction by Russian capital from Port Arthur northwards *viâ* Mukden, to connect with the Siberian main line to Vladivostok. British capital has been invested in the extension of the Chinese Northern railway to Newchwang, and the fact was officially recognized by an agreement between Great Britain and Russia in 1899.

Vide Blue Book, *China*, No. 2 (1899), and "Report on Manchuria," by Colonel Browne, military attaché, Blue Book, *China*, No. 1 (1899).

Mancini, Pasquale Stanislao (1817–1888), Italian jurist and statesman, was born at Castel Baronia, in the province of Avellino, on 17th March 1817. At Naples, where he studied law and displayed great literary activity, he rapidly acquired a prominent position, and in 1848 was instrumental in persuading Ferdinand II. to participate in the war against Austria. Twice he declined the offer of a portfolio in the Neapolitan Cabinet, and, upon the triumph of the reactionary party, undertook the defence of the Liberal political prisoners. Threatened with imprisonment in his turn, he fled to Piedmont, where he obtained a university professorship and became preceptor of the Crown Prince Humbert. In 1860 he prepared the legislative unification of Italy, opposed the idea of an alliance between Piedmont and Naples, and, after the fall of the Bourbons, was sent to Naples as administrator of justice, in which capacity he suppressed the religious orders, revoked the Concordat, proclaimed the right of the State to Church property, and unified civil and commercial jurisprudence. In 1862 he became Minister of Public Instruction in the Rattazzi Cabinet, and induced the Chamber to abolish capital punishment. Thereafter, for fourteen years, he devoted himself chiefly to questions of international law and arbitration, but in 1876, upon the advent of the Left to power, became Minister of Justice in the Depretis Cabinet. His pronounced Liberal tendencies found expression in the extension of press freedom, the repeal of imprisonment for debt, and the abolition of ecclesiastical tithes. During the Conclave of 1878 he succeeded, by negotiations with Cardinal Pecci (afterwards Leo XIII.), in inducing the Sacred College to remain in Rome, and, after the election of the new pope, arranged for his temporary absence from the Vatican for the purpose of settling private business. Resigning office in March 1878, he resumed the practice of law, and secured the annulment of Garibaldi's marriage. The fall of Cairoli, in consequence of the occupation of Tunis by France in 1881, led to Mancini's appointment to the Foreign Office (April 1881), where he conducted the negotiations for and concluded the Triple Alliance, and promoted a closer understanding between Italy and Great Britain, although, partly through lack of military preparation, he declined to join in the British expedition to Egypt. In 1885, however, he undertook an expedition to Massawa with the consent of Great Britain, and thus inaugurated Italian colonial policy. During the cholera epidemic of 1885 he accompanied King Humbert to Naples, and displayed great courage and activity in organizing measures of relief. In June 1885 he was succeeded at the Foreign Office by Count di Robilant, and died at Rome on 26th December 1888. A man of extraordinary versatility and of facile though verbose eloquence, Mancini possessed for many years considerable ascendancy over the Italian Chamber, and, while not a great statesman, left an indelible mark upon the history of his country.

(H. W. S.)

Mandalay, formerly the capital of independent Burma (*q.v.*), now the headquarters of the Mandalay division and district, as well as the chief town in Upper Burma. The division includes the districts of Mandalay, Bhamo, Myit Kyina, Katha, and Ruby Mines, with a total area of 25,767 square miles, and a population (1891) of 641,466, (1901), 778,255, giving an average density of 30 inhabitants to the square mile. There were 2950 towns and villages in 1898–99, and the revenue paid was Rs.16,52,036. The Mandalay district has an area of 2071 square miles, and a population (1891) of 375,055, (1901) 367,230, showing a density of 177 inhabitants to the square mile. It is divided into five subdivisions, with seven townships and 786 villages. About 600 square miles of the district along the Irrawaddy river are flat land, nearly all cultivated. To the north and east of the district there are some 1500 square miles of high hills and tablelands, forming geographically a portion of the Shan tableland. Here the fall to the plains averages 3000 to 4000 feet in a distance of 10 miles. This part of the district is well wooded and watered. The rainfall in the plain is scanty. The Maymyo subdivision has very fine plateaus of 3000 to 3600 feet in height. The highest peaks are between 4000 and 5000 feet above sea-level. The Irrawaddy, the Myit-ngè, and the Madaya are the chief rivers. The two last come from the Shan States, and are navigable for between 20 and 30 miles. There are many canals in the district, most of which have fallen greatly into disrepair, and the Aungbinle, Nanda, and Shwepyi lakes also supply water for cultivation. A systematic irrigation scheme is being carried out by Government. The Sagyin hills near Madaya are noted for their alabaster, and rubies are also found, but in no great quantity. There are 285½ square miles of forest reserve in the district, but there is little teak, and its quality is not great. The tracts are chiefly reserved for bamboos and the ordinary kinds of timber. The climate of the district is dry and healthy. During May and June and till August strong winds prevail. The thermometer rises to about 107° in the shade in the hot weather, and the minimum in the month of December is about 55°. The rainfall is small, the average being under 30 inches (23·77 in 1898–99). Epidemics are rare.

Mandalay Town stands on the left bank of the Irrawaddy, in 21° 58′ N. and 96° 8′ E. Its height above mean sea-level is 315 feet. Its area is—town, 18·51 square miles, cantonment, 6·14 square miles; total, 24·65. Mandalay is quite a modern town, and was built in 1856–57 by King Mindôn. It is now divided into the municipal area and the cantonment. The town covers an area of six miles from north to south and three from east to west, and has well-metalled roads lined with avenues of trees and regularly lighted and watered. The cantonment consists of the area inside the old city walls, and is now called Fort Dufferin. In the centre stands the palace, a group of wooden buildings, many of them highly carved and gilt, resting on a brick platform 900 feet by 500 feet, and 6 feet high. The greater part of it is now utilized for military and other offices. The garrison consists of one regiment of British infantry, one British mountain battery, and two regiments of native infantry. There are many fine pagodas and monastic buildings in the town. The population was 188,815 in 1891, and 182,498 in 1901, showing a decrease of 3·36 per cent. The population is very mixed. Besides Burmese there are Zerbadis (Burman Mahommedans, the offspring of a Mahommedan with a Burman wife), Mahommedans, Hindus, Suratis, Jews, Chinese, Shans, and Manipuris, called Kathe Kachins and Palaungs. The chief classes in the district in 1891 were Buddhists and Jains, 343,376; Mahommedans, 18,693; Hindus, 9613; and native Christians, 2230. Trains run from Mandalay to Rangoon, Myit Kyina, and up the Mandalay–Kunlong railway, now in part open. The steamers of the Irrawaddy Flotilla Company also ply in all directions. The chief public buildings are the court-house, the courts of the commissioner and judicial commissioner, telegraph office, post office and general hospital. There are twenty bazaars, the chief of which, the Zegyo, was burnt in 1897, but is rebuilt.

(J. G. Sc.)

Mandaue, a town on the eastern coast of the island of Cebú, Philippine Islands, in 10° 26′ N. Its climate is very hot, but healthful. The principal occupation of its inhabitants is rice-culture. Cebú-Visayan is the language. Population, 15,000.

Mandi, a native state of India, within the Punjab. It ranks as the most important of the hill states to which British influence extended in 1846 after the first Sikh war. The territory lies among the lower ranges of the Himalaya, between Kangra and Kulu.

Area, 1131 square miles; population (1881), 147,017; (1891), 166,923; (1901), 174,045; average density, 158 persons per square mile; estimated gross revenue, Rs.4,30,000; tribute, Rs.1,00,000; military force, 691 men. The chief, whose title is raja, is a Rajput of old family. Owing to infirmity, he is assisted in administration by a British official. Considerable sums have been expended on roads and bridges. An important product of the state is salt, which is mined in two places. The British Government manages the mines, and pays to the raja 13 annas on every maund of salt sold, which yielded him Rs.1,01,264 in 1897–98. The town of Mandi is on the left bank of the Beas, which is here a mountain torrent, 2991 feet above the sea. Population about 5000.

Mandla, a town and district of British India, in the Jubbulpore division of the Central Provinces. The town is on the river Nerbudda, 1787 feet above the sea. Population (1881), 4732; (1891), 5057.

The district of Mandla, among the Satpura hills, has an area of 5056 square miles; population (1881), 301,760; (1891), 339,373; (1901), 297,454, showing an increase of 12 per cent. between 1881 and 1891, and a decrease of 12·35 per cent. between 1891 and 1901; average density, 58 persons per square mile; land revenue, Rs.1,46,000, being little more than one anna per acre; cultivated area (1897–98), 446,923 acres, of which only 1078 were irrigated; number of police, 315; boys at school (1896–97), 2290, being 8·9 per cent. of the male population of school-going age, the lowest rate in the province; registered death-rate (1897), 96·24 per thousand, showing the results of the famine. The principal crops are rice, wheat, other food grains, pulse, and oil-seeds. There is a little manufacture of country cloth. There is no railway, and few roads. The district suffered most severely from the famine of 1896–97, partly owing to its inaccessibility, and partly from the shy habits of the aboriginal tribes. For an interesting account of the special difficulties of famine relief in Mandla see Appendix to the *Report on the Famine in the Central Provinces* (Nagpur, 1898). The famine of 1900 was scarcely felt.

Mandsaur, or Mandesur, a town of India, in the native state of Gwalior, on the Rajputana railway, 31 miles south of Neemuch. Population (1881), 22,596; (1891), 27,785. It gave its name to the treaty with Holkar, which concluded the Maratha–Pindari war in 1818. It is now a centre of the Malwa opium trade. In 1897–98 the exports of opium amounted to 4574 chests, paying a duty of Rs.25,32,400. It has a school and dispensary.

Mandvi, a seaport of India, in the native state of Cutch, within the Gujarat province of Bombay, 36 miles from Bhuj, and 182 miles by sea from Karachi. Population (1881), 35,980; (1891), 38,155. It is a weekly port of call for steamers of the British India line, though vessels of 70 tons cannot come any nearer than 500 yards. The pilots and sailors of Mandvi have a high reputation.

Manet, Édouard (1832–1883), French painter, who is regarded as the most important master of the Impressionist school (*q.v.*), was born in Paris in 1832. After spending some time under the tuition of the Abbé Poiloup, he entered the Collège Rollin, where his passion for drawing led him to neglect all his other lessons. His studies finished in 1848, he was placed on board the ship *Guadeloupe*, voyaging to Rio de Janeiro, and during the passage never ceased sketching everything he saw. On his return he first studied in Couture's studio (1851), where his independence often infuriated his master. For six years he was an intermittent visitor to the studio, constantly taking leave to travel, and going first to Cassel, Dresden, Vienna, and Munich, and afterwards to Florence, Rome, and Venice, where he made some stay. Some important drawings date from this period, and one picture, "A Nymph Surprised." Then, after imitating Couture, more or less, in "The Absinthe-drinker" (1866), and Courbet in "The Old Musician," he devoted himself almost exclusively to the study of the Spanish masters in the Louvre. A group was already gathering round him—Whistler, Legros, and Fantin-Latour haunted his studio in the Rue Guyot. His "Spaniard playing the Guitar," in the Salon of 1861, roused much animadversion. Delacroix alone defended Manet, but, this notwithstanding, his "Fifer of the Guard" and "Breakfast on the Grass" were refused by the jury. Then the "Exhibition of the Rejected" was opened, and round Manet a group was formed, including Bracquemond, Legros, Jongkind, Whistler, Harpignies, and Fantin-Latour, the writers Zola, Duranty, and Duret, and Astruc the sculptor. In 1863, when an amateur, M. Martinet, lent an exhibition-room to Manet, the painter exhibited fourteen pictures; and then, in 1864, contributed again to the Salon "The Angels at the Tomb" and "A Bull-fight." Of this picture he afterwards kept nothing but the toreador in the foreground, and it is now known as "The Dead Man." In 1865 he sent to the Salon "Christ reviled by the Soldiers" and the famous "Olympia," which was hailed with mockery and laughter. It represents a nude woman reclining on a couch, behind which is seen the head of a negress who carries a bunch of flowers. A black cat at her feet emphasizes the whiteness of the sheet on which the woman lies. This work is now in the Luxembourg, to which it was presented by a subscription started by Claude Monet (1890). It was hung in 1897 among the Caillebotte collection, which includes the "Balcony," and a study of a female head called "Angelina." This production, of a highly independent individuality, secured Manet's exclusion from the Salon of 1866, so that he determined to exhibit his pictures in a place apart during the Great Exhibition of 1867. In a large gallery in the Avenue de l'Alma, half of which was occupied by Courbet, he hung no fewer than fifty paintings, and among them, besides the works already mentioned, "The Child with a Sword," "A Matador," "Lola of Valence" (from a poem by Baudelaire), "A Monk at Prayer," "A Spanish Dance," "A Vase of Flowers," "Views of the Sea," "A Young Woman in a Spanish Costume" reclining, and many others now scattered through public and private galleries. Only one important picture was absent, "The Execution of the Emperor Maximilian"; its exhibition was prohibited by the authorities. From that time, in spite of the fierce hostility of some adversaries, Manet's energy and that of his supporters began to gain the day. His "Young Girl" (Salon of 1868) was justly appreciated, as well as the portrait of Lola; but the "Balcony" and the "Breakfast" (1869) were as severely handled as the "Olympia" had been. In 1870 he exhibited "The Music Lesson" and a portrait of Mlle E. Gonzales. Not long before the Franco-Prussian war, Manet, finding himself in the country with a friend, for the first time discovered the true value of open air to the effects of painting in his picture "The Garden," which gave rise to the "open air" or *plein air* school. After fighting as a gunner, he returned to his family in the Pyrenees, where he painted "The Battle of the *Kearsarge* and the *Alabama*." His pictures were now bought by collectors—MM. Duret, Gérard, Faure, Hecht, Ephrussi, and De Bellio. His "Bon Bock" (1873) created a *furore*. But in 1875, as in 1869, there was a fresh outburst of abuse, this time of the "Railroad," "Polichinelle," and "Argenteuil," and the jury excluded the artist, who for the second time arranged an exhibition in his studio. In 1877 his "Hamlet" was admitted to the Salon, but "Nana" was rejected. The following works were exhibited at the Salon of 1881: "In the Conservatory," "In a Boat," and the portraits of Rochefort and Proust; and the Cross of the Legion of Honour was conferred on the painter on 31st December in that year. Manet died in Paris on 30th April 1883. He left, besides his pictures, a number of pastels and engravings. He illustrated *Les Chats* by Champfleury, and Edgar Allan Poe's *Raven*.

Authorities.—Zola. *Manet.* Paris, 1867.—E. Bazire. *Manet.* Paris, 1884.—G. Geffroy. *La vie artistique.* 1893. (H. FR.)

Mangaldan, a town in the northern portion of the province of Pangasinan, Luzon, Philippine Islands, about two miles from the shore of the Gulf of Lingayen. Most of its inhabitants are engaged in rice-culture, for which the low and fertile fields in its vicinity are especially adapted. The principal language is Pangasinan; Ilocano is also spoken. Population, 16,000.

Mangaldas Nathoobhai, Sir (1832–1890), Seth or head of the Kapole Bania section of Bombay, a caste of Hindus well known for their thrift and keen commercial instincts, was born on the 15th of October 1832 of a family whose ancestors emigrated from the island of Diu to Bombay soon after the town came into British possession. His grandfather, Ramdas Manoredas, amassed a considerable fortune, which, owing to the premature death of his father, came into the sole possession of Mangaldas at the age of eleven. He had consequently to take charge of the business in early life, though he gave some of his time to English studies under a private tutor. He was married at sixteen to Sethanee Rukminbai, and had three sons and two daughters. After a happy wedded life of sixteen years, his wife died, when Mangaldas established a dispensary at Kalyan in her memory at a cost of about Rs.70,000, and built a special female ward in connexion with the David Sassoon Hospital in Poona at a heavy cost. As a merchant Mangaldas was upright and successful. In social matters he stood forth as a reformer, and to him the change to election from hereditary succession to the headship of the caste is due. In the turmoil caused by the attacks of Karsondas Mulji (*q.v.*) on the proceedings of the Vallabhacharyan maharajas, Mangaldas was his firm supporter. From early years he espoused the cause of education. In 1862 he founded a fellowship in Bombay University to allow graduates to spend some years in Europe. A bequest in his will of a great sum enabled the University to establish seven other similar scholarships. He took keen interest in learning, and in such institutions as the Asiatic and Geographical Societies. In 1866 he was nominated to the Legislative Council, and sat there till 1874, his industry and independent character being reflected in the debates. When failing health compelled him to retire, the local government expressed "the strong sense it entertained of his attention to business and devotion to the interests of the public." In 1867 he revived the Bombay Association, a native political body, over which he presided for a time. In 1872 he was made C.S.I., and in 1875 the dignity of Knight Bachelor was also conferred on him. On the 25th November 1875 the Prince of Wales, being then in Bombay, honoured with his presence the marriage ceremonies of two of Mangaldas's sons. Besides a large donation to the Irish Famine Fund, Sir Mangaldas is known to have expended Rs.75,00,000 on Indian charities. He died at Bombay on the 9th March 1890. (N. B. W.)

Mangalore, a seaport town of British India, administrative headquarters of the South Kanara district of Madras. Population (1881), 32,099; (1891), 40,922; (1901), 43,821; municipal income (1897–98), Rs.47,430. The harbour is formed by the backwater of two small rivers. Vessels ride in 24 to 30 feet of water, and load from and unload into lighters. In 1897–98 the total seaborn trade of the district was valued at Rs.1,77,04,146; 79 vessels entered and cleared for foreign trade, with an aggregate burthen of 11,897 tons. The chief exports are coffee, cocoa-nut products, timber, rice, and spices. There is a small shipbuilding industry. In 1897–98, 19 vessels were registered, of an aggregate burthen of 377 tons. It has a large Roman Catholic population, with a European bishop, several churches, a convent, and a college. It is the headquarters of the Basel Lutheran mission, which possesses one of the most active printing-presses in southern India, and has also successfully introduced the industries of weaving and the manufacture of tiles. Two colleges (Government and St Aloysius) had 164 students in 1896–97. Besides, there are four high schools, with 1016 pupils, as well as training schools for masters and mistresses. Five printing-presses issue three vernacular periodicals, and there are four libraries and literary associations.

Mang Lön, a state in the northern Shan states of Burma. It is the chief state of the Vü or Wa tribes, some of whom are head-hunters, and Mang Lön is the only one which in 1901 had submitted to the British Government. The state bestrides the Salween, and extends from about 21° 30′ to 23° N., or for 100 miles along the river. Its width varies greatly, from a mile or even less on either side of the river to perhaps 40 miles at its broadest part near Taküt, the capital. It is divided into East and West Mang Lön, the boundary being the Salween. There are no Vü or Wa in West Mang Lön. Shans form the chief population, but there are Palaungs, Chinese, and Yanglam, besides Lahu. The bulk of the population in East Mang Lön is Vü, but there are many Shans and Lahu. Both portions of the state are very hilly, and the only flat land is along the banks of streams in the valleys, and here the Shans are settled. There are, however, prosperous settlements and bazaars at Nawng Hkam and Möng Kao in West Mang Lön. The Vü of the eastern half have long since given up head-hunting, and many profess to be Buddhists. The population does not probably exceed 6000 or 7000, and about 5000 of these are Vü. The capital, Taküt, is perched on a hill-top 6000 feet above sea-level. The Sawbwa is a Vü, and has control over two sub-states, Mōt Hai to the north and Maw Hpa to the south.

Manila, the capital and chief port of the Philippine Islands, situated on the west coast of Luzon. Its cathedral is in 14° 35′ 31″ N. and 120° 58′ 03″ E. Included within the municipality are Manila proper, sometimes called "Old Manila" or "Intramuros," and the wards or districts known as Binondo, Tondo, Trozo or San José, Santa Cruz, Sampaloc, Quiapo, San Miguel, Ermita, Paco, and Arroceros. The important suburb of Malate, although continuous with Ermita, lies outside the city limits. Manila proper is enclosed by walls which were constructed about 1690 and are in a very perfect state of preservation. The surrounding moat is choked with vegetation. Bronze smooth-bore cannon for centuries crowned the ramparts, but have all been removed. Only a saluting battery remains. At the north-west angle of the wall is situated Fort Santiago, called the Black Hole of Manila, on account of the suffocation of a number of native prisoners in one of its foul dungeons during the revolt which began in 1896. Within the walls are a fine cathedral, the cloisters of the Augustinian, Franciscan, Dominican, and Recollect friars, and of the Jesuits, spacious churches belonging to each of these orders, the mission church of the Capuchins, and a convent and church belonging to the order of Santa Clara; the Ayuntamiento, a fine building formerly occupied by municipal officers, and under American rule the headquarters of the military government; the Intendencia, or treasury building; Saint Thomas University, San José Medical and Pharmaceutical College, and a school for primary and secondary instruction, known as San Juan de Letran, all in charge of the Dominicans; the Ateneo Municipal, a school for primary and secondary instruction, in charge of the Jesuits; a nautical school, in charge of an officer of the United States navy; the so-called College of Santa Isabel, which is a school for girls; a large civil hospital, known as San Juan de Dios; the official residence of the archbishop; the Audiencia, or Supreme Court building; a Government mint, capable of coining 12,000 large coins and 11,000 small coins in a day of six hours; large and well-appointed barracks; several poor hotels, and a considerable number of residences. Business within the walls is confined to a few small shops. The streets are so arranged that one side is always in the shade, and the more important of them are paved. The population of the Intramuros district is estimated at 14,000. Between its walls and the bay runs a fine drive, extending southwards from the monument erected in honour of Simon de Anda on the Passig river, to the Luneta, an oval promenade by the sea, which is crowded with carriages every fine evening. The batteries of heavy modern guns, which formerly lay in front of the city wall and at the southern end of the Luneta, were all removed in 1900. Immediately to the east of the Luneta is an open field, called Bagumbayan, the scene of public executions in Spanish days. To the southward of the Luneta and Bagumbayan are situated Ermita and Malate, the most desirable residential districts, on account of the sandy soil and the cool breezes from the bay. In Ermita there is a fine building belonging to the Jesuits, in which are thoroughly equipped meteorological, seismological, and magnetic observatories, and a normal school. Adjacent to this building is a fairly good astronomical observatory, also owned by the Jesuits.

Paco has a few fine residences, numerous native houses, and a large municipal cemetery, where the dead are buried in niches in two concentric circular walls. The remaining districts of the city are on the north side of the Passig river, which is spanned by three bridges, known respectively as the Bridge of Spain, the Suspension Bridge, and the Ayala Bridge. These structures are inadequate to meet the necessities of the public, and a fourth bridge was begun in 1900. The central span of the Ayala Bridge rests on an island, where are situated an insane asylum and an orphanage. At its southern end is the large new "Germinal" tobacco factory. At the northern end of the suspension bridge is a good cold-storage plant, opened to the public in 1900; at its southern end is the Government ice and cold-storage plant, which is capable of producing 60 tons of ice daily, and has 433,440 cubic feet of cold storage, divided between ten refrigerating rooms for meat, sufficient for 5000 carcases of beef, 7000 of sheep, and 107 tons of pork, and two rooms for game, fruits, and vegetables. Binondo, on the north bank of the Passig, is the most important district of the city and the centre of its great business interests. Its more important buildings are the post office, the custom-house, the Hotel de Oriente, and "La Insular" tobacco factory. All the large foreign commercial houses and the banks are in Binondo. Two of its streets, the Escolta and the Rosario, are the most important business streets of the city. In the former are situated the best shops, while the latter is lined from end to end with the shops of Chinese merchants. Tondo lies immediately to the north of Binondo. It is a native residential quarter, but has some unimportant shops and "La Rosa" tobacco factory. Many of the houses are of nipa. The greater part of this district was burned over by insurgents on the night of 22nd February 1899, and the most important market in the city was destroyed. In its place has arisen a very large modern fireproof structure of iron and cement. Tondo church is one of the most conspicuous buildings in the city. In this district are the only cotton-mills in the Philippines and the Manila station of the only railway. Santa Cruz and Quiapo are occupied chiefly by the residences and shops of the middle class. There is a large tobacco factory in the latter district. One of the finest churches in the city is situated in San Sebastian; also a large distillery. In San Miguel many of the finest residences are to be found, including the palace of the governor-general. The only brewery in the Philippines is in this district. In Trozo are situated a large gaol and penitentiary and the leper hospital, San Lazaro.

The ground on which Manila is built is flat, and at no point rises more than 15 feet above water-level at high tide. As a consequence, whole districts are often flooded during typhoons. Esteros, or creeks, connecting with the river, ramify through the city in various directions, and when improved will afford a valuable means of transportation. They have always been used to a considerable extent by small native craft. Only a few of the principal streets are paved, but many others have been macadamized since the American occupation. The city has good waterworks, and is well lighted by electricity. Under American administration it has been thoroughly cleaned; two crematories for the destruction of garbage have been erected, and a third begun. No rapid transit facilities exist. There are two short tram lines, on which small cars are drawn by native ponies, the service thus afforded being wretchedly inadequate. There are six theatres, in two of which European companies sometimes appear. With the exception of the churches, no high buildings have been constructed in Manila, on account of danger from earthquakes. The better residences have a lower story of stone or brick and a second story of wood, with roof of tiles or corrugated iron. Window-glass is little used, its place being taken by thin squares of oyster shell set in sliding wooden frames. Lower-story windows are barred with iron. Small steamers engaged in the coasting trade can enter the Passig river, but large vessels are forced to lie in the bay, which is too large to afford them any protection. Under Spanish administration, millions of dollars were expended on two breakwaters designed to cut off an extensive basin from the bay immediately south of the mouth of the river. The completion of these breakwaters and the dredging of the basin thus formed will give excellent harbour facilities. A million dollars in gold were appropriated by the United States in September 1900 for the carrying out of this work. The relative commercial importance of Manila, as compared with other ports of entry in the Philippines, is set forth in the following table of entrances and clearances of vessels for the year ending 30th June 1900:—

Foreign Trade.

	Entered.	Tonnage.	Cleared.	Tonnage.
Manila . . .	412	541,158	348	511,522
All other entry ports .	154	125,155	153	130,453

Coastwise Trade.

	Entered.	Tonnage.	Cleared.	Tonnage.
Manila . .	1280	241,193	1310	255,004
All other entry ports .	2066	217,882	2356	225,998

The volume of trade is increasing rapidly. The largest receipts from customs under Spanish sovereignty were $5,888,330 in 1897. For the fiscal year ending 30th June 1899 the receipts were $9,770,431. The population of Manila is estimated at 250,000 souls, of whom about 50,000 are Chinese. (D. C. W.)

See also Philippines and Spanish-American War.

Maning, Frederick Edward (1812–1883), New Zealand judge and author, son of Frederick Maning, of Johnville, county Dublin, was born on the 5th of July 1812. His father emigrated to Tasmania in the ship

Ardent in 1824, and took up a grant of land there. Young Maning served in the fatuous expedition which attempted to drive in the Tasmanian blacks by sweeping with an unbroken line of armed men across the island. Soon afterwards he decided to try the life of a trader among the wild tribes of New Zealand, and, landing in the beautiful inlet of Hokianga in 1833, took up his abode among the Ngapuhi. With them the tall Irish lad—he stood 6 feet 3 inches—full of daring and good-humour, and as fond of fun as of fighting, quickly became a prime favourite, was adopted into the tribe, married a chief's daughter, and became a "Pakeha-Maori" (foreigner turned Maori). With the profits of his trading he bought a farm of 200 acres on the Hokianga, for which, unlike most white adventurers of the time, he paid full value. When New Zealand was peacefully annexed in 1840, Maning's advice to the Maori was against the arrangement, but from the moment of annexation he became a loyal friend to the Government, and in the wars of 1845–46 his influence was exerted with effect in the settlers' favour. Again, in 1860, he persuaded the Ngapuhi to volunteer to put down the insurrection in Taranaki. Finally, at the end of 1865, he entered the public service as a judge of the Native Lands Court, where his unequalled knowledge of the Maori language, customs, traditions, and prejudices was of solid value. In this office he served until 1881, when ill-health drove him to resign, and, two years later, to seek surgical aid in London, where, however, he died of cancer on the 25th of July 1883. At his wish, his body was taken back to New Zealand and buried there. A bust of him is placed in the public library at Auckland. Maning is chiefly remembered as the author of two short books, *Old New Zealand*, and *History of the War in the North of New Zealand against the Chief Heké*. Both books were reprinted in London in 1876 and 1884, with an introduction by the earl of Pembroke. The former, written in an easy, gossipy style, embodies recollections of the days of tribal warfare, trading in heads, cannibalism, and anarchy, and as a sketch of Maori life and manners it is unrivalled, and must remain so. The story of Heké's war is dramatically put into the mouth of a Maori chief who took part in it, and shows an extraordinary grasp of the native mind and point of view. Maning, who was an excellent *raconteur*, and had a well-stored memory, wrote little else; but some of his judgments in native land disputes are of real historical interest, containing much more than dry technical expositions of tribal land titles. (W. P. R.)

Manipur, a native state on the north-east frontier of India, in political subordination to the chief commissioner of Assam. Estimated area, 8000 square miles; estimated population (1881), 221,070; (1901), 283,957. The records of the census of 1891 were destroyed in the disturbances of that year.

The country is called Kasse or Kathe by the Burmese, and the proper name of the capital is Imphal. Disputed successions have always been a cause of trouble. The raja, Chandra Kirti Singh, died in 1886, and was succeeded by his eldest son, Sura Chandra Singh, who appointed his next brother, Kula Chandra Dhuya Singh, *jubraj* or heir apparent. In 1890 another brother, the *senaputti* (or commander-in-chief) Takendrajal Singh, dethroned the raja, and installed the *jubraj* as regent, the ex-raja returning to Calcutta. At the end of February 1891 the chief commissioner of Assam (Mr Quinton) marched to Manipur with 400 Gurkhas, in order to settle the question of succession. His purpose was to recognize the new ruler, but to remove the *senaputti*. After some futile negotiations with a view to the holding of a durbar, Mr Quinton sent an ultimatum requiring the surrender of the *senaputti*, by the hands of the political resident, Mr F. Grimwood; but no result followed. An attempt was then made to arrest the *senaputti*, but after some sharp fighting, in which Lieut. Brackenbury was killed, he escaped; and the Manipuris then attacked the British residency with an overwhelming force. Mr Quinton was compelled to ask for a parley, and he, Colonel Skene, Mr Grimwood, Mr Cossins, and Lieut. Simpson, unarmed, went to the fort to negotiate. They were all there treacherously murdered, and when the news arrived the Gurkhas retreated (25th March) to Cachar, Mrs Grimwood and the wounded being with them. This led to a military expedition, which did not encounter much resistance. The various columns, converging on Manipur, found it deserted; and the regent, *senaputti*, and others were captured during May. After a formal trial, the *senaputti* and one of the generals of the rebellion were hanged, and the regent transported to the Andaman Islands. But it was decided to preserve the existence of the state, and a child of the ruling family, named Chura Chand, of the age of five, was nominated raja. He was sent to be educated in the Mayo College at Ajmere. Meanwhile the administration was conducted under British supervision. In 1897–98 the total revenue was Rs.3,46,709, of which Rs.1,94,348 was derived from land and Rs.97,640 from house tax. The expenditure included Rs.75,810 for public works, Rs.58,901 for police, and a tribute of Rs.50,000 imposed after the rebellion. The police force numbers 338 men. A Gurkha battalion is permanently stationed at Manipur. There are ten schools, with 594 pupils. Three roads are maintained—to Cachar, to Kohima in the Naga Hills, and to Tammu on the Burma frontier. In 1897–98 the total imports were valued at Rs.1,65,000, chiefly piece goods, mineral oil, betel-nuts, and dried fish. The exports were Rs.93,000, chiefly cattle, tea-seed, and rice. During five years the rainfall averaged 80·55 inches.

See GRIMWOOD, MRS ETHEL ST CLAIR. *My Three Years in Manipur.* London, 1891.—*Manipur:* compiled from the columns of the *Pioneer*, Allahabad, 1891.

Manisa, the ancient *Magnesia ad Sipylum*, the chief town of the Saru-khán sanjak of the Aidin (Smyrna) viláyet of Asia Minor, situated in the valley of the Gediz Chai, Hermus, at the foot of Mount Sipylus, and connected by railway with Smyrna, Ala-shehr, and Konia. Manisa is an important commercial centre, and contains interesting buildings dating from the times of the Seljúk and early Osmanli sultans. It is the seat of a flourishing American mission. The population amounts to 38,000 (Moslems 22,000, Christians 15,000, Jews 1000). In 1204 Manisa was occupied by John Ducas, who, when he became emperor, made it the Byzantine seat of government. In 1313 the town was taken by Saru Khán, and in 1398 it submitted to the Osmanli sultan Bayezid I. In 1419 it was the scene of an insurrection, which was crushed by Prince Murad, whose residence in the town as Murad II., after twice abdicating the throne, is one of the most romantic stories in Turkish history. In the 17th century Manisa became the residence of the powerful Dere Bey family, Kara Osman Oghlu.

Manistee, a city of Michigan, U.S.A., capital of Manistee county, on the shore of Lake Michigan, at the mouth of Manistee river, on the west side of the Lower Peninsula, at an altitude of 600 feet. It is irregularly laid out, is divided into seven wards, and has sewerage and water works (the Holly pumping system). It is entered by three railways—the Pere Marquette, the Manistee and Grand Rapids, and the Manistee and North-Eastern. It has extensive salt manufactures from salt springs, and large lumber mills, including saw, shingle, and planing mills. It has also an extensive lake commerce. Population (1890), 12,812; (1900), 14,260, of whom 4966 were foreign-born.

Manitoba, a province of Canada, bounded on the S. by the United States, on the W. by Assiniboia and Saskatchewan, on the N. by Saskatchewan and Keewatin, and on the E. by Keewatin and Ontario. (For the geology, fauna, and flora, see CANADA.) Cold winters and warm summers, with a clear, bracing atmosphere, and small rainfall and snowfall, are the salient features of the climate. The table on the next page gives the normal temperature and precipitation at a number of places:—

	Elevation. Feet.	Average Temperature.		Average Precipitation. Inches.
		Summer.	Winter.	
Winnipeg	764	59·7°	1·5°	20·67
Portage la Prairie	854	61·7°	0·7°	18·84
Brandon	1194	58·4°	0·2°	16·20
Russell	1830	55·8°	−2·4°	18·04
Fort Ellice	850	57·9°	3·5°	16·07
Sourisford	1464	63·8°	2·4°	13·57

Area and Population.—The area covers 73,956 square miles, of which 64,066 are land and 9890 water. The population in 1871 was 18,995; 1881, 62,260; 1891, 152,506; and 1901, 254,947 (138,332 males, 116,615 females). The principal cities and towns are: Winnipeg (42,340), Brandon (5380), Portage la Prairie (3901), St Boniface (2019), West Selkirk (2188), and Morden (1522). In 1901, 49,102 families inhabited 48,415 houses, and the proportion of the urban population to the rural was 27·5 to 72·5. In 1891 there were 34,574 persons engaged in agricultural pursuits; in domestic and personal service, 6712; manufactures and mechanical industries, 5267; professional, 2096; trade and transportation, 6335; non-productive, 932. Classified according to place of birth, the principal nationalities were as follows in 1901:—Canada, 180,853; England, 20,392; Scotland, 8099; Ireland, 4537; other British possessions, 490; Germany, 2291; Iceland, 5403; Austria, 11,570; Russia and Poland, 8854; Scandinavia, 1772; United States, 6922; other countries, 4028. In 1901 the Indians numbered 5827; half-breeds, 10,372.

Government.—The province is under a lieutenant-governor, appointed for a term of five years, with an executive council of five members, responsible to the local legislature, which consists of forty members. It is represented in the Dominion Parliament by four senators and seven members in the House of Commons.

Religion.—Classified according to religion, the various denominations were, in 1901, as follows:—Presbyterians, 65,310; Episcopalians, 44,874; Methodists, 49,909; Roman Catholics, 35,622; Baptists, 9098; Lutherans, 16,473; Mennonites, 15,222; Greek Catholics, 7898; other denominations, 9903; not specified, 638.

Education.—The dual system of education, established in 1871, was abolished in 1890, and the administrative machinery consolidated under one superintendent and a council of public instruction. This act was amended in 1897 to meet the wishes of the Roman Catholic minority, but separate schools were not re-established, nor was the council divided into denominational committees. In 1901 there were 1352 schools with 1669 teachers (618 males and 1151 females); the school population was 63,881, and the number of pupils registered was 51,888; the average attendance was 27,550. There are collegiate institutes for more advanced education at Winnipeg, Brandon, and Portage la Prairie, with a total of 1094 pupils enrolled. There is also a normal school at Winnipeg for the training of teachers. The total receipts during the year were $1,310,805, Government grant, $113,452, and municipal taxes, $553,359; expenditure, $1,272,617; assets, $2,440,804; liabilities, $1,455,420; value of schools, lands, &c., $1,650,338. There are four denominational colleges and a university for higher education.

Finance.—The principal sources of revenue are the annual subsidy from the Dominion Government, fees for registration of land titles, liquor licences, sale of lands, &c. The chief items of revenue and expenditure for 1901 were as follows:—

Revenue.		Expenditure.	
Dominion Govt. subsidy	$483,687	Civil government	$174,748
Land titles office, fees	85,495	Administration of justice	89,252
Provincial lands, sales	120,566	Education	158,998
Asylums, &c.	54,427	Agriculture and immigration	127,459
Interest	86,733	Public works	36,944
Miscellaneous	227,745	Miscellaneous	400,850
	$1,008,653		$988,251

The gross debt on 31st December 1901 was $10,240,488; total assets, $9,390,384. The Dominion Government debt allowance was $3,707,196; other assets, not including buildings and land, were $5,683,188.

Agriculture.—The principal crops are wheat, oats, and barley. The manufacture of butter and cheese is rapidly increasing in importance. The number of beef cattle exported is also increasing, and mixed farming is becoming more general. The following table gives statistics of field crops for the years specified:—

	1883.	1890.	1894.	1901.
	Bushels.	Bushels.	Bushels.	Bushels.
Wheat	5,686,355	14,665,769	17,172,883	50,502,085
Oats	9,478,965	9,513,443	11,907,854	27,796,588
Barley	1,898,430	2,069,415	2,981,716	6,536,155
Flax	No statistics collected.		366,000	266,420
Rye	,,	,,	59,924	62,261
Peas	,,	,,	18,434	16,349
Potatoes	,,	,,	2,035,336	4,797,433
Other roots	,,	,,	1,841,942	2,925,362

In 1901 there were 2,952,002 acres under crop as follows:—wheat, 2,011,835; oats, 689,951; barley, 191,009; flax, rye, and peas, 24,564; potatoes, 24,429; and other roots, 10,214; average yield of wheat, 25·1 bushels per acre. An experimental farm of 670 acres is supported by the Dominion Government at Brandon; the local government maintains a dairy school, and makes special efforts to encourage the manufacture of cheese and butter.

Fisheries.—The fisheries are all fresh-water, principally whitefish, pickerel, and pike. The total value of the catch—including the adjoining portions of the North-West Territories—in 1900 was $718,159; the value of vessels, nets, &c., was $300,980; of exports, $211,748.

Manufactures.—The following table shows the growth of the manufacturing interests:—

	1881.	1891.
Number of establishments	344	1031
Number of employés	1921	4403
Capital invested	$1,383,331	$5,684,237
Wages paid	$755,507	$1,905,981
Cost of raw material	$1,924,821	$5,688,151
Finished product	$3,413,026	$10,155,182

Commerce.—The table below gives statistics of exports, &c., for the period 1874 to 1901, at intervals of five years:—

Year.	Exports.	Imports.	Duty.
1874	$797,762	$1,797,033	$67,472
1879	512,899	1,140,871	274,235
1884	722,730	3,734,573	664,038
1889	782,606	2,191,083	549,458
1894	1,864,964	2,353,768	602,466
1899	2,092,988	5,695,715	1,140,052
1901	1,084,992	5,396,189	1,016,973

Railways.—In 1901 there were 2141 miles of railway in the province, which constituted 11·6 per cent. of the railway mileage of Canada. The principal railways are the Canadian Pacific, Northern Pacific and Manitoba, and Canadian Northern. There was 1 mile of track to 20·9 square miles of area of the province.

(J. Wh*.)

Manitoba, a lake of the province of the same name, Canada, situated between 50° 11′ and 51° 48′ N. and 97° 56′ and 99° 35′ W. It has an area of 1711 square miles, a length of shore-line of 535 miles, and is at an altitude of 810 feet above the sea. It has a total length of 119 miles, a maximum width of 29 miles, discharge of 14,833 cubic feet per second, and an average depth of 12 feet. The Waterhen river, which carries the discharge of Lake Winnipegosis, is the only considerable stream entering the lake. It was discovered by Chevalier de la Verendrye in 1739.

Manitowoc, a city of Wisconsin, U.S.A., capital of Manitowoc county, on the western shore of Lake Michigan, at an altitude of 592 feet. It has a regular plan, is divided into seven wards, and has three railways, the Chicago and North-Western, the Pere Marquette, and the Wisconsin Central. It has a large lake commerce and some manufactures. Population (1890), 7710; (1900), 11,786, of whom 2998 were foreign-born. The death-rate in 1900 was 14·3.

Mankato, a city of Minnesota, U.S.A., capital of Blue Earth county, on the Minnesota river, at its southward bend, in the southern part of the state, at an altitude of 778 feet. It is irregularly laid out, with six wards, and has four railways—the Chicago and North-

Western, the Chicago, Milwaukee and St Paul, the Chicago, St Paul, Minneapolis and Omaha, and the Chicago Great Western. It is in a rich farming region, and has considerable trade and manufactures. Population (1890), 8838; (1900), 10,599, of whom 2578 were foreign-born and 7 were negroes.

Mannheim, a town of Germany, grand-duchy of Baden, on the Rhine, at the confluence of the Neckar, 39 miles by rail north of Carlsruhe. It stands at the head of effective navigation on the Rhine, and is not only the largest port on the upper course of that stream, but the principal emporium for south Germany of such commodities as cereals, coals, petroleum, timber, sugar, and tobacco, with an added large trade in hops, wine, and other south German produce. Owing to the rapid increase in the traffic, it was found necessary to make a new harbour on the other side of the Neckar, which was opened in 1898. The total volume of the trade, by river and rail combined, increased from about 1½ million tons in 1875 to very nearly 9 million tons in 1898. The traffic by the Rhine increased from 6648 vessels of 6,604,800 tons arrived and cleared in 1895 to 12,935 vessels of 9,737,200 tons in 1899; and to this must be added the traffic up and down the Neckar, which also increased from 6243 vessels of 908,300 tons in 1895 to 5556 vessels of 946,100 tons in 1899. In addition to the large harbour opened in 1875, a new commercial harbour was built on the opposite side of the Neckar in the last years of the 19th century, and a third harbour made at Rheinau, three miles above the town. The last was entered by 3408 vessels of 573,130 tons in 1900, as compared with 2404 vessels of 388,621 tons in the preceding year. Mannheim is also the seat of very active and extensive industries, producing especially flour, ironware, machinery, agricultural implements, iron ships, chemicals, oils, cigars, wood-pulp and cellulose articles, carpets, sugar, soap, cement, aniline dyes, furniture, shoes, vehicles, clothing, books, beer, and spirits; it has also several saw and planing mills. A new bridge was thrown across the Neckar in 1890–91. The town has been adorned with a monument to the Emperor William I. (1894) and two fountains (1898) in the palace courtyard, a monument of the war of 1870–71 (1896), and a monument to Bismarck (1900) near the principal railway station. Population (1885), 61,273; (1890), 79,058; (1900), 140,384.

Manning, Henry Edward (1808–1892), English Roman Catholic cardinal, was born at Totteridge, Hertfordshire, on the 15th July 1808,[1] being the third and youngest son of William Manning, a West Indian merchant, who was a director of the Bank of England and governor, 1812–13, and who sat in Parliament for some thirty years, representing in the Tory interest Plympton Earle, Lymington, Evesham, and Penryn consecutively. His mother, Mary, daughter of Henry Leroy Hunter, of Beech Hill, Reading, was of a family said to be of French extraction. Manning's boyhood was mainly spent at Coombe Bank, Sunridge, Kent, where he had for companions Charles and Christopher Wordsworth, afterwards bishops of St Andrews and of Lincoln. He was educated at Harrow, 1822–27, Dr Butler being then the headmaster, but obtained no distinction beyond being in the cricket eleven in 1825. He matriculated at Balliol College, Oxford, in 1827, and soon made his mark as a debater at the Union, where Gladstone succeeded him as president in 1830. At this date he was ambitious of a political career, but his father, having sustained severe losses in business, found himself no longer in a position to leave his sons free of any necessity to earn their living, and in these circumstances Manning, having graduated in first-class honours in 1830, obtained the year following, through Viscount Goderich, a post as supernumerary clerk in the Colonial Office. This, however, he resigned in 1832, his thoughts having been turned towards a clerical career under Evangelical influences, which affected him deeply throughout life. Returning to Oxford, he was elected a Fellow of Merton College, and was ordained; and in 1833 he was presented to the rectory of Lavington with Graffham in Sussex by Mrs Sargent, whose granddaughter, Caroline, he married on 7th November of that year, the ceremony being performed by the bride's brother-in-law, Samuel Wilberforce, afterwards bishop of Oxford and of Winchester. Manning's married life was of brief duration. His young and beautiful wife was of a consumptive family, and died childless (24th July 1837). The lasting sadness that thus early overshadowed him tended to facilitate his acceptance of the austere teaching of the Oxford Tracts; and though he was never an acknowledged disciple of Newman's, it was due to the latter's influence that from this date his theology assumed an increasingly High Church character, and his printed sermon on the "Rule of Faith" was taken as a public profession of his alliance with the Tractarians. In 1838 he took a leading part in the Church education movement, by which diocesan boards were established throughout the country; and he wrote an open letter to his bishop in criticism of the recent appointment of the ecclesiastical commission. In December of that year he paid his first visit to Rome, and called on Dr Wiseman in company with Mr Gladstone. In January 1841 Shuttleworth, bishop of Chichester, appointed him archdeacon, whereupon he began a personal visitation of each parish within his district, completing the task in 1843. In 1842 he published a treatise on *The Unity of the Church*, and his reputation as an eloquent and earnest preacher being by this time considerable, he was in the same year appointed select preacher by his University, thus being called upon to fill from time to time the pulpit which Newman, as vicar of St Mary's, was just ceasing to occupy. Four volumes of his sermons appeared between the years 1842 and 1850, and these had reached the 7th, 4th, 3rd, and 2nd editions respectively in 1850, but were not afterwards reprinted. In 1844 his portrait was painted by Richmond, and the same year he published a volume of University sermons, in which, however, was not included the one on the Gunpowder Plot. This sermon had much annoyed Newman and his more advanced disciples, but it was a proof that at that date Manning was loyal to the Church of England as Protestant. Newman's secession in 1845 placed Manning in a position of greater responsibility, as one of the High Church leaders, along with Pusey and Keble and Marriott; but it was with Gladstone and James Hope (afterwards Hope-Scott) that he was at this time most closely associated. In the spring of 1847 he was seriously ill, and that autumn and the following winter he spent abroad, chiefly in Rome, where he saw Newman "wearing the Oratorian habit and dead to the world." He had public and private audiences with the Pope on 9th April and 11th May 1848, but recorded next to nothing in his diary concerning them, though numerous other entries show an eager interest in everything connected with the Roman Church, and private papers also indicate that he recognized at this time grave defects in the Church of England and a mysterious attractiveness in Roman Catholicism, going so far as to question whether he might not one day be a Roman Catholic himself. Returning to England, he protested, but with moderation, against the appointment of Hampden as bishop of Hereford, and continued to take an active part in the religious education controversy. Through the influence of Samuel Wilberforce, he was offered the post of sub-almoner to Queen Victoria, always recognized as a stepping-stone to the episcopal bench, and his refusal of it was honourably consonant with all else in his career as an Anglican dignitary, in which he united pastoral diligence with an asceticism that was, at any rate in those days, quite exceptional. In 1850 the decision of the Privy Council, that the bishop of Exeter was bound to institute the Rev. G. C. Gorham to the benefice of Brampford Speke in spite of the latter's acknowledged disbelief in the doctrine of baptismal regeneration, brought to a crisis the position within the Church of England of those who believed in that Church as a legitimate part of the infallible *Ecclesia docens.* Manning made it clear that he regarded the matter as vital, though he did not act on this conviction until no hope remained of the decision being set aside or practically annulled by joint action of the bishops. In July he addressed to his bishop an open letter on "The Appellate Jurisdiction of the Crown in Matters Spiritual," and he also took part in a meeting in London which protested against the decision. In the autumn of this year (1850) was the great popular outcry against the "Papal aggression" (see **Wiseman**), and Manning, feeling himself unable to take part in this protest, resigned, early in December, his benefice and his archdeaconry; and writing to Mr Hope-Scott, who a little later became a Roman Catholic with him, stated his conviction that the alternative was "either Rome or licence of thought and will." He was received into the Roman Catholic Church by Father Brownbill, S.J., at the church in Farm Street, on Passion Sunday, 6th April 1851. On the following Sunday he was confirmed and received to communion by Cardinal Wiseman, who also, within ten weeks of his reception, ordained him priest. Manning thereupon proceeded to Rome to pursue his theological studies, residing at the college known as the "Academy for Noble Ecclesiastics," and attending lectures by Perrone and Passaglia among others. The Pope frequently received him in private audience, and in 1854 conferred on him the degree of D.D. During his visits to England he was at the disposal of Cardinal Wiseman, who through him, at the time of the Crimean war, was enabled to obtain from the Government the concession that for the future Roman Catholic army chaplains should not be regarded as part of the staff of the Protestant chaplain-general. In 1857 the Pope, *proprio motu*, appointed him provost (or head of the chapter) of Westminster, and the same year he took up his residence in Bayswater as superior of a community known as the "Oblates of St Charles," an association of secular priests on the same lines as the institute of the Oratory, but with this difference, that they are by their constitution at the beck and call of the bishop in whose diocese they live. The community was thus of the greatest service to Cardinal Wiseman, whose right-hand man Manning thenceforward became. During the eight years of his life at Bayswater he was most active in all the duties of the priesthood, preaching, hearing confessions, and receiving converts; and he was notably zealous to promote in England all that was specially Roman and papal, thus giving offence to old-fashioned Catholics, both clerical and lay, many of whom were largely influenced by Gallican ideas, and had with difficulty accepted the restoration of the hierarchy in 1850. In 1860 he delivered a course of lectures on the Pope's temporal power, at that date seriously threatened, and shortly afterwards he was appointed a papal "Domestic Prelate," thus becoming a "Monsignor," to be addressed as "Right Reverend." He was now generally recognized as the able and effective leader of the Ultramontane party among English Roman Catholics, acting always, however, in subordination to Cardinal Wiseman; and on the latter's death (15th February 1865) it was felt that, if Manning should succeed to the vacant archbishopric, the triumph of Ultramontanism would be secured. Such a consummation not being desired by the Westminster chapter, they submitted to the Pope three names, and Manning's was not one of them. Great efforts were made to secure the succession for the titular archbishop Errington, who at one time had been Wiseman's coadjutor with that right reserved to him, but who had been ousted from that position by the Pope acting under Manning's influence. In such circumstances Pius IX. could hardly do otherwise than ignore Errington's nomination, as he also ignored the nomination of Clifford, bishop of Clifton, and of Grant, bishop of Southwark; and, by what he humorously described as "the Lord's own *coup d'état*," he appointed Manning to the archiepiscopal see. Consecrated at the pro-cathedral at Moorfields (since destroyed) by Dr Ullathorne, bishop of Birmingham (8th June 1865), and enthroned there (6th November), after receiving the *pallium* in Rome, Manning began his work as archbishop by devoting himself especially to the religious education of the poor and to the establishment of Catholic industrial and reformatory schools. He steadily opposed whatever might encourage the admission of Catholics to the national universities, and so put his foot down on Newman's project to open a branch house of the Oratory at Oxford with himself as superior. He made an unsuccessful and costly effort to establish a Catholic university at Kensington, and he also made provision for a diocesan seminary of strictly ecclesiastical type. Jealous of the exclusive claims of the Roman Church, he procured a further condemnation at Rome of the "Association for the Promotion of the Unity of Christendom," which advocated prayers for the accomplishment of a kind of federal union between the Roman, Greek, and Anglican Churches, and in a pastoral letter he insisted on the heretical assumption implied in such an undertaking. He also worked for the

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[1] Purcell's assertion that the year of his birth was 1807 rests on no trustworthy evidence.

Cardinal Manning.
(*From a photograph by Elliott and Fry, London.*)

due recognition of the dignity of the secular or pastoral clergy, whose position seemed to be threatened by the growing ascendancy of the regulars, and especially of the Jesuits, whom, as a practically distinct organization within the Church, he steadily opposed. In addition to his diocesan synods, he presided in 1873 over the fourth provincial synod of Westminster, which legislated on "acatholic" universities, church music, mixed marriages, and the order of a priest's household, having previously taken part, as theologian, in the provincial synods of 1853 and 1859, with a hand in the preparation of their decrees. But it was chiefly through his strenuous advocacy of the policy of defining papal infallibility at the Vatican council (1869–70) that Manning's name obtained world-wide renown. In this he was instant in season and out of season. He brought to Rome a petition in its favour from his chapter at Westminster, and during the progress of the council he laboured incessantly to overcome the opposition of the "inopportunists," his belief in the importance of the definition for the welfare of the Church being as deep as it was sincere. And he never ceased to regard it as one of the chief privileges of his life that he had been able to take an active part in securing the definition, and in having heard with his own ears that doctrine proclaimed as a part of divine revelation. In 1875 he published a reply to Gladstone's attack on the Vatican decrees; and on 15th March in that year he was created cardinal, with the title of SS. Andrew and Gregory on the Cœlian. He was present at the death of Pius IX. (7th February 1878); and in the subsequent conclave, while some Italian cardinals were prepared to vote for his election to fill the vacant chair, he himself supported Cardinal Pecci, afterwards known as Leo XIII. With him, however, Manning found less sympathy than with his predecessor, though Manning's advocacy of the claims of labour attracted Leo's attention, and influenced the encyclical which he issued on the subject. After the Vatican council, and more especially after the death of Pius IX., Manning devoted his attention mainly to social questions, and with these his name was popularly associated during the last fifteen years of his life. From 1872 onwards he was a strict teetotaller, not touching alcohol even as a medicine, and there was some murmuring among his clergy that his teaching on this subject verged on heresy. But his example and his zeal profoundly influenced for good the Irish poor forming the majority of his flock; and the "League of the Cross" which he founded, and which held annual demonstrations at the Crystal Palace, numbered nearly 30,000 members in London alone in 1874. He sat on two royal commissions, the one on the housing of the working classes (1884), and the other on primary education (1886); and in each case the report showed evident marks of his influence, which his fellow-commissioners recognized as that of a wise and competent social reformer. In the cause of labour he was active for many years, and in 1872 he set an example to the clergy of all the churches by taking a prominent part in a meeting held in Exeter Hall on behalf of the newly-established Agricultural Labourers' Union, Joseph Arch and Charles Bradlaugh being among those who sat with him on the platform. In later years his strenuous advocacy of the claims of the working classes, and his declaration that "every man has a right to work or to bread," led to his being denounced as a Socialist. That he was such he denied more than once (Lemire, *Le Cardinal Manning et son Action Sociale*, Paris, 1893, p. 210), nor was he ever a Socialist in principle; but he favoured some of the methods of Socialism, because they alone seemed to him practically to meet the case of that pressing poverty which appealed to his heart. He took a leading part in the settlement of the dockers' strike in the autumn of 1889, and his patient and effectual action on this and on similar occasions secured for him the esteem and affection of great numbers of working men, so that his death on 14th January 1892, and his funeral a week later, were the occasion for a remarkable demonstration of popular veneration. The Roman Catholic cathedral at Westminster is his joint memorial with his predecessor, Cardinal Wiseman.

Whatever may have been the value of Manning's services to the Roman Catholic Church in England in bringing it, as he did, up to a high level of what in earlier years was commonly denounced as Ultramontanism, it is certain that by his social action, as well as by the earnestness and holiness of his life, he greatly advanced in the minds of his countrymen generally their estimate of the character and value of Catholicism. Pre-eminently he was a devout ecclesiastic, a "great priest"; and his sermons, both Anglican and Catholic, are marked by fervour and dignity, by a conviction of his own authoritative mission as preacher, and by an eloquent insistence on considerations such as warm the heart and bend the will rather than on such as force the intellect to assent. But many of his instincts were those of a statesman, a diplomatist, a man of the world, even of a business man; and herein lay, at least in part, the secret of his influence and success. Intellectually he did not stand in the front rank. He was neither a philosopher nor a literary genius. Among his many publications, written, it is only fair to admit, amidst the urgent pressure of practical work, there is barely a page or even a sentence that bears the stamp of immortality. But within a somewhat narrower field he worked with patience, industry, and self-denying zeal; his ambition, which seemed to many personal, was rather the outcome of his devotion to the cause of the Church; and in the later years of his life especially he showed that he loved righteousness and hated iniquity, and that he realized as clearly as any one that the service of God was incomplete without the service of man.

The publication in 1896 of Manning's *Life*, by Purcell, was the occasion for some controversy on the ethics of biography. Edward Purcell was an obscure, inaccurate, and small-minded Catholic journalist, to whom Manning, late in life, had entrusted, rather by way of charitable bequest, his private diaries and other confidential papers. It thus came to pass that in Purcell's voluminous biography much that was obviously never intended for the public eye was, perhaps inadvertently, printed, together with a good deal of ungenerous comment. The facts disclosed which mainly attracted attention were—(1) that Manning, while yet formally an Anglican, and while publicly and privately dissuading others from joining the Roman Catholic Church, was yet within a little convinced that it was his own duty and destiny to take that step himself; (2) that he was continually intriguing at the back-stairs of the Vatican for the furtherance of his own views as to what was desirable in matters ecclesiastical; (3) that his relations with Newman were very unfriendly; and (4) that, while for the most part he exhibited towards his own clergy a frigid and masterful demeanour, he held privately very cordial relations with men of diverse religions or of no theological beliefs at all. And certainly Manning does betray in these autobiographical fragments an unheroic sensitiveness to the verdict of posterity on his career. But independent critics (among whom may specially be named M. François de Pressensé) held that Manning came well through the ordeal, and that Purcell's *Life* has great value as an unintentionally frank revelation of character.

(A. W. Hu.)

Manœuvres, Military.—Manœuvres may be defined as the higher training for war of troops of all arms in large bodies, and have been carried out in most countries ever since the first formation of standing armies. In England no manœuvres or camps of exercise appear to have been held till the beginning of the 19th century, when Sir John Moore trained the famous Light Brigade at the camp of Shorncliffe. In France, however, under Louis XIV., large camps of instruction were frequently held, the earliest recorded being that of 18,000 troops at Compiègne in 1666; and these were continued at intervals under his successor. At these French camps much time was devoted to ceremonial, and the manœuvres performed were of an elementary description. Still their effect upon the training of the army for war was far-reaching, and bore fruit in the numerous wars in the first half of the 18th century. Other countries followed suit, but it was reserved for Frederick the Great to inaugurate a system of real manœuvres, and to develop on the training-ground the system of tactics which bore such good fruit in his various campaigns. The numbers of troops assembled were large; for example, at Spandau in 1753, when 36,000 men carried out manœuvres for twelve days. The king laid the greatest stress on these exercises, and took immense pains to turn to account the experience gained in his campaigns. Great secrecy was observed, and before the Seven Years' War no stranger was allowed to be present. The result of all this careful training was shown in the Seven Years' War, and after it the Prussian manœuvres gained a reputation which they have maintained to this day. But with the passing away of the great king they became more and more pedantic, and the fatal results were shown in 1806. After the Napoleonic wars, yearly manœuvres became the custom in every large Continental army. Great Britain alone thought she could dispense with them, perhaps because of the constant practical training her troops and officers received in the various Indian and colonial wars; and it was not till 1853 that, by the advice of the Prince Consort, a body of troops were gathered together for a camp of exercise on Chobham Common, and that eventually a standing camp of exercise was evolved out of the temporary camp formed during the Crimean War at Aldershot.

Most Continental armies have, since the great successes of the Germans in 1870, copied more or less their system of military training; hence it is appropriate to consider their methods first. The whole training of the army is based on a yearly programme of gradual progression, from the joining of the recruits in October to the training by squads, companies, battalions, and regiments, the latter finishing their field training about the middle of August, when the manœuvre period begins. First of all, the brigades go through five working days of drills on flat ground, to get them under the hand of their commanders and prepare them for manœuvres. Then follow ten working days of manœuvres in new and varied ground, of which four are "brigade," four "divisional," and two "corps" manœuvres, in each case the unit named being divided into two portions of all arms, which manœuvre against one another. Each year two or more army corps carry out manœuvres before the Emperor, working against one another, the largest body ever assembled having been four corps, 117,000 men, near Homburg in 1897. The chief feature of the German manœuvres is the free hand allowed to leaders of sides. Of course, for reasons of supply and transport, it is necessary to keep the troops within a certain area, but the general and special ideas are so framed that, while retaining their own initiative, the leaders of sides have to give such orders as will suit the arrangements made by the director of manœuvres for supply. The faculty of quartering troops on private individuals to any extent, and the fact of the troops being provided with portable tent equipment, give great latitude to the German leaders in their choice of quarters for troops, and so increase the similitude of manœuvres to war. The Austrian and Italian manœuvres are a close copy of the German, but those of the French present the peculiarity of a certain amount of prearrangement, especially at grand manœuvres, when it is frequently laid down beforehand which side is to be victorious. Thus a series of pictures of war is presented, but the manœuvres are hardly a test of the skill of the rival leaders. In Russia the climatic and social conditions, and the distribution of the army, necessitate a quite peculiar system. The troops leave their barracks and move into standing camps generally in May, and in these for about three months their training up to that in battalions is carried out on the drill ground. Camps of mixed units are then formed for a month, and from them, but always over the same ground, the manœuvres of regiments, brigades, and divisions are performed. Then follow the so-called mobile manœuvres, which last for ten days or a fortnight. At some of these large masses are assembled, as in Volhinia in 1890, when 194 battalions, 140 squadrons, and 82 batteries were engaged. Of all European manœuvres these are perhaps the nearest approach to war, for the sides start a great distance apart, and ample time is allowed for cavalry reconnaissance. Besides, the Russian soldier does not require elaborate arrangements for supply; hence the director is not so tied down by consideration of this matter as in other armies.

In England the military authorities have long been hampered in the organization of manœuvres by the necessity of carrying them out on very limited portions of Government land or on areas lent as a favour by, or hired from, private individuals. There has been no want of recognition by the military authorities of the necessity for, and value of, manœuvres, and the training at the camps of instruction has been supplemented as far as possible by small manœuvres on such portions of country as could be made available. But, with the exception of spasmodic efforts in 1871 and 1872, it was not until 1897 that the Government allowed itself to be convinced by its military advisers, and passed a Military Manœuvres Act, by which certain districts could be "proclaimed" for purposes of manœuvres, and troops in consequence could traverse all ground. In 1898 the first manœuvres under this Act were held in Wilts and Dorset, and were intended to be repeated at fixed intervals in future years. In addition, every effort was made to add to the existing permanent training grounds for troops, and ground was acquired on Salisbury Plain with the intention of developing it into a second Aldershot. But the training on those well known grounds, excellent as it is in itself as a preparation, is not "manœuvres," and never can do away with the necessity for them, with a more or less free hand given to the leaders over fresh country.

Much misconception prevails as to the nature and limitation of the military instruction to be imparted at manœuvres. Manœuvres are a school for the leaders, in a less degree for the led, and consequently the minor details of instruction must be completed, and the troops fully trained as units, before they can take part in them with advantage. The time during which large bodies of troops can be kept together for manœuvres is too short, and the expense too great, to justify time being spent on exercises which might as well be carried out in the ordinary stations or at the great training camps. Therefore it may be laid down as a principle that manœuvres, properly so-called, should be begun with units not smaller than a brigade of infantry on each side, with a due proportion of the other arms attached. It is useful if these can precede the manœuvres of larger bodies, as the training is then progressive and the result more satisfactory.

The choice of ground is of great importance. Its extent should be proportionate to the force to be employed and the nature of the instruction to be imparted. It should not be too hilly nor yet too flat, but both descriptions should be judiciously combined; and regard must be had to the water supply, and the road and railway net for the convenience of the supply service. Once the ground has been selected, the general and special ideas must be so framed that the troops are thereby confined to the chosen ground without seeming to tie the hands of the leaders of sides. It is of great advantage if the same idea can be maintained throughout each series of operations, as thereby the interest of all concerned and the likeness to actual warfare are increased; and, if possible, the "state of war" should be continuous also. Within the limits of the special idea, the utmost latitude should be left to leaders; but if the orders of one or both sides seem to render a collision unlikely, the director should so modify the special idea as to compel one or other to re-cast his orders in such a way that contact is brought about. Such interference will scarcely be necessary after the first issues of orders in each series. In war the number of marching days vastly outnumbers those of fighting, but in manœuvres this must not be allowed; tactical instruction is what is desired, and a manœuvre day in which none is imparted is not fully utilized. It is not necessary that all the troops should be engaged, but at least the advanced bodies must come into contact, and the rest must carry out marches as on active service. Each action should be fought to its end, "Cease firing" being sounded when the crisis has been reached; and on a decision being given by the director, one side should retire and the fight be broken off in a proper military manner. The troops should place outposts each day, and act in all respects as if on active service.

The quartering and supply of troops are the chief difficulties in the arrangement of manœuvres, and afford ample opportunity for the practising of the officers and departments responsible for these matters. In England, where in peace it is not possible to billet troops on private individuals, quartering must be replaced by encampments or bivouacs, and the selection of ground for them affords invaluable practice. If possible, their position should be selected to conform to the military situation; but if it is found necessary, for reasons of water or food supply, to withdraw troops to positions other than such as they would occupy in real warfare, time should be allowed them on the following day to regain the positions they would otherwise have occupied. It is next to impossible, for various reasons, financial and other, to organize the food supply in manœuvres as it would be in war. Sufficient transport *cadres* cannot be kept up in peace, and consequently recourse must be had to hired transport, which cannot be treated as a military body. Again, food cannot be requisitioned, and local purchase at the time cannot be trusted to; so depôts of supplies must be formed beforehand in the manœuvres area, which more or less tie the hands of the supply service. Still, with a judicious choice of the points at which these are formed, much may be done to approximate to service conditions, and the more nearly these are realized the more instructive for the supply will the manœuvres become.

Finally, a word must be said as to the umpire staff, which represents the bullets. The most careful selection of officers for this important duty is necessary, and they must have sufficient authority and be in sufficient number to make their influence everywhere felt. Their principal object should be to come to a decision quickly, so as to prevent the occurrence of unreal situations; and by constant intercommunication they must ensure uniformity in their decisions, and so maintain continuity of the action all over the manœuvres battlefield. (J. M. GR.)

Manor.—It will be most convenient to describe a typical English manor in its best known period, the 13th century, and to indicate briefly the modifications of the type which varying conditions may produce. Topographically such a manor consisted partly of the houses of the inhabitants more or less closely clustered together, and surrounded by the arable land divided into large fields, two or three in number. Each of these fields was divided again into shots or furlongs, and each of the shots was broken up into cultivated strips a pole wide, each containing an acre, separated by narrow balks of turf. There were also certain meadows for supplying hay; and beyond the cultivated land lay the wood and waste of the manor. Portions of arable or meadow land might be found apart from the organization of the remainder; the lord of the manor might have a park, and each householder a garden, but the land of the manor was the open fields, the meadows, and the wastes or common. The condition of the inhabitants of such a manor is as complex as its geography.

Rights of lord and tenants.

At the head of the society came the lord of the manor, with his hall, court, or manor-house, and the land immediately about it, and his demesne both in the fields and in the meadow land. The arable demesne consisted of certain of the acre strips lying scattered over the various furlongs; his meadow was a portion assigned to him each year by the custom of the manor. He had also rights over the surrounding waste paramount to those enjoyed by the other inhabitants. Part of his demesne land would be granted out to free tenants to hold at a rent or by military or other service; part would be in the lord's own hands, and cultivated by him. Each part so granted out will carry with it a share in the meadow land and in the profits of the waste. These rights of the free tenants over the waste limited the lord's power over it. He could not by enclosure diminish their interest in it. The statute of Merton (20 Henry III.) and the second statute of Westminster (Edward I.) marked the utmost limit of enclosure allowed in the 13th century. Below the lord and the free tenants came the villeins, natives, bondmen, or holders of *virgates* or yard-lands, each holding a house, a fixed number of acre strips, a share of the meadow and of the profits of the waste. The number of strips so held was usually about thirty; but virgates of fifteen acres or even eighty are not unknown. In any one manor, however, the holdings of all the villeins were equal.

Rights of villeins.

Normally the holder of a virgate was unfree; he had no rights in the eye of the law against his lord, who was protected from all suits by the *exceptio villenagii;* he could not without leave quit the manor, and could be reclaimed by process of law if he did; the strict contention of law deprived him of all right to hold property; and in many cases he was subject to certain degrading incidents, such as *merchet*, a payment due to the lord upon the marriage of a daughter, which was regarded as a special mark of unfree condition. But there are certain limitations to be made: firstly, all these incidents of tenure, even merchet, might not effect the personal status of the tenant; he might still be free, though holding by an unfree tenure; secondly, even if unfree, he was not exposed to the arbitrary will of his lord, but was protected by the custom of the manor as interpreted by the Manor Court. Moreover, he was not a slave; he was not bought and sold apart from his holding. The hardship of his condition lay in the services due from him. As a rule a villein paid for his holding in money, in labour, and in kind. In money he paid, firstly, a small fixed rent called rent of assize; and, secondly, dues under various names, partly in lieu of services commuted into money payments, and partly for the privileges and profits enjoyed by him on the waste of the manor. In labour he paid more heavily. Week by week he had to come with his own plough and oxen to plough the lord's demesne; when ploughing was done he had to harrow, to reap the crops, to thresh and carry them, or do whatever might be required of him, until his allotted number of days' labour in the year was done. Beyond this his lord might request of him extra days in harvest or other seasons of emergency, and these requests could not be denied. Further, all the carriage of the manor was provided by the villeins, even to places as much as a hundred miles away from the manor. The mending of the ploughs, hedging, ditching, sheep-shearing, and other miscellaneous work, also fell upon him, and it is sometimes hard to see what time remained to him to work upon his own holding. In kind he usually rendered honey, eggs, chickens, and perhaps a ploughshare, but these payments were almost always small in value.

Cotters.

Another class of inhabitants remains to be mentioned—the cotters. These are the poor of the manor, who hold a cottage and garden, or perhaps one acre or half an acre in the fields. They were unfree in condition, and in most manors their services were modelled upon those of the villeins. From their ranks were usually drawn the shepherd of the manor, the bee-keeper, and other minor officials of the manor.

A complicated organization necessarily involves administrators. Just as the services of the tenants and even their names vary from manor to manor, so does the nature of the staff. Highest in rank came the steward; he was attached to no manor in particular, but controlled a group, travelling from one to another to take accounts, to hold the courts, and generally represent the lord.

Staff.

Under him are the officers of the several manors. First came the bailiff or beadle, the representative of the lord in the manor; his duty was to collect the rents and services, to gather in the lord's crops, and account for the receipts and expenditure of the manor. Closely connected with him was the "messor" or reaper; in many cases, indeed, "reaper" seems to have been only another name for the bailiff. But the villeins were not without their own officer, the provost or reeve. His duty was to arrange the distribution of the services due from the tenants, and, as their representative, to assist the bailiff in the management of the manor. Sometimes the same man appears to have united both offices, and we find the reeve accounting to the lord for the issues of the manor. To these important officials may be added a number of smaller ones, the shepherd, the swine-herd, the bee-keeper, the cow-herd, the ploughman, and so on, mostly selected from the cotters, and occupying their small holdings by the services expressed in their titles. The number varies with the constitution and needs of each estate, and they are often replaced by hired labour.

Manor Court.

The most complicated structure in the system is the Manor Court. The complication is, indeed, partly the work of lawyers interpreting institutions they did not understand by formulæ not adapted to describe them. But beyond this there remain the facts that the court was the meeting-point of the lord and the tenants both free and unfree, that any question touching on the power and constitution of the court was bound to affect the interests of the lord and the tenants, and that there was no external power capable of settling such questions as did arise. Amid this maze a few clear lines can be laid down. In the first place, so far as the 13th century goes, all the discussion that has collected about the terms court-leet, court-baron, and court-customary may be put aside; it relates to questions which in the 13th century were only just emerging. The Manor Court at that date exercised its criminal, civil, or manorial jurisdiction as one court; its names may differ, the parties before it may be free or unfree, but the court is the same. Its president was the lord's steward; the bailiff was the lord's representative and the public prosecutor; and the tenants of the manor, both free and unfree, attended at the court and gave judgment in the cases brought before it. To modern ears the constitution sounds unfamiliar. The president of the court settled the procedure of the court, carried it out, and gave the final sentence, but over the law of the court he had no power. All that is comprised in the word "judgment" was settled by the body of tenants present at the court. This attendance was, indeed, compulsory, and absence subjected to a fine any tenant owing and refusing the service known as "suit of court." It may be asked who in these courts settled questions of fact. The answer must be that disputed questions of fact could only be settled in one way, by ordeal; and that in most manorial courts the method employed was the wager of law. The business of the court may be divided into criminal, manorial, and civil. Its powers under the first head depended on the franchises enjoyed by the lord in the particular manor; for the most part only petty offences were triable, such as small thefts, breaches of the assize of bread and ale, assaults, and the like; except under special conditions, the justice of great offences remained in the king. But offences against the custom of the manor, such as bad ploughing, improper taking of wood from the lord's woods, and the like, were of course the staple criminal business of the court. Under the head of manorial business the court dealt with the choice of the manorial officers, and had some power of making regulations for the management of the manor; but its most important function was the recording of the surrenders and admittances of the villein tenants. Into the history and meaning of this form of land transfer it is not necessary to enter here. But it must be noted that the conveyance of a villein's holding was effected by the vendor surrendering his land to the lord, who thereupon admitted the purchaser to the holding. The same procedure was employed in all cases of transfer of land, and the transaction was regularly recorded upon the rolls of the court among the records of all the other business transacted there. Finally, the court dealt with all suits as to land within the manor, questions of dower and inheritance, and with civil suits not connected with land. But it need hardly be said that in an ordinary rural manor very few of these would occur.

It will be clear on consideration that the Manor Court as here described consisted of conflicting elements of very different origin and history. Founded partly on express grants of franchises, partly on the inherent right of a feudal lord to hold a court for his free tenants, partly on the obscure community traceable among the unfree inhabitants of the manor, it is incapable of strict legal definition. All these elements, moreover, contain in themselves reasons for the decay which gradually came over the system. The history of the decay of the manorial jurisdictions in England has not yet been written. On the one hand were the king's courts, with new and improved processes of law; on the other hand the gradual disintegration which marks the history of the manor during the 14th and 15th centuries. The criminal jurisdiction was the first to disappear, and was closely followed by the civil jurisdiction over the free tenants; and in modern times all that is left is the jurisdiction over the customary tenants and their holdings, and that in an attenuated form.

A few words must be given to the legal theories of the 15th century on the Manor Court. It would seem to have become the law that to the existence of the manor two courts were necessary—a court customary for customary tenants, and a court baron for free tenants. In the court customary the lord's steward is the judge; in the court baron the freeholders are the judges. If the freeholders in the manor diminish to less than two in number the court baron cannot be held, and the manor perishes. Nor can it be revived by the grant of new freehold tenures, because under the statute of *Quia Emptores* such new freeholders would hold not of the lord of the manor, but of his lord. The customary tenants and the court customary may survive, but the manor is only a reputed manor. Of the 13th century all this is untrue, but even at that date the existence of free tenants was in a measure essential to the existence of the Manor Court. If there were none the jurisdiction of the court over free tenants of course collapsed; but in addition to this the lord also lost his power of exercising the highest criminal franchises, even if he otherwise possessed them; he could, for instance, no longer hang a murderer on his own gallows. Perhaps it may be said that to the exercise of the feudal power and of the royal franchises the presence of free tenants was necessary. But it is clear that no such condition was necessary to the existence of the manor.

Apart from the change in the court of the manor, the most important thread in its history is the process which converted the villein into the copyholder. Here again the subject is imperfectly explored, and part of it is still subject to controversy. In the strict view of contemporary lawyers the holding of the villein tenant of the 13th century was at the will of the lord, and the king's courts of law would not protect him in his possession. If, however, the villein were a tenant on the king's ancient demesne his condition was improved. The writs of *monstraverunt* and the little writ of right close protected him from the improper exaction of services and from ejection by the lord. But in ordinary manors there was no such immunity. That ejection was common cannot be believed, but it was legally possible; and it was not until the well-known decision of Danby, C.J., and Bryan, C.J., in 7 Edw. IV., that the courts of law would entertain an action of trespass brought against his lord by a customary tenant. From that date the courts both of law and equity begin to intervene; and the records of the Courts of Star Chamber and Requests show that in the Tudor period equitable suits brought by tenants against their lords are not infrequent. Side by side with the alteration in the legal condition of the manor there went on an economic change. The labour rents and other services slowly disappeared, and were replaced by money payments. The field divisions gave way before enclosures, effected sometimes by the lords and sometimes by the tenants. Change in legal and agricultural practice went on side by side, and finally the manor ceased to be an important social form, and became only a peculiar form of land tenure and the abode of antiquarian curiosities.

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Manresa, a town of Spain, in the province of Barcelona, 30 miles from Barcelona. Its population, 22,685 in 1887, increased to 25,931 in 1897, with the development of the local industries—manufactures of woollen, cotton, and linen goods, ribbons, hats, leather, soap, paper, chemicals, alcohol, and flour, and iron-founding—which have thriven since 1892. A new town has sprung up on the right bank of the river Cardonero. A canal 18 miles long connects with the river Llobregat.

Mans, Le, chief town of department Sarthe, and headquarters of the 4th Army Corps, France, 133 miles south-west of Paris by the railway to Brest. The suburb of Pré on the right bank of the river covers an area three times that of the old town, and in its westward extension embraces the former town of St Pavin-des-Champs. Steam tramways connect the town with several outlying places. Population (1881), 43,178; (1901), 63,272.

Mansfield, a municipal borough (1891) in the Mansfield parliamentary division of Nottinghamshire, England, in Sherwood Forest, on the river Mann or Maun, 17 miles north by west of Nottingham by rail. A free library has been opened. The manufacture of boots is important. Population (1891), 15,925; (1901), 21,441.

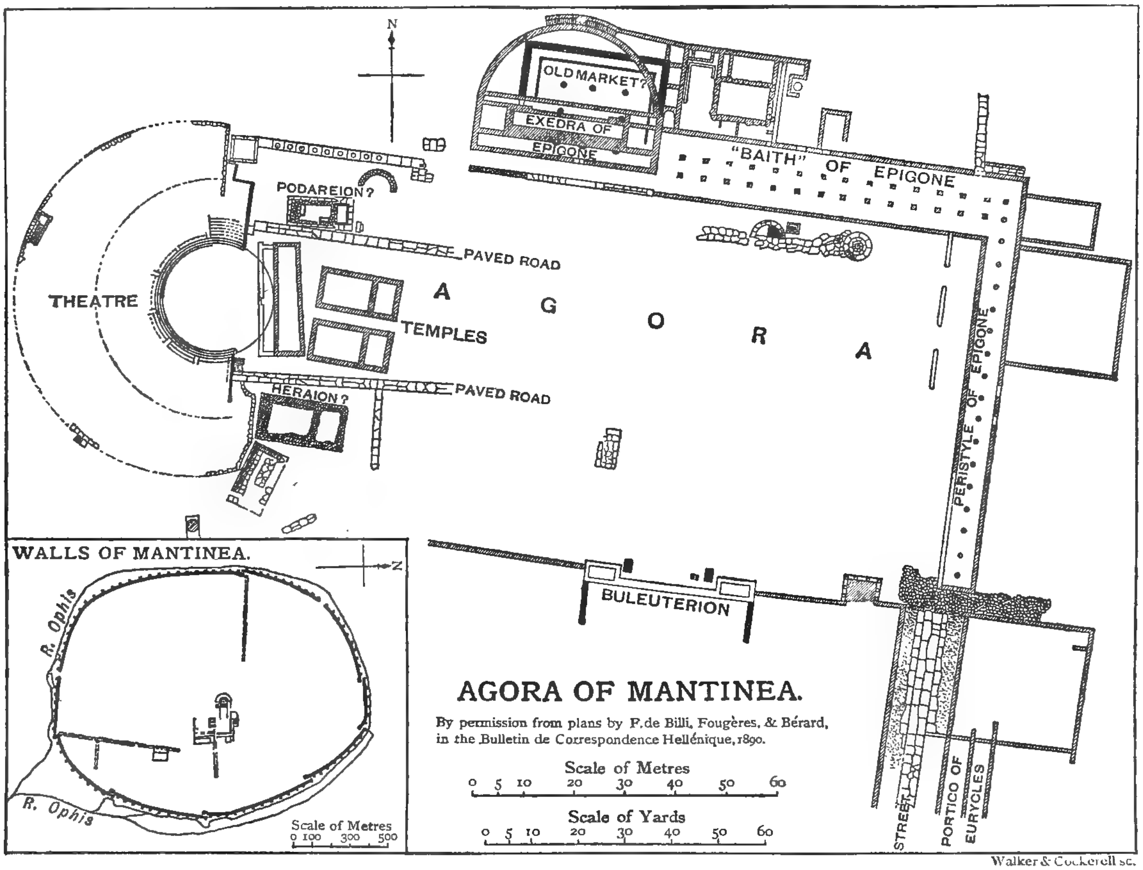
Mansfield, a city of Ohio, U.S.A., capital of Richland county, in the northern part of the state, at an altitude of 1151 feet. It has a regular plan, is divided into ten wards, and has three railways, the Baltimore and Ohio, the Erie, and the Pennsylvania. It has extensive manufactures, especially of agricultural implements. Population (1890), 13,473; (1900), 17,640, of whom 1781 were foreign-born, and 123 were negroes.

Mansurah, a town of Lower Egypt, capital of the province of Dakahlieh, near the west side of Lake Menzaleh, an important railway station on the Cairo–Damietta line, with population (1900) 27,000. It dates from 1221, and was famous in the wars of the Crusaders, Louis IX. having been imprisoned here after his disastrous retreat and capture in 1250. It has several cotton-ginning, cotton, linen, and sail-cloth factories.

Mantes, chief town of arrondissement and railway station, department of Seine-et-Oise, France, 27 miles north-west of Versailles, on the left bank of the Seine, which separates it from Limay. The 15th-century auditorium of the cathedral church of Notre Dame is now the seat of the civil tribunal, the Hôtel de Ville dates from the 17th century, and there is a beautiful fountain of the Renaissance period. The principal manufactures are musical instruments and artificial incubators. Poultry-rearing is an important industry, and there is commerce in cereals, fruits, and vegetables. In 1087 William the Conqueror, when besieging the town, met with the accident which cost him his life. The castle, demolished in 1721, was visited by several sovereigns. Population (1881), 5847; (1901), 8034.

Manteuffel, Edwin Hans Karl von, Freiherr (1809–1885), Prussian field-marshal, son of the president of the Superior Court of Magdeburg, was born at Dresden on the 24th February 1809. He was brought up with his cousin, Otto von Manteuffel (1805–1882), the Prussian statesman, entered the Dragoon Guards at Berlin in 1827, and was promoted lieutenant in 1828. After attending the War Academy for two years, and serving successively as adjutant to General von Müffling and to Prince Albert of Prussia, he was promoted captain in 1843 and major in 1848, when he became aide-de-camp to Frederick William IV., whose confidence he enjoyed. Promoted lieutenant-colonel in 1852, and colonel to command the 5th Uhlans in 1853, he was sent on important diplomatic missions to Vienna and St Petersburg. In 1857 he became major-general and chief of the military cabinet, an invidious post, in which he had to deal with the personal merits of the officers of the army, and promote or weed them out as he thought desirable. He gave hearty support to the Prince Regent's plans for the reorganization of the army. In 1861 he was violently attacked in a pamphlet by Herr Twesten, a Liberal leader, whom he wounded in a duel. He served as lieutenant-general in the Danish war of 1864, and at its conclusion was appointed civil and military governor of Schleswig. He took the initiative in the Austrian war of 1866 by ejecting the Austrians from Holstein, commanded a division under Vogel von Falkenstein in the Hanoverian campaign, and succeeded him, in July, in command of the army of the Main. His successful operations ended with the occupation of Würzburg, and he then went on a diplomatic mission to St Petersburg, where he was *persona grata*, and succeeded in gaining Russia's assent to the new position in North Germany. He was appointed to the command of the ninth army corps in 1866, and transferred to the first corps in 1868. In the Franco-German war of 1870–71 he commanded the first army corps under Steinmetz, distinguishing himself in the fighting round Metz—in the battles of Colombey and Neuilly, and especially in the repulse of Bazaine at Noisseville. He succeeded Steinmetz in October in the command of the first army, won the battle of Amiens against General Farre, and occupied Rouen, but was less fortunate against Faidherbe at Pont Noyelles and Bapaume. In January 1871 he commanded the newly-formed army of the south, which he led, in spite of hard frost, through the Côte d'Or and over the plateau of Langres, cut off Bourbaki's army of the east (80,000 men), and, after the action of Pontarlier, compelled it to cross the Swiss frontier, where it was disarmed. The southern army was disbanded, and Manteuffel commanded, first, the second army, and, from June 1871, the army of occupation left in France until 1873, showing great tact in a difficult position. He was made a field-marshal for his services, went on several diplomatic missions, was for a time governor of Berlin, and in 1879 was appointed governor-general of Alsace-Lorraine; and this office he held until his death at Karlsbad, Bohemia, on 17th June 1885. (r. h. v.)

Mantinea.—The site of Mantinea was excavated by M. Fougères, of the French School at Athens, in 1888. The plan of the agora and adjacent buildings has been recovered, and the walls have been completely investigated. The town was situated in an unusual position for a Greek city, on a flat marshy plain, and its walls form a regular ellipse about 4 kilometres in circumference. When the town was first formed in 470 b.c. by the "synœcism" of the neighbouring villages, the river Ophis flowed through the midst of it, and the Spartan king Agesipolis dammed it up below the town and so flooded out the Mantineans and sapped their walls, which were of unbaked brick. Accordingly, when the city was rebuilt in 370 b.c., the river Ophis was divided into two branches, which between them encircled the walls; and the walls themselves were constructed to a height of about 3 to 6 feet of stone, the rest being of unbaked brick. These are the walls of which the remains are still extant. There are towers about every 80 feet; and the gates are so arranged that the passage inwards usually runs from right to left, and so an attacking force would have to expose its right or shieldless side. Within the walls the most conspicuous landmark is the theatre, which, unlike the majority of Greek theatres, consists entirely of an artificial mound standing up from the level plain. Only about a quarter of its original height remains. Its *scena* is of rather irregular shape, and borders one of the narrow ends of the agora. Close to it are the foundations of several temples, one of them sacred to the hero Podaros. The agora is of unsymmetrical form; its sides are bordered by porticoes, interrupted by streets, like the primitive agora of Elis as described by Pausanias, and unlike the regular agoras of Ionic type. Most of these porticoes were of Roman period—the finest of them were erected, as we learn from inscriptions, by a lady named Epigone; one, which faced south, had a double colonnade, and was called the Βαίτη; close to it was a large exedra. The foundations of a square market hall of earlier date were found beneath this. On the opposite side of the agora was an extensive Buleuterion or senate-house. Traces remain of paved roads both within the agora and leading out of it; but the whole site is now a deserted and feverish swamp. The site is interesting for comparison with Megalopolis; the nature of its plan seems to imply that its main features must survive from the earlier "synœcism," a century before the time of Epaminondas.



AGORA OF MANTINEA.

By permission from plans by P. de Billi, Fougères, & Bérard, in the Bulletin de Correspondence Hellénique, 1890.

Walker & Cockerell sc.

See *Bulletin de Corréspondance Hellénique*, 1890, G. Fougères; *Mantinée et l'Arcadie orientale*, Paris, 1898. (E. GR.)

Mantua (Italian *Mantova*), a fortified town and capital of the province of Mantua, Italy, on the river Mincio, 71 miles east-south-east of Milan by rail. It possesses an antiquarian museum, which ranks as one of the most important in North Italy. The educational institutions embrace also a chemical laboratory, a botanical garden, and a mineralogical museum. Amongst the industries are iron-works, tanneries, printing, furriery, doll-making, and flour-mills. The champion of Tyrolese liberty, Andreas Hofer, was shot at Mantua by the French in 1810. Population (1881), 28,048; (1901), 29,160.

Manures. See AGRICULTURE.

Manzanares, a town of Spain, in the province of Ciudad Real. Its population was 9700 in 1887, and 10,447 in 1897. An ancient castle dates from the 13th century. Manzanares is the seat of an active trade in wine, aniseed, saffron, wheat, and alcohol; local industries include manufactures of chalk, bricks, and soap, and distilling.

Manzanillo, an important commercial city of Cuba, situated at the mouth of the Rio Cauto in Santiago province. It exports large quantities of sugar, hides, tobacco, and bees-wax. The last battle of the Spanish-American war was in progress here when the protocol of peace was signed. Population (1899), 14,464.

Map.—Since 1875 topographical surveys have gained much in accuracy, and thus, whilst formerly it was deemed sufficient if a topographical map answered the requirements of the soldier, such a map, before it can be accepted as satisfactory at the present day, must equally meet the interests of the civil engineer and of the man of science. Various processes for the production of maps have been perfected and are extensively employed. Photography, including heliogravure, has in this manner largely superseded the more tedious processes of engraving on copper or stone, and the time thus gained may fairly be considered to compensate for a less attractive appearance when printed. Topographical maps of the more perfect type are still exceedingly rare. As a rule, maps of this kind are based upon the cadastral plans adjusted to a trigonometrical survey, the additional details required for military purposes being filled in with the aid of plane-table and tacheometer. The contours (Isopyreæ) are merely sketched in, and are dependent upon a limited number of altitudes determined with more or less accuracy. Where cadastral plans are not available recourse is had to the plane-table, and occasionally, but only in mountainous districts, to photographic surveying or photogrammetry.

United Kingdom.

Topographical Surveys.—The year 1855 marks an entirely new departure in the work of the Ordnance Survey of the United Kingdom, for in that year it was determined that cities and towns should thenceforth be surveyed on a scale of 1 : 500 (10-foot scale) or 1 : 1056 (5-foot scale), agricultural districts on a scale of 1 : 2500 (25-inch scale), and that the old 6-inch scale (1 : 10,560) should be retained for uncultivated hilly districts and for a general map of the whole kingdom. The contour lines inserted upon these large scale maps or plans are based upon instrumental measurement. As regards Great Britain, the whole of this survey was completed and published in 1895. This rapid publication was rendered possible by substituting zincography for the tedious process of copper engraving. It is upon maps of this minute accuracy that the popular "New Series" of the 1-inch scale (1 : 63,360) is based. This 1-inch map, in outline, including contours at intervals of 50 or 100 feet, was completed for the whole of the United Kingdom in 1896, and many sheets of it have since been thoroughly revised and brought up to date. In the second edition the hills are hachured in black. There are also in progress an edition with the hills in brown hachures and contours, another printed in five colours, and a third showing distinctly the boundaries of all civil parishes. The department has likewise had in hand since 1898 a 4-mile map (1 : 253,440) of Great Britain, which is mainly intended to show five classes of roads. Taken as a whole, these Ordnance maps may fairly challenge comparison with the maps of any other country in the world; and if the hill hachures of the 1-inch maps are not quite satisfactory, this deficiency is in a large measure compensated for by the presence of absolutely trustworthy contours (see *Report on the Ordnance Survey*, annually presented to Parliament, and Colonel Sir J. Farquharson in the *Geographical Journal*, xv., 1900).

France.

The famous *Carte de France de l'État-major* (1 : 80,000) was completed in 273 sheets in 1880. It has served as a basis for a *Carte de la France* on a scale of 1 : 100,000, published by the Service Vicinal, and of a general map on a scale of 1 : 200,000, in 81 sheets, which is printed in colours and was completed in 1888. Meanwhile the question of producing an entirely new map of France was referred to a committee, presided over by General De la Noir, in 1897; and if the recommendations of this committee are carried out, the result will be a map equal in accuracy to the British Ordnance Survey map, and possibly superior to it in attractiveness. There is to be an entirely new cadastral survey, connected with the triangulation of France. These cadastral plans are to be reduced to a scale of 1 : 10,000, or, in the case of mountain regions, of 1 : 20,000, and upon them the features of the ground are to be inserted by means of contours at intervals of 5 metres. Ultimately these *minutes* are to be published on a scale of 1 : 10,000, as also a general map of the whole country on a scale of 1 : 50,000. This latter is to be printed in colours, and the hills are to be shown by clearly marked contours and shading in chalk. Hachures are to be discarded, mainly owing to the great expense involved.

Germany.

For the greater part of Germany there are now available maps on a scale of 1 : 25,000—*Messtischblätter*, called *Positionsblätter* in Bavaria. Most of these are merely plane-table sections, with contours sketched in. The older among them leave very much to be desired on the point of fidelity and artistic finish, but those of later date exhibit much improvement, as, for instance, the kingdom of Saxony (since 1879), the grand-duchy of Baden (since 1876), and more especially the new topographical map of Würtemberg. This last is a reduction of the cadastral survey on a scale of 1 : 2500; and the features of the ground are shown by contours based upon 300 to 800 measured altitudes to each square mile, and shading in chalk. The older maps of the separate states have now been nearly superseded by the new *Karte des Deutschen Reiches* in 674 sheets (610 published), on a scale of 1 : 100,000. This is an excellent map of its kind, engraved on copper, the hills being shown by hachures. The Prussian Government, moreover, acquired in 1874 Reymann's *Spezialkarte von Mittel-Europe*, on a scale of 1 : 200,000, which will ultimately consist of 796 sheets. A new topographical map (1 : 200,000), printed in three colours, was begun in 1900.

Austria-Hungary.

The *Spezialkarte* of Austria-Hungary, on a scale of 1 : 75,000 (763 sheets), was completed in 1889 and published in heliogravure. This map is based upon triangulation and cadastral surveys, where available, but it was produced far too rapidly to meet modern requirements as to accuracy, and in 1896 the director of the military geographical establishment at Vienna, Field-Marshal von Steeb, initiated what may be called an "epoch of exact measurements." The new map will be based upon a primary triangulation completed in 1890, and upon 11,610 miles of spirit-levelling. The cadastral plans are to be reduced to a uniform scale of 1 : 25,000, and the necessary details filled in with the aid of a plane-table and a tacheometer. A photogrammeter is to be used only in mountain districts. The hills are to be hachured, and the whole of the survey is to be completed in 75 years. The Austrian Government has its *Generalkarte von Mittel-Europe* (a very useful map, in 283 sheets), on the same scale as Reymann's map (1 : 200,000), but covering a different area, including nearly the whole of the Balkan Peninsula.

Switzerland.

The mountainous nature of Switzerland has always challenged the skill of the cartographer to give it true expression, and certainly among the maps produced in this Alpine region there are several which claim a prominent place on account of their truth to nature. Whether the maps of the new Topographical Atlas of Switzerland—the so-called Siegfried Atlas, in 552 sheets—will universally be recognized as one of the most successful efforts of which the cartographic art is capable, may well be doubted. The maps constituting that atlas are the plane-table sections from which Dufour's famous map of Switzerland (1 : 100,000) was produced. They are on a scale of 1 : 25,000 for the hills and plains, and of 1 : 50,000 for the Alpine regions; they show the hills by contours drawn at intervals of 10 or 30 metres, and are printed in many colours. Lovers of maps will do well to study some of the so-called "Relief Karten" of the different cantons, which claim to delineate the ground in such a way as to give the impression of a relief.

Belgium and Netherlands.

The new survey of Belgium was completed in 1872, and there have now been published the plane-table sections (*planchettes*) on a scale of 1 : 20,000, and a "Carte topographique de la Belgique," on a scale of 1 : 40,000. The Netherlands likewise have long since published their topographical maps, on scales of 1 : 25,000, 1 : 50,000, and 1 : 200,000.

Denmark. Denmark since 1890 has completed its *Generalstabens Kaart*, on a scale of 1:100,000, as also plane-table sections (*Maalebordsblade*), on a scale of 1:20,000. A *Generalstabens Kaart* of Jutland, 1:40,000, is approaching completion. **Sweden and Norway.** The *generalstabenskarta* of Sweden (1:100,000) is still in progress. It only embraces the country to 65° N., and is to consist of 234 sheets. The northern kingdom (*Karta öfver Norra Suerige*) has been mapped on a scale of 1:200,000. In the sister kingdom of Norway a topographical map, on a scale of 1:100,000, is in progress, in 354 sheets. Neither the *Amtskarter* (1:200,000) nor the *generalkart* of southern Norway (1:400,000) have yet been completed.

Spain and Portugal. Proceeding into southern Europe, we find that a plane-table survey on a scale of 1:20,000 has been in progress ever since 1870, but that of the map of Spain in 1080 sheets (1:50,000), which has been in progress since 1884, only about 117 sheets had up till 1901 been published by the Depósito de la Guerra. Meanwhile reference may be made to B. F. Coello's *Atlas de España* (1848–90), the maps in which are on a scale of 1:200,000. Portugal has completed her *Charta chorographica* (1:100,000, 37 sheets) since 1856. **Italy.** In Italy a *Carta del Regno d'Italia* (1:100,000) and *Tavolette rilevate* (1:25,000 and 1:50,000) have been in progress since 1873. The former will consist of 277 sheets.

Balkan Peninsula. Greece, although the most ancient seat of civilization in Europe, is still dependent upon foreigners for its maps, among which the *Carte de la Grèce* (1:200,000), from rapid surveys made by General Palet in 1828, was published in a new edition in 1880. A similar map, mainly based upon surveys made by Austrian officers and revised by Henri Kiepert (1:300,000), was published by the Military-Geographical Institute of Vienna in 1885. Far superior to these preliminary maps are the *Karten von Attika*, based upon careful surveys made by Prussian officers, and published by Curtius and Kaupert on behalf of the German Archæological Institute in Athens. It is not long since the inhabitants of the Balkan Peninsula were indebted to foreigners for such maps as they made use of. This is the case no longer, for the kingdom of Servia has been surveyed (1880–91) by officers of the General Staff, and the map, on a scale of 1:75,000, has been published; whilst the triangulation was begun in Rumania in 1874, and a topographical survey in 1878. The results are being published on scales of 1:10,000 and 1:200,000. For the greater part of our knowledge of the topography of the Balkan Peninsula we are, however, still indebted to Austrian and Russian officers. The work of the former has already been referred to. The Russians in 1877–79 triangulated and surveyed a great part of the country, and the maps published include one of Turkey in Europe, 1 : 420,000 (1879–84), a map of Bulgaria and eastern Rumelia, 1 : 210,000 (1880–83), with contours at intervals of 70 feet, and a map of the eastern part of the Balkan Peninsula, 1 : 126,000 (1883). In 1899 a map of Turkey in Europe (1 : 218,000) was published by the Turkish General Staff, and there is some talk of beginning a regular survey.

Russia. Of Russia in Europe only the more densely peopled governments have been surveyed in the manner of other European countries, while for vast territories we have as yet only so-called "military surveys," or even mere itinerary surveys, the interior details being filled in from information collected on the spot. The most readily available map of the whole country is the 10-verst map (1 : 420,000) known as General Strelbitzki's, and published 1865–80. A 3-verst military topographical map (1 : 126,000) now embraces the whole of western Russia, with Poland, and seems ultimately to be designed to be extended over the whole empire. Of this map 507 sheets have been published. It is engraved on copper, the hills are hachured, and on the sheets recently published contours at intervals of 70 feet are indicated. Certain governments—Moscow, Kief, Kaluga, &c.—have been published on a scale of 1 : 84,000, whilst Finland, as far as 61° N., was re-surveyed in 1870–95, and a map on a scale of 1 : 42,000 is approaching completion. Surveys in Asiatic Russia are conducted by the topographical departments organized at Tiflis, Orenburg, Tashkent, Omsk, and Yakutsk; and that of Tiflis deserves credit for having produced a 5-verst map of the Caucasus from actual surveys made since 1866, which answered general requirements, but was found so defective in the mountain regions that a new and more accurate survey was begun in 1886. The maps of other parts of the empire are on too small a scale to be styled "topographical." Among them may be mentioned, however, the maps of Orenburg (1858–79), Ferghana (1882), western Siberia (1880), and Lake Baikal (1886), all on a scale of 1 : 420,000. A map of the whole of western Siberia (1 : 680,000) was published in 1880–85, and one of the whole of Asiatic Russia (1 : 4,200,000) in 1883.

Turkey. In Asiatic Turkey several districts of historical interest have been surveyed by foreign associations, and surveys have likewise been made in the interest of railways, but there is no such thing as a general survey carried on under the direction of the Government. Of this part of the world our maps, such as the Russian general map (1 : 630,000, published 1880–85), or the various maps by the late Dr H. Kiepert (for instance, western Asia Minor, 1 : 250,000, published in 1890), still remain compilations from materials very widely differing in value. A new map (1 : 210,000) of Turkey in Europe, based upon the Austrian map, has been published by the Turkish General Staff. Of Cyprus an excellent map on a scale of 1 mile to the inch, from surveys by Major H. (afterwards Lord) Kitchener, was published in 1884.

Persia. In the case of Persia we are still dependent upon compilations produced by the Russian and the Anglo-Indian Governments, such as the map by Colonel Sir T. H. Holdich (Simla, 1897), or the Russian Staff map (1 : 840,000), published in 1886.

India. British India, including Ceylon, can boast of a survey which in most respects is quite equal to those of most of the European states. The surveys are made on various scales, according to the necessities of the case or the nature of the country, and they are extended as occasion offers beyond the boundaries of India proper. Apart from plans of towns and villages on a large scale, the survey department publishes topographical maps of the provinces and native states on a scale of 1 inch to the mile, and the more generally useful *Indian Atlas* on a scale of 4 miles to 1 inch, which includes Ceylon and the Malay Peninsula, and will ultimately consist of 177 full sheets, of which 120 have now been published. The sheets of this atlas are kept up to date, and re-engraved as the results of fresh surveys become available.

Siam. Indo-China. In Siam a regular survey, initiated by Mr J. M'Carthy, a former official of the Indian Survey, has been begun (see *Surveying in and Exploration in Siam*, published by the Royal Geographical Society). In French Indo-China a cadastral survey has been in progress since 1881, whilst the Bureau Topographique has published a general map of Indo-China in 45 sheets (1 : 200,000, 1895), as also separate maps of the provinces of Tongking, Annam, and Cochin-China, on a scale of 1 . 500,000.

China. Japan.

In China we are still largely dependent upon the labours of the Jesuits during the 18th century, and native maps of the interior. The results of the coast surveys and of numerous local surveys will be found embodied in Baron F. von Richthofen's *Atlas von China* (1:750,000; Berlin, 1890), and in Bretschneider's *Map of China* (1:4,600,000), a new edition of which appeared at St Petersburg in 1896. Japan may boast of a regular survey department originated by Europeans and successfully carried on by natives. The primary triangulation was completed in 1880, and in addition to maps on a large scale, there are in course of publication an agronomical map (1:100,000) and geological maps (1:200,000 and 1:400,000).

Dutch East Indies.

Of Java we possess an excellent topographical map, completed in 1887 (1:100,000). A similar map has been in progress for Sumatra since 1883, whilst the maps of the remaining Dutch Indies are still based almost exclusively upon flying surveys. For general purposes J. N. Stemfoort's and J. J. ten Siethoff's *Atlas der Nederlandsche Bezittingen in Oost-Indië*, of which a new edition has been in progress since 1900, may be consulted with confidence.

Africa.

In Africa regular surveys up till now only extend over a small proportion of its vast area. In Egypt excellent work is done by a survey department in charge of Major H. G. Lyons, R.E., which has published provincial irrigation maps (1:100,000), and has extended its operations into the Egyptian Sudan. Algeria and Tunis have been in course of survey since 1868. The topographical map is being published on a scale of 1:50,000, in addition to which there is a *carte de reconnaissance* on a scale of 1:200,000. Eritrea, the Italian colony on the Red Sea, has been regularly surveyed since 1884, and the results have been published on scales of 1:50,000 and, as a *carta dimostrativa*, 1:250,000 (16 sheets, 1897–1900). In Madagascar a regular survey has been begun by the French. In British South Africa a careful triangulation has been carried far into Bechuanaland, but as yet there are no comprehensive regular surveys, and maps are therefore mostly compilations from the plans prepared by the surveyors-general of the various colonies. Amongst these may be mentioned the map of the police districts of Cape Colony (1:627,800, 1887), Jeppe's *Map of the Transvaal* (1:476,000; Winterthur, 1899), Herfst's official *Kaart van de Oranje Vrijstaat* (1:460,000, 1890), Stanford's *Map of Mashonaland and Rhodesia* (1:1,000,000, 1900). In other parts of Africa explorations and partial surveys are carried on with considerable vigour, but the time seems to have arrived now for organizing at least a reconnaissance survey embracing the entire continent, which, in the opinion of so competent a judge as Colonel Sir T. Holdich, might be carried on at no greater expense than is involved now in numerous exploratory expeditions, and certainly much more efficiently.

Australia.

What has been said of South Africa applies in an almost equal degree to the Australian colonies. In all of these cadastral surveys conducted by surveyors-general have been in progress for many years past, as also trigonometrical surveys (West Australia excepted), whilst the publication of parish and township or county maps keeps pace with the settlement of the country; but none of the colonies is as yet in possession of a topographical map equal in accuracy to similar maps published in Europe. Among more general maps may be mentioned those of Queensland (4 miles to the inch, 1897–99), New South Wales (8 miles to the inch, 1898), Victoria (1:443,520), South Australia (1:1,100,000, 1894) and West Australia (1:560,000, 1897).

Canada.

In America, Canada and the United States take the lead in the production of topographical maps. The surveys in Canada are carried on by the Commissioners of Crown Lands in Quebec, the Dominion Land Office (which lays out townships as in the United States, but with greater accuracy), the Surveyor-General's office attached to the Department of the Interior, and the Geological Survey. The last publishes its regular service maps on a scale of 4 miles to an inch, and reconnaissance or preliminary maps on half that scale. The maps of the Surveyor-General are on various scales (1:40,000, 1:190,000, &c.), and the photographic apparatus is successfully employed in the Rocky Mountain surveys. Among more comprehensive maps is one of the north-western part of the Dominion (3 miles to the inch, 1898), and another of the Yukon districts (1:380,000, 1898). The older maps are kept up to date.

United States.

In the United States the topographical maps produced since 1882 by the U.S. geographical surveys supersede all older maps, including the very imperfect ones of the Land Office. They are based upon a triangulation by the U.S. Coast and Geodetic Survey, and the details are considered sufficient to admit of the selection of general routes for railways and other public works. The maps of the more densely peopled parts of the Union are published on a scale of 1:62,500 (1 inch to the mile), and those of the remainder of the country on half that scale. The hills are shown by contours. The survey progresses at the rate of about 40,000 square miles annually. There are, of course, many maps of the separate states, based on older surveys, as also a general map by H. Gannett and H. King (1:2,500,000; Washington, 1900). Maps of the islands of Cuba and of Puerto Rico were published in 1898 by the War Department on a scale of 1:250,000.

Central and South America.

In Mexico the surveys are in charge of a Comisión Geografica-exploradora attached to the Secretaria de Fomenta, but up till now only about fifteen sheets of the *Carta general de la República*, on a scale of 1:100,000, have been published. There is also a *Carte general* of the state of S. Luis Potosi (1:250,000, 1894) and one of the environs of Puebla (1:20,000). These maps are excellent of their kind, but the slow progress of their publication is to be regretted. None of the other states of America can be said to possess a topographical survey department organized on a comprehensive basis. In the Argentine a geographical institute was established in 1879, but neither Seelstrang's *Atlas* (1892) nor Hoskold's *Mapa topografica* (1:2,000,000, London, 1895), which were published by it, nor any of the numerous provincial maps, are based upon scientific surveys. In Brazil little or nothing is done by the central government, but the progressive states of São Paulo and Minas Geräes have Comisãos Geographicos e Geologicos charged with the production of detailed topographical maps. In Chile a Comision Topografico was appointed as long ago as 1848, but the map produced under its auspices by Prof. A. Pissis (1:250,000, 1870–77) leaves much to be desired. A proposal for a cadastral and topographical survey made in 1895 by M. A. Bertrand has not as yet been acted upon. A *Mapa del Peru* based upon explorations made by A. Raimondi, 1850–69, has been in course of publication at Paris since 1889 on a scale of 1:500,000. Most of our maps are all dependent upon partial exploration, and it is satisfactory in these circumstances that the Service Géographique of the French army should have commenced (in 1900) the publication of a map of the whole of America on the scale of 1:1,000,000. It may also be mentioned that the same department is publishing a map of Asia on the same scale, and that the British Intelligence Department has in hand a like map of Africa. Thus the proposal of Prof. Penck to produce a map of the whole world on a scale of 1:1,000,000 will be realized, at least in part.

The publication of maps on smaller scales than those enumerated above, as also of maps for special purposes,—physical, political, or historical,—has, as a rule, been left to private firms, among whom Perthes in Germany, Ilyin in Russia, Hölzl in Austria, Hachette in France, Bartholomew, Philip, and Stanford of the United Kingdom, and the Matthews-Northrup Company in the United States, are the best known.

HYDROGRAPHIC SURVEYS.

Hydrographic surveys have been in progress since the early Middle Ages, but even now only a portion of the world's coastlines have been surveyed in a definite manner. Much of this work has been done by the survey departments of the different states concerned, but the British Hydrographic Office may justly claim the credit of having contributed the lion's share of the work lying outside the limits of civilized states, and British Admiralty charts (see CHARTS) are consequently most in demand throughout the world. Great Britain has taken the lead in those deep-sea explorations which reveal to us the configuration of the sea bottom, and enable us to construct charts of the ocean bed corresponding to the contoured maps of dry land yielded by detailed topographical surveys.

For geological maps, see GEOLOGY.

HISTORY OF MAPS.—The development of cartography since the time of the revival of Ptolemy has been set forth in the most brilliant manner by Nordenskiöld in his *Facsimile-atlas till Kartografiens äldsta historia, innehållande af bildningar af de vigtigaste Kartor tryckta före år 1600* (Stockholm, 1889). Other collections of reproductions of old and rare maps have been prepared by Dr. K. Miller (*Die ältesten Weltkarten*, Stuttgart, 1895, which only contains maps not influenced by the ideas of Ptolemy), Gabriel Marcel (*Reproductions de Cartes et de Globes relatives à la découverte de l'Amérique du XVI^e au XVIII^e Siècle*, Paris, 1893), E. H. Coote (*Remarkable Maps of the XVth, XVIth, and XVIIth Centuries, reproduced in their original size. I.-VI.*, published by F. Müller, Amsterdam, 1894–97), and *Bibliotheca Lindesiana*, with facsimiles of the "Harleian" and other Dieppese maps of the 16th century. The large maps of Mercator, found anew in Breslau; the map of Europe, 1554; of Great Britain, 1564; and the map of the world, 1569, were published in facsimile in 1891 by the Berlin Geographical Society; and we owe an excellent synopsis of all known terrestrial and celestial globes to Matteo Fiorini (*Sfere terrestri e celesti di Autore italiano oppure fatte o conservate in Italia*, Roma, 1899).

The old "compass" charts have attracted the attention of students. So long as maritime cartography was confined to the Mediterranean and its immediate environment, and there was no practical need for determining the relation of the longitudinal axis of this sea to the circumference of the whole earth, nautical geography was satisfied with the registration of the distance in *miglia* between two coast points, and entered in the valuations in the sheets of the map. After numerous measurements Prof. Wagner has come to the conclusion that the *miglie*, in terms of which distances were measured on the old nautical maps, amounted to only about 1250 metres, *i.e.*, 230 metres less than the Roman mile. He further concludes that this small nautical mile reaches back a long way beyond the year A.D. 1000, and is therefore much older than the oldest nautical maps extant, and that in all probability we have here a measure handed down from antiquity and continued in use among the mariners. On the other hand, on the Pisan map (of the 13th century) the Roman mile of 1480 metres was applied to the measurement of the Atlantic seaboard. The smaller sea mile ($=\frac{2}{3}$ of the nautical mile) has in the Frisian waters maintained its validity to the present day. Obviously the Mediterranean maps are much older than the maps of the Atlantic coasts. But, without taking in hand the task of reduction, the ancient cartographers joined together the different sheets of the Mediterranean and the Atlantic into a collective representation, not troubling their minds about the error thus originated. The false orientation of their maps, shown especially in the primary orientation line from west to east, does not, however, proceed from the magnetic misdirection; but there are typical errors demonstrable in the representations of the Mediterranean such as may be found in Ptolemy himself, a fact pointing also to the connexion between Ptolemy and the nautical maps. Thus Ptolemy places Rhodes and Argos on the same parallel of latitude; Mount Athos and Cape Malea on the same meridian. These errors appear also after 1318 on the maps of Vesconte. The projection, however, employed by Ptolemy is not applied in the Italian nautical maps. It is impossible to draw over these nautical maps either the equidistant azimuthal projection or the Mercator's projection. The only network of degrees capable of being brought into conformity with these maps is that of an oblong plane-chart. This fact serves to confute the often uttered but never proven assertions that Henry the Navigator had already introduced graded maps, and so had substantially advanced the development of cartography. After the investigations made down to this date, it may be taken as authenticated that the mediæval nautical maps were first designed in Italy, in the land where navigation attained its highest development, and that we are not, as in his great work, *The Periplus*, Nordenskiöld has endeavoured to maintain, to look for the origin of these topographical maps among the Catalonians. The two oldest maps of the world, designed in Catalonian style, which only again became known in modern times, are the production of an Italian, Angelino Dalorto, whence it may be concluded that Catalonian cartography received its first impulses from Italy.

Many old nautical maps have been republished, such as those by Th. Fischer (*Sammlung mittelalterlicher Welt-u-See Karten*—"A collection of maps of the mediæval world and nautical maps"; Venice, 1886); K. Kretschmer (*Atlas zur Entdeckung Americas*—"Atlas illustrating the discovery of America," Berlin, 1892); G. Marcel (*Choix de Cartes et de Mappemondes des XIV$_e$ et XV$_e$ Siècles*—"A selection of maps, and maps of the world of the 14th and 15th centuries," Paris, 1896); and Nordenskiöld (*Periplus*, Stockholm, 1897). In addition to these collections, there are single maps published in geographical works and maps published separately in great number, not to mention that all the original works preserved in libraries have not yet been made fully known. It is therefore impossible to give a list of them here, or to supplement lists already published.

For a fairly complete list of modern maps of all parts of the world, we refer the reader to Mr J. G. BARTHOLOMEW's "Mapping of the World" (*Scottish Geographical Magazine*, 1890 and 1891); for reports on the progress of cartography, to the *Geographisches Jahrbuch*, published by Perthes of Gotha, and for announcements of new publications to the *Geographical Journal*.

(S. R.; E. G. R.)

Maracaibo, capital of the state of Zulia, Venezuela, South America, on the western shore of Lake Maracaibo. It is one of the most important and most progressive cities in the republic, with a population of over 35,000 inhabitants. The bar which closes the gulf will not allow vessels drawing more than 12 feet to cross, but inside the bar there is a depth of 30 feet and more close to the town. Maracaibo maintains valuable commercial relations with foreign markets and with the interior, and is the port of transit for goods intended for Colombia. It is the starting-point also for passenger and freight steamers and the railway lines of the Trujillo and Táchira sections of the state of Los Andes. The most important buildings are the public market, the executive mansion, legislative palace, municipal buildings, the Baralt theatre, university, new gaol, and six churches. There is a dockyard for the construction of sailing vessels. The town is equipped with electric lighting, telegraphs, telephones, tramways, &c. The import duties collected in the year ending 30th June 1896 amounted to £252,769, the imports of domestic products, salt, &c., for same period amounting to £86,736. The amount of coffee exported in 1896 was 28,211 tons, and in 1900, 20,050 tons. The export of hides is rapidly increasing, amounting in 1900 to 34,793 hides, besides 121,392 goatskins. Cocoa, fustic, dividivi, sugar, and copaiba are the chief of the remaining exports. The imports in 1898 amounted to £196,787, and exports to £842,600. In 1898 there entered 302 foreign vessels of 29,220 tons.

Máramarossziget, a corporate town of Hungary, with 15,210 inhabitants in 1891, and 17,445 in 1901. Among its educational establishments are a law academy, a state upper school for girls, &c. It is an important centre for the timber industry, with large steam mill, saw-mills, furniture factories, &c.

Maranhao, or MARANHAM, a state of north-east Brazil, with a coast-line of about 300 miles, in which the Atlantic receives the waters of six large rivers, all navigable by steamers. Its area covers 177,566 square miles. The population in 1872 was 359,010, and in 1890 it was 459,040. The capital, San Luis, is a finely-built city of 38,000 inhabitants. Other towns are Caxias (24,000), Alcantara (15,000), Carolina (10,000), Vianna, Grajahú, Itapicurú-mirim, and Turyassú.

Marañon. See AMAZON.

Marash (Assyrian *Maras*, Roman *Germanicia*, Byzantine *Marasion*), the chief town of a sanjak of the same name in the Aleppo viláyet of Asiatic Turkey, altitude 2600 feet, situated north of the Jihún river, at the foot of Mount Taurus. The sanjak lies almost wholly in Mount Taurus, and includes the Armenian town of Zeitún. Marash is prosperous, and has a large trade in Kúrd carpets and embroideries. The climate is good, except in summer. Of the population (40,000), about half are Armenians. There are a college, churches, and schools belonging to the American mission, and a Jesuit establishment. Marash occupies an ancient site on which "Hittite" inscriptions have been found. It was seized by the Crusaders after their march across Mount Taurus, became an important town of Lesser Armenia, and was taken by the Seljúks in 1147. In the 16th century it was added to the Osmanli empire by Selim I.

Marathon.—The tumulus or "Soros" at Marathon was excavated by M. Stais in 1891 and 1892. A slight previous excavation had brought to light some prehistoric implements, and so it was supposed that the mound had no connexion with the battle; but it has now been discovered that the presence of those prehistoric things was accidental. Underlying the mound was found a stratum about 85 feet long by 20 broad, consisting of a layer of sand, above which lay the ashes and bones of many corpses; together with these were the remains of many lecythi and other vases, some of them contemporary with the Persian wars, some of them of much earlier style, and probably taken in the emergency from neighbouring cemeteries. It is conjectured with some probability that a large vase containing ashes may have been used as the burial urn of one of the Athenian generals who fell. There was also, in the middle of the stratum, a trench for funeral offerings about 30 feet by 3; it contained bones of beasts, with ashes and fragments of vases. There can therefore be no doubt that the tumulus was piled up to commemorate the 192 Athenians who fell in the battle, and that it marks the place where the carnage was thickest. A selection from the contents of the tumulus has been placed in the National Museum at Athens.

See 'Αρχαιολογικὸν Δελτίον, 1891, pp. 67 *sqq.* (E. GR.)

Marbella, a town and seaport of Spain, on the Mediterranean coast, in the province of Malaga. The town is well built, with clean, regular streets. An old castle crowns the height above, and the parish church has been restored. The local industries include the manufactures of alcohol, porcelain, and sugar, besides founding, and lead and iron mining. The port admits vessels drawing 18 to 20 feet; but there is good anchorage in deep water about half a mile from shore. There is a pier 1050 feet long, with a railway for bringing down and loading ores, and a lighthouse. Fish, grain, raisins, figs, cork, and iron ore are exported, but the trade is not of great extent. Population about 10,000.

Marblehead, a town of Essex county, Massachusetts, U.S.A., on a peninsula on the east side of Salem harbour on the north shore of Massachusetts Bay. The principal occupation of the permanent inhabitants is the manufacture of shoes. The town has become a popular summer resort and summer home for people of Boston. It has a public library, reading-room, and art gallery. Population (1890), 8202; (1900), 7582, of whom 973 were foreign-born.

Marburg, the second town in the Austrian duchy of Styria, a German enclave in a Slovene district. Population, with suburbs (1900), 24,501, German and Catholic, excepting 16 per cent. Slovenes and 1 per cent. Protestants. The garrison numbers 1343 men.

Marburg, a town of Prussia, province of Hesse-Nassau, on the right bank of the Lahn, 60 miles north of Frankfort-on-Main by the railway to Cassel. It is the seat of a university with (1900) 1184 students and 93 professors. A new villa quarter has grown up at the south foot of the castle hill. In the years 1873–91 a university building of sandstone was erected in the Early Gothic style. In 1884 the "Teutonic" house was converted into the zoological and mineralogical institutes of the university. The Lutheran church was restored in 1893. The university library contains about 160,000 volumes. The castle was restored in 1866–84; it contained the collections of the Hessian Historical Society. There are further a new post office (1882–84), various scientific institutes belonging to the university, an agricultural school, and a botanical garden. The industries include tanning and manufacture of machinery, pottery, tobacco, and toys. Population (1885), 12,668; (1900), 17,527.

March, a market town in the Isle of Ely parliamentary division of Cambridgeshire, England, 14 miles north-west by north of Ely; a junction station on the Great Eastern and Great Northern Joint railway. There is a public hall (1895). Population of parish (an urban district, 1894) (1891), 6988; (1901), 7565.

Marches, The, a territorial division of Italy, bordering on the Adriatic, and lying between Abruzzi on the S. and Emilia on the N. It embraces the provinces of Ancona, Ascoli-Piceno, Macerata, and Pesaro and Urbino, with an area of 3763 square miles, and a population of 983,670 (1881), and 1,064,749 (1901). Its principal crops are wheat, maize, wine, and tobacco. Except building stone and sulphur, there are no minerals of value. The silk industries, making of strawplait and straw hats, rearing of silkworms and cocoons, with some sugar refining, tobacco, terra-cotta, and paper manufacture, brickworks, and iron-works, furnish the chief occupations of the people, next after agriculture and pastoral pursuits. The principal towns are Ancona (which is the chief seaport), Pesaro, Macerata, Urbino, Jesi, Ascoli, Camerino, Fano, Fermo, Fabriano, Recanati, and Senigallia. This division belonged down to 1860 to the Papal States.

Mardin, the chief town of a sanjak of the same name in the Diarbekr viláyet of Asiatic Turkey, and a military station, situated on the Diarbekr–Mosul road. Half of the population, 12,000, are Christian. During the Armenian massacres of 1895 Mardin was attacked by Kúrds, who were driven off by the garrison. It is the seat of an American mission, with church, schools, and medical officer.

Maree, Loch, one of the most beautiful of Scottish lakes, situated in Gairloch parish, Wester Ross. It is 32 feet above sea-level, 12⅜ miles long, and from 3 furlongs to 2¼ miles broad, with a general depth of 360 feet. Skirted by lofty mountains, it contains twenty-seven islands, and is drained by the river Ewe. The fish are salmon, sea-trout, yellow trout, and char.

Margate, municipal borough, seaport, and market-town in the Isle of Thanet division of Kent, England, 4 miles west of North Foreland, and 90 miles by rail east of London. The old pier is used chiefly by fishermen and colliers; the landing-place has received several additions. Municipal offices have been presented to the town, and a theatre erected. The town has grown largely, especially in the part called Cliftonville, on the eastern side. There are electric trams running between Margate, Broadstairs, and Ramsgate. Dane Park (33 acres) was presented to the town in 1898. Population (1891), 18,662; (1901), 23,057. The visiting population in summer is very numerous. WESTGATE-ON-SEA, 2 miles west by south and practically a suburb, has a station on the South-Eastern and Chatham railway. It attracts a somewhat higher class of visitors than Margate. Population, 3000. BIRCHINGTON, a little farther to the west, is also a growing resort.

Margherita Maria Teresa, OF SAVOY (1851——), dowager-queen of Italy, daughter of Ferdinand, duke of Genoa, and of Elisabeth of Saxony, was born at Turin on 20th November 1851. Until eight years of age she lived with her mother, the widowed duchess of Genoa, at Stresa, on Lago Maggiore, but in 1859 returned to Turin, occupying a small apartment in the royal palace. Educated simply under the care of a Viennese governess, she took little part in court life until her marriage. Gifted with beauty and great personal charm, she acquired widespread popularity, and exercised her duties as princess royal with unfailing tact. Shortly after the occupation of Rome in 1870 she, with her husband, the crown prince, took up her residence in the Quirinal, where she continued to reside throughout the reign of King Humbert. A few months after the accession of her husband to the throne in January 1878 an attempt upon his life, committed at Naples by a lunatic named Passanante, produced a deep impression upon her mind, and, though she displayed the utmost fortitude at the moment, left for some years unpleasant traces upon her nervous system. An exemplary wife and devoted mother, she combined with these qualities a full perception of her rights and duties as queen, and ever discharged with assiduous alacrity the functions of her royal station. Thoroughly conversant with Latin, Greek, and music, speaking several modern languages with fluency, widely read, and keenly interested in all manifestations of art, Queen Margherita holds a foremost place among the many distinguished women of the house of Savoy. (See also HUMBERT.)

Mariana, or MARIANNE ISLANDS. See MICRONESIA.

Marianao, a residential suburb on the shore of Cuba, to the west of the city of Havana, with which it is connected by means of a steam tram. Population (1899), 5416.

Maria Theresiopel. See SZABADKA.

Mariazell, a village and place of pilgrimage in the duchy of Styria, Austria. It is estimated that the shrine is visited by about 200,000 pilgrims annually. The principal resource of the inhabitants is the entertainment of visitors and the sale of rosaries, pictures, medals, and other souvenirs. Population (1890), 1116; (1901), 1341.

Marienbad, a celebrated watering-place in Bohemia, Austria. The permanent population in 1890 was 2119, and in 1900, 4588, mostly Catholic and German. The public buildings now include two hospitals for the poor, a convalescent home, a Russian church, a synagogue, the *Stadthaus* (containing the post and telegraph offices, the custom-house, a concert and ball room, a restaurant, and reading and assembly rooms), new bathing establishments, &c. It is visited annually by about 17,000 patients.

Marienberg, a town of Germany, 16 miles south-east of Chemnitz, in the circle of Zwickau, kingdom of Saxony, on the Flöha–Reitzenhain railway. It has a central school, a non-commissioned officers' school, and a preparatory school; and the industries comprise wool-spinning, flax-dressing, the making of lace, toys, and cigars, and silver-mining. Population (1890), 6300; (1900), 7108.

Marienburg, a town of Prussia, province of West Prussia, on the Nogat, an eastern arm of the Vistula, crossed here by a fine railway bridge (1892), 32 miles by rail south-east of Danzig. It is famous for the great castle and fortress of the Teutonic order. Its newer buildings embrace a couple of churches and the post office (1894). It possesses an agricultural school, a seminary for male and another for female teachers, and a deaf and dumb asylum; its industries include saw-mills, flour-mills, factories for cotton and wool, potteries, machine-shops, wool-cleansing, brick-making, and breweries. Population (1885), 10,136; (1900), 10,732.

Marienwerder, a town of Prussia, province of West Prussia, near the right bank of the Vistula, 23 miles south of Marienburg by rail. The town was founded in the year 1233 by the Teutonic order. It has a cathedral of the same century, a triple Gothic edifice, restored in 1874; a (Gothic) town hall (1880); a Roman Catholic basilica (1858); a non-commissioned officers' school; a monument of the war of 1870–71 (1897); an archæological collection; and a seminary for female teachers. The industries include iron-foundries, saw-mills, breweries, and printing works. Population (1885), 8079; (1900), 9685.

Marietta, a city of Ohio, U.S.A., capital of Washington county, on the Ohio river, at the mouth of the Muskingum, in the south-eastern part of the state, at an altitude of 600 feet. It has a large river commerce, and is entered by four railways, the Baltimore and Ohio South-Western, the Cleveland and Marietta (part of the Pennsylvania), the Toledo and Ohio Central, and the Ohio and Little Kanawha. It has iron-works, saw-mills, and agricultural implement works. It is the seat of Marietta College, a non-sectarian institution, founded in 1835, which had, in 1899, 18 instructors and 198 students, 72 of whom were women. The limits of the city were enlarged in 1890 by the addition of Harmar. Population (1890), 8273; (1900), 13,348, of whom 679 were foreign-born and 361 were negroes.

Mariinsk, a district town of Russia, West Siberia, government of Tomsk, on the bank of the Kiya river, 147 miles by rail east of Tomsk. It is built of timber, but has a stately cathedral and a town hospital. Its inhabitants, 8300 in 1897, live by agriculture, small tanneries, and soap-works, and especially by the currying trade. It is an entrepôt for the gold mines, and a centre from which the miners start in summer.

Marine Insurance. See INSURANCE.

Marines, formerly (1694) styled mariners, are sea soldiers—that is, troops appropriated and specially adapted to the requirements of maritime war. This force is in origin, use, and application peculiarly British. The only other nation possessing a special force discharging exactly similar functions is the United States.

The origin of the marine force was an Order in Council 1664, directing "1200 Land souldgers to be forthwith rayzed to be in readiness to be distributed in His Majesty's fleete prepared for sea service." This body was named the "Admiral's regiment." At this period land warfare had developed a system, and was waged by men organized, disciplined, and trained. Sea warfare was left "to every man's own conceit." War-ships were built to be manned in a hurry, by "the press," when needed. Men were thus obtained by force and grouped without organization or previous training in ships. When no longer required they were turned adrift. The administration of England's fleet was "a prodigy of wastefulness, corruption, and indolence; no estimate could be trusted, no contract was performed, no check was enforced." Such officers as had been "bred to the sea seemed a strange and savage race." They robbed the king and cheated the seamen. As regards land force, it was a violation of the law to keep at home in the king's pay "any other body of armed men, save as a guard for the royal person." On the other hand, it was "illegal to land press men" in a foreign country, but soldiers "only required a little persuasion to land." Thus by thrusting into naval chaos and confusion a nucleus of disciplined, trained, and organized land troops, an expedient was found which offered a solution of the many political and administrative difficulties of the time. This "Admiral's regiment" was the germ which by a constant process of evolution during a period of over 235 years has produced not merely the marine forces, but the royal navy, organized, disciplined, and trained as it is to-day. In 1668 the experiment of the Admiral's regiment was extended. At a Council held "to discourse about the fitness for entering men presently for manning the fleete," King Charles II. "cried very civilly, 'If ever you intend to man the fleet without being cheated by the captains and pursers, you may go to bed and resolve never to have it manned.'" This seems to throw some light on the Council's order a few days later "to draw out and furnish such numbers of His Majesty's Foot Guards for His Majesty's service at sea this summer, as H.R.H. the Duke of York, Lord High Admiral of England, shall from time to time desire." The men were to be paid and accounted for by their own officers. This maritime force subsequently disappeared, but two new regiments of "marines" were raised in 1694, the House of Commons directing they "were to be employed in the service of the navy only." One regiment only was to be on shore at a time, and to be employed in the dockyards with extra pay. None of the officers were to be sea commanders, save two colonels. The intention was to make these regiments feeders for the navy, captains being ordered to report periodically "the names of such soldiers as shall in any measure be made seamen, and how far each of them is qualified toward being an able seaman." In 1697 these regiments were disbanded, but early in the reign of Queen Anne a number of regiments of marines were raised, and independent companies of marines were also enlisted in the West Indies. At the Peace of Utrecht (1713) the marines were disbanded, but reappeared in 1739 as part of the army; and in 1740 three regiments of marines were raised in America, the colonels being appointed by the Crown, the captains by the provinces. In 1747 the marine regiments were transferred from the control of the Secretary of War to that of the Admiralty, and the next year once more wholly disappeared on the Treaty of Aix la Chapelle (1748).

During the preceding period of fifty-four years the marine force appeared and disappeared with war. It was a military body, applied to naval purposes. Its main functions were threefold—(1) for fighting in ships; (2) for seizing and holding land positions necessary or advantageous to the naval operations of war; (3) for maintaining discipline of the ships, and by "expertness in handling arms to incite our seamen to the imitation of them." Incidentally the force came to be regarded as so good a feeder for the navy that Admiral Vernon (1739) urged "the necessity of converting most of our marching regiments into marines, and if, as they became seamen they were admitted to be discharged as such, that would make a good nursery for the breeding of them."

The organization of the force was purely military. Regiments were embarked in fleets, and distributed in the ships. The officers were interchangeable with those of the guards and line. John Churchill (afterwards Duke of Marlborough) and George Rooke (afterwards Admiral Sir George Rooke) were together at one time ensigns of marines. During this period the marines were never regarded as a reserve for the fleet. The navy in peace did without them. The necessities of maritime war demanded a mobile military force adapted to naval conditions and at naval disposal, and so in all naval operations during these eighty-four years the marines played a conspicuous part. The navy had been slowly groping towards a system. For example, sea officers had been granted a uniform, and a naval academy (1729) had been established for the education of young gentlemen for the sea service. But in its main features the navy remained in 1748 as it was in 1664. The sailor was kidnapped and forced into ships, to become an outcast when no longer wanted. The marine when not in a ship was comfortably housed and looked after by his officers in barracks on shore.

In 1755 the marine force once more reappeared under the Admiralty, and from that date its history has been continuous. But the regimental system was abandoned, and an entirely new principle of organization was applied. Companies were raised, and these companies were grouped into great depôts, called divisions, at Portsmouth, Plymouth, and Chatham. At these divisions this force could be increased and reduced at pleasure, without disturbing the basis of organization, and from them could be supplied as many or as few sea soldiers as fleets or ships needed, while preserving in the varying units so provided all the essentials of uniformity of system, drill, training, ties of comradeship, and *esprit de corps.* This force then and for ninety-eight years afterwards was the only continuously trained, disciplined, and organized fighting force placed by the country at the disposal of naval officers. On the establishment of this new marine force the purchase of commissions was abolished, but interchange with the army was for a time permitted. When embarked, marines were under the naval code of discipline; when on shore, under the marine Mutiny Act, identical with that of the army. When the seamen of the fleet mutinied at the Nore, at the close of the 17th century, and turned their officers out of the ships, the marines, undaunted, stood firm by theirs.

Mutiny lurked beneath the deck of many a ship before and long years after that dramatic event. The control of admirals and captains over their own men was precarious in the extreme. This was the natural result of the country's neglect of its seamen. The discipline of the fleet in those days rested on the firm bayonets of the marines. What England owes to them may be gathered from Lord St Vincent's recorded testimony: "There never was an appeal made to them for honour, courage, or loyalty, that they did not more than realize my highest expectation. If ever real danger should come to England, the marines will be found the country's sheet anchor." At his earnest solicitation the marines were made a royal corps in 1802. It is worthy of note that in those days of masts, yards, sails, and pure seamanship, this greatest of naval statesmen, this matchless naval strategist, whose practical experience of maritime war was unrivalled, strenuously advocated as the true policy for England what in these days of steam and mastless ships would be scouted and ridiculed. It was to make service afloat as marines a part of the duty of every regiment of the line in rotation.

Down to 1804 the marines were an infantry force; the improvement in artillery towards the close of the century had necessitated the occasional putting into the fleet of detachments of Royal Artillery. This, as regards gunnery duties in the fleet, was repeating on a smaller scale the expedient adopted in the time of Charles II. So much friction arose between the naval and the artillery officers that a special corps of Royal Marine Artillery was raised in 1804, on the recommendation of Nelson. This special corps fulfilled the expectations of its founders. It was charged with the care, equipment, and working of the larger ordnance afloat and field guns ashore, and was employed also as a body of gunnery instructors to the fleet. In 1831, a certain number of naval officers being thought to be sufficiently trained in gunnery, this corps, of which Napier wrote, "Never in my life have I seen soldiers like the Royal Marine Artillery," was, without warning, abolished. Then the marine force ceased to be composed of two corps, artillery and infantry, and it reverted to a single one of infantry. Very soon afterwards, however, the Admiralty began to build up what they had so suddenly and ruthlessly destroyed, by ordering the conversion of one company of each infantry marine division into artillery. The number of these artillery companies gradually increased, and were grouped in a separate depôt. Just as the wars from Charles II. to George III. had demanded marines, so the Crimean war led to their increase. Thus in 1859 the artillery companies of marines were formed into a separate division, and in 1862 the old name of Royal Marine Artillery was restored.

The marines thus became once more and still remain two corps, the official designation of the whole being Royal Marine Forces. In 1855 the marine infantry corps became light infantry, and in 1869 the Woolwich division (added in 1805) was abolished; and more recently a marine depôt, as a feeder of the other divisions, was established at Walmer. The headquarters of the R.M.A. are at Eastney, Southsea. The divisions R.M.L.I. are at Gosport, Chatham, and Devonport. The uniform of the R.M.A. is blue with red facings, that of R.M.L.I. red with blue facings. The badge of both corps is the globe surrounded with the laurel wreath, with the motto "Per mare per terram." The Royal Marine Forces share with the 3rd Battalion Grenadier Guards, the East Kent Regiment (formerly the Buffs), and the Royal London Militia the privilege of marching through the City of London with colours flying, bands playing, and bayonets fixed. This is due to a common original association with the London train bands.

War Services.—To describe these would be to review the wars waged by England by sea and by land for over 200 years. In every sea fight, great or small, marines have taken part, and on every continent they have served in big and little wars, sometimes as part of the army, sometimes with naval contingents, sometimes alone. The varied nature of the work done by the marines afloat and ashore during the Napoleonic war may be shortly illustrated by quoting the record of war services of one single marine officer, who died wholly unnoticed within the memory of many men now living. His name was Nicolls, but in official or public regard it had no honoured place. "With 13 volunteers in a boat of the *Blanche* frigate, he boarded and captured on 3rd November 1803 the French armed cutter *Albion* from under the guns of Monte Cristi, San Domingo; in this action he was severely wounded by a musket ball, which, entering the abdomen and coming out at his right side, lodged in the arm. On board the *Standard* at the passage of the Dardanelles on 19th February 1807. On 26th June 1808, with a boat's crew he boarded and captured the Italian gunboat *Volfe* near Corfu. Present at the reduction of the island of Anholt in May 1809. Severely wounded at the attack on Fort Bowyer 15th September 1814. Was frequently employed in boat and battery actions. In 1808 was in a boat at the capture of a French brig; in 1804 he commanded the Royal Marines during the siege of Curaçoa, and for twenty-eight consecutive days was exposed to several attacks of the enemy. At the passage of the Dardanelles he captured the Turkish flag, and was honourably mentioned. In 1807 he was at the blockade of Corfu and the expedition to Egypt. In North America he raised and commanded a regiment of Indians, and was senior major of all the troops engaged in the attack on New Orleans in 1814. Was also governor of the islands of Anholt and Ascension. During the above service he had his left leg broken and right leg severely wounded, was shot through the body and right arm, received a severe sabre cut in the head, was bayoneted in the chest, and lost the sight of an eye in his 107th action with the enemies of his country. He was frequently mentioned in despatches, and received a sword of honour from the Patriotic Fund."

During the Crimean war, mortar-boat flotillas in the Baltic and Black seas were commanded and manned by R.M.A., while comrades in the same corps served with the Royal Artillery in the trenches before Sebastopol—a marine infantry brigade occupying the heights of Balaklava. During the Indian Mutiny marines (artillery and infantry) served with the Naval Brigade under Peel. In the China wars batteries and brigades of the marine force played a prominent part, and likewise were represented in all the Egyptian and Sudan campaigns, 1881 to 1898. In one action the R.M.A. gunners came to the relief of the Royal Horse Artillery when exhausted, and fought their guns; in another the R.M.A., out of the *débris* of the enemy's Krupp guns captured, built up one complete gun and fought it with effect; in the final campaign gunboats were brought up in pieces, put together, and fought by a detachment of the R.M.A.

In 1899 in the Boer war the marine artillery and infantry took part with the Naval Brigade, maintaining their historic reputation, and at the battle of Enslin their losses were exceptionally severe.

Characteristics of Marine System.—The recruit first goes to the depôt at Walmer, and is trained as a soldier before joining his division to complete instruction as a marine. His division is his permanent military home, from which he goes on service and to which he returns at its conclusion. Restrictions on marriage, necessary under the army system, are not necessary in the marine forces. The permanent home of the wife and family is not broken up by the marine going abroad; the wife thus can continue any local goodwill in any business her industry may secure. This fixed home enables a marine to learn a trade in the workshops of his division which supply the clothing, &c., to the corps. Marines are enlisted for 12 years, and if of good character they can re-engage to complete 21 years, entitling to pension. The periods of service abroad for marines are shorter (generally 3 years), but more constantly recurrent than for the army. The administrative, as distinct from the instructional, staff necessary for a marine division is more simple and less expensive than that of a numerical army equivalent expressed in regiments. The system of pay and accounts is also less complex. The following table shows the relative proportions of marine forces to the whole navy at different periods:—

Year.	Navy proper. Officers and Men.	Marines. Officers and Men.	Grand Total.	Maritime. Peace or War.	Percent. Marines to Total Forces.	Nature of Ships.
1805	90,000	30,000	120,000	War (Trafalgar)	25	Sailing.
1838	23,165	9,000	32,165	Peace	28	Sailing.
1858	40,219	14,919	55,138		27	Sailing with auxiliary steam.
1878	42,046	13,727	55,773		24	Steam with auxiliary sail.
1898	78,441[1]	17,099	95,540		17	Steam and mastless ships.

The above table indicates a gradual change in naval policy and practice as regards marines. It will be observed that, concurrently with the gradual disappearance of masts, sails, and yards, the proportion of marines has steadily declined. Down to very recent times the marine spent more time ashore than afloat. Now the reverse is the case. There are 10,806 afloat and only 7745 on shore, and the latter figure includes the whole of the administrative and instructional staff and all the recruits under training.

By the introduction of the Continuous Service Act, 1853, the blue-jacket was placed on exactly the same footing as the marine in respect of conditions of service and pension, and now the blue-jacket when not afloat is quartered in barracks. The main difference between the blue-jacket and marine is the dress and the pay. The blue-jacket is better paid than the marine. As regards opportunity of discipline, there is now no difference; and in short, all the reasons for the existence of a marine force have disappeared except as regards duties on shore incidental to naval operations of war, *e.g.*, the holding of ports and the seizing of minor positions necessary to prosecution of maritime war. The facts that modern ships cannot now as formerly carry a supernumerary force sufficient for such purposes, and are more dependent on fixed bases of supply and repair than in old days, point to a different method of using and applying the marine force to the sole purpose for which they are now necessary as a distinct branch of the naval service. If employed at the headquarters of a naval station, their efficiency as marines could be preserved by occasional embarkation of the officers and men in rotation. The substitution of marine for army garrisons at coaling stations would also relieve the army of a class of duties incidental to naval warfare which the marine force formerly performed, and which prejudicially affects the organization and arrangement of the army as a mobile field force.

Marine Corps, United States.—This is the oldest force in the American service. It was formed in 1775, and it has a history of brilliant services rendered by land and sea in all the wars of America since that date. The headquarters of the corps are at Washington, and the strength of the corps was fixed by Act of Congress (3rd March 1899) at 211 officers and 5920 non-commissioned officers and men. Its organization and system are based on the British model, and the dress corresponds to that of the United States army. A brigade of three battalions served in the Philippines in 1899. (J. C. R. C.)

Marine Salvage. See SALVAGE.

Marinette, a city of Wisconsin, U.S.A., capital of Marinette county, on the shore of Green Bay, Lake Michigan, at the mouth of the Menominee river, in the eastern part of the state, at an altitude of 611 feet. It is opposite Menominee, Michigan, with which it is connected by bridges over the Menominee river. It has an excellent harbour, and a large lake commerce, principally in lumber and iron ore. It has three railways, the Chicago and North-Western, the Chicago, Milwaukee, and St Paul, and the Wisconsin and Michigan. Its manufacturing establishments consist in great part of saw, shingle, and planing mills, and paper and pulp mills. Population (1880), 2750; (1890), 11,523; (1900), 16,195, of whom 5542 were foreign-born. The death-rate in 1900 was 14·3.

Marino, a town of the province of Rome, Italy, on a spur (1422 feet) of the Alban hills, 15 miles south-east of Rome. It occupies the site of the ancient *Castrimœnium.* In the Middle Ages it was a stronghold, first of the Orsini, then of the Colonna. It has a cathedral, and possesses soap factories, ironworks, and tanneries, and is famous for its wine. Population, about 6000.

Mario, Giuseppe, COUNT OF CANDIA (1810–1883), Italian singer, the most famous tenor of the 19th century, son of General di Candia, was born at Cagliari in 1810. His career as a singer was the result of accidental circumstances. While serving as an officer in the Sardinian army he was imprisoned at Cagliari for some trifling offence. When his period of confinement was over, he resigned his commission. His resignation was refused, and he fled to Paris. There his success as an amateur vocalist produced an offer of an engagement at the Opera. He studied singing for two years under M. Ponchard and Signor Bordogni, and made his *début* in 1838 as the hero of Meyerbeer's *Robert le Diable.* His success was immediate and complete, but he did not stay long at the Opera. In 1839 he joined the company of the Théâtre Italien, which then included Malibran, Sontag, Persiani and Grisi, Rubini, Tamburini, and Lablache. His first appearance here was made in the character of Nemorino in Donizetti's *Elisir d'Amore.* He sang in London for the first time in the same year. His success in Italian opera far surpassed that which he had won in French, and in a short time he acquired a European reputation. He had a handsome face and a graceful figure, and his voice, though less powerful than that of Rubini or that of Tamberlik, had a velvety softness and richness which have never been equalled. Experience gave him ease as an actor, but he never excelled in tragic parts. He was an ideal stage lover, and he retained the grace and charm of youth long after his voice had begun to show signs of decay. He created very few new parts, that of Ernesto in *Don Pasquale* (1843) being perhaps the only one deserving of mention. Among the most successful of his other parts were Otello in Rossini's opera of that name, Gennaro in *Lucrezia Borgia,* Almaviva in *Il Barbiere di Siviglia,* Fernando in *La Favorita,* and Manrico in *Il Trovatore.* Mario made occasional appearances in oratorio, singing at the Birmingham Festival of 1849 and at the Hereford Festival of 1855, and undertook various concert tours in the United Kingdom, but his name is principally

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[1] Includes 22,289 of the engineer branch providing the locomotion of modern ships—just as seamen from 1805–58 provided it for ships of the past.

"A Village Scene." By Jacob Maris.

associated with triumphs in the theatre. In 1856 he married Giulia Grisi, the famous soprano, by whom he had five daughters. Mario bade farewell to the stage in 1871. He died at Rome in reduced circumstances, 11th December 1883. (R. A. S.)

Marion, a city of Indiana, U.S.A., capital of Grant county, 67 miles north-east of Indianapolis, towards the north-eastern part of the state, on the Cleveland, Cincinnati, Chicago and St Louis, the Pittsburg, Cincinnati, Chicago and St Louis, and the Toledo, St Louis and Western railways, at an altitude of 811 feet. It is in an agricultural and natural gas region, and its manufacturing establishments include glass-works, flour-mills, and steel rolling mills. It is the site of a national soldiers' home. Population (1880), 3182; (1890), 8769; (1900), 17,337, of whom 564 were foreign-born and 650 were negroes.

Marion, a city of Ohio, U.S.A., capital of Marion county, a little north of the centre of the state, on the Cleveland, Cincinnati, Chicago and St Louis, the Hocking Valley, the Columbus, Sandusky and Hocking, and the Erie railways, at an altitude of 979 feet. It is in a rich agricultural region, and its manufactures consist mainly of agricultural tools and machinery. Population (1880), 3899; (1890), 8327; (1900), 11,862, of whom 782 were foreign-born and 112 were negroes.

Maris, Jacob (1837–1899), Dutch painter, first studied at the Antwerp Academy, and subsequently in Hébert's studio during a stay in Paris from 1865 till 1871. He returned to Holland when the Franco-Prussian war broke out, and died there in August 1899. Though he painted, especially in early life, domestic scenes and interiors invested with deeply sympathetic feeling, it is as a landscape painter that Maris will be famous. He was the painter of bridges and windmills, of old quays, massive towers, and level banks; even more was he the painter of water, and misty skies, and chasing clouds. In all his works, whether in water or oil-colour, and in his etchings, the subject is always subordinate to the effect. His art is suggestive and realistic rather than decorative, and his force does not seem to depend on any preconceived method, such as a synthetical treatment of form or gradations of tone. And yet, though his means appear so simple, the artist's mind seems to communicate with the spectator's by directness of pictorial instinct, and we have only to observe the admirable balance of composition and truthful perspective to understand the sure knowledge of his business that underlies such purely impressionist handling. Maris has shown all that is gravest or brightest in the landscape of Holland, all that is heaviest or clearest in its atmosphere—for instance, in the "Grey Tower, Old Amsterdam," in the "Landscape near Dordrecht," in the "Seaweed Carts, Scheveningen," in "A Village Scene" (see Plate), and in the numerous other pictures which have been exhibited in the Royal Academy, London, Edinburgh (1885), Paris, Brussels, and Holland, and in various private collections. "No painter," says M. Philippe Zilcken in his work on the modern painters of the Netherlands, "has so well expressed the ethereal effects, bathed in air and light through floating silvery mist, in which painters delight, and the characteristic remote horizons blurred by haze; or again, the grey yet luminous weather of Holland, unlike the dead grey rain of England or the heavy sky of Paris."

See Max Rooses. *Dutch Painters of the Nineteenth Century.* London, 1899.—R. A. M. Stevenson. "Jacob Maris," *Magazine of Art*, 1900.—Ph. Zilcken. *Peintres Hollandais Modernes.* Amsterdam, 1893.—Jan Veth. "Een Studie over Jacob Maris," *Onze Kunst.* Antwerp, 1902. (O. M*.)

Maritime Province (*Primorskaya Oblast*), a province of Russia, representing a strip of territory along the Pacific coast of Russian Manchuria and East Siberia, from the Korean town Kyghen-nu (42° 38′ N.) to Bering Strait. Area, 715,990 square miles. The population in 1898 was 228,824, of whom only 73,455 were women, and 50,585 lived in towns, while the remainder were distributed as follows:—South Usuri, 98,711 (and 29,185 at Vladivostok); North Usuri Cossacks, 20,917. The population of the Khabarovsk district is 12,692 (and 15,082 in the town of Khabarovsk); of Udskoi district, 10,032 (and 5726 at Nikolaievsk); Okhotsk district, 4615 (and 199 at Okhotsk town); Petropavlovsk district (Kamchatka), 8010, and 398 at the town of same name; Ghizhiga district, 7571; Commander Islands, 653; Anadyr district (Chukchi Land), 12,425; mining district, 2608. The Russians number 128,946; the natives (Chukchi, Tungus, Orochons, Golds, &c.), 44,705; the Koreans, both Russian and Korean subjects, 23,279; the Chinese, 29,284 (only 453 women); the Japanese, 2030; various, 580. The yearly increase during the years 1895–97 was from 2438 to 3170. Commander Islands—Bering, Myednyi (Copper), and Tyuleniy—are important as the centre for seal-hunting. In the years 1871 to 1891 an average of 30,000 seals (occasionally 50,000) were killed on these islands every year. But as the American and British hunters kill the seals at distances of from 30 to 150 miles from the islands, the number of seals obtained on Commander Islands fell to an average yearly catch of only 13,000.

Hunting remains an important branch of income, the yearly items being about 5800 sable furs, 15 beaver, 2700 fox, 65,000 squirrel, 1830 bear, and so on. Fishing (salmon and other fish) is considerable in Kamchatka, the Sea of Okhotsk, and along the Manchurian coast, as also in the Amur, the Usuri, and other rivers. Active measures were taken in 1883–97 for increasing the Russian population in the South Usuri district, the result being that 29,093 immigrants, chiefly Little Russian peasants, transported on board ships from Russia, settled there, although 501 of them chose to return to Russia. Besides, 3788 Cossacks from the Don and Orenburg (1746 women) came to settle among the Usuri Cossacks. The immigration of Koreans to the Usuri region, which was especially strong after the famine in Korea in 1869, has now been stopped by law. Agriculture is gradually developing in the South Usuri region, where 127,600 acres were under grain crops in 1897, but it shows slow progress among the Cossacks, who had only 18,900 acres under crops. It is estimated that there were in the same year 39,215 horses, 58,070 horned cattle, 1250 sheep, 168,700 reindeer, and 32,130 trail-dogs in the Maritime Province. Gold-mining has been started in the province on the Amguñ, a tributary of the Amur, and from 264 ℔ in 1889 it attained 4660 ℔ in 1897. Coal is found on the Muravioff-Amursky peninsula, near Vladivostok, as well as in Kamchatka. Maritime trade has been on the increase, the number of ships visiting Nikolaievsk, at the mouth of the Amur, being 86 (chiefly Japanese), and Vladivostok, 246 (chiefly German), in 1897. The total imports were: 14,340,000 roubles in 1896, and 6,299,000 in 1897 (mostly for the Crown). As to river steamers, 120 were afloat in the same year in the system of the Amur, and this number has increased since. But when the Amur is frozen, there is no communication between Khabarovsk and Blagovyestchensk or Nikolaievsk, except on sledges along the river, or on horseback when the ice is not safe. Roads exist only in the South Usuri district. At present a railway line runs from Vladivostok to Nikolsk (69 miles), and thence to Khabarovsk along the right bank of the Usuri (400 miles). At Nikolsk begins the Manchurian railway, which, notwithstanding the delay occasioned by the Boxer rising, is ready now as far as Transbaikalia, and is open for service and partly for private traffic.

See *Maritime Province* (*Primorskaya Oblast*), by P. Th. Unterberger. St Petersburg, 1900.—*Memoirs* of Russ. Geogr. Soc., Statistics, vol. viii. (P. A. K.)

Markby, Sir William (1829–——), English jurist, the fourth son of the Rev. William Henry Markby, rector of Duxford St Peter's, was born at Duxford, Cambridge, in 1829. He was educated at Bury St Edmunds and Merton College, Oxford, where he took his degree in 1850. In 1856 he was called to the bar, and in 1865 he became recorder of Buckingham. In 1866 he went to India as judge of the High Court of Calcutta. This post he held for twelve years, and on his retirement was appointed Reader in Indian Law at Oxford. In 1892 he was a member of the Commission to inquire into the administration of justice at Trinidad and Tobago. Besides *Lectures on Indian Law*, he wrote *Elements of Law considered with reference to the General Principles of Jurisprudence.* The latter, being intended in the first place for Indian students, calls attention to many difficulties in the definition and application of legal conceptions which are usually passed over in text-books, and it ranks as one of the few books on the philosophy of law which are both useful to beginners and profitable to teachers and thinkers. In 1897 appeared *The Indian Evidence Act, with Notes.* Sir William Markby also contributed to the law magazines articles on *Law and Fact, German Jurists and Roman Law, Legal Fictions*, &c., several of which are embodied in the later editions of the *Elements.* He was made D.C.L. of Oxford in 1879, and K.C.I.E. in 1889.

Market.—This term is used in two well-defined senses:—

(1) It means a definite place where traders who are retail sellers of a specific class of commodity or commodities are in the habit of (*a*) awaiting buyers every day in shops or stalls; or (*b*) proceeding to the place in question on specified days at more or less frequent regular intervals. Covent Garden market for fruit and flowers, and Leadenhall market for meat and poultry, are good examples in London of the kind of institution included in class (*a*). They are a very ancient economic phenomenon, dating from the earliest period of the development of organized communities of human beings, and in general characteristics have changed little since they began to exist. Markets of the type of class (*b*) are also of very ancient origin (see Fairs, vol. viii.), but inasmuch as they are constituted essentially by the presence of persons, many of whom assemble from various places outside the place of meeting, they were capable of a little more development than those belonging to class (*a*), owing to increased facilities for locomotion. The nature of an ancient market of class (*a*), whither a citizen, say of Athens, or his chief slave, proceeded daily to make household purchases, differs little from the group of shops visited by the wives of the poor or less wealthy citizens of modern states. In many places abroad, and not a few in England, actual markets still exist. It may be said that the huge collections of shops, such as the various co-operative stores, are only a revival of the old "market-place," with its shops or booths gathered round a central area, adapted to the needs of modern big cities.

(2) The term "market" has come to be used in another and more general sense in modern times. According to Jevons, a market is "any body of persons who are in intimate business relations, and carry on extensive transactions in any commodity." He adds that "these markets may or may not be localized," and he instances the money market as a case in which the term "market" denotes no special locality. As a rule, however, most of the business of a market is transacted at some particular place, such as the London Stock Exchange, the Baltic, the Bourse of Paris, the Chicago "Wheat-pit." Even in the case of the London money market, merchants still meet twice a week at the Royal Exchange to deal in foreign bills, although a considerable part of the dealings in these securities is arranged daily at offices and counting-houses by personal visits or by telegraphic or telephonic communication. The markets in any important article are all closely interconnected. The submarine cable has long ago made Chicago as important an influence on the London corn market as Liverpool, or rather both London and Liverpool affect and are simultaneously affected by Chicago and other foreign markets. In like manner the Liverpool cotton market is influenced by the markets in New Orleans and other American cities separated from it widely in space. In a minor degree the dealers in all places where a cotton market exists affect the bigger markets to some extent. What is true of the cotton market is also true to some extent of all markets, though few markets are so highly organized or show such large transactions as that for cotton. Among other markets of the first class may be mentioned those for pig-iron, wheat, copper, coffee, and sugar. There are many articles the markets for which are of considerable dimensions at times, but are of an intermittent character, such as the London Wool Sales, which take place now in five "series" during the year. Formerly the number of "series" was four.

Characteristics of Markets.

The conditions required in order that the operations of a trading body may display the fully-developed features of a modern market, whether for commodities or securities, are:—

(1) A large number of parties dealing.

(2) A large amount of the commodities or securities to be dealt with.

(3) An organization by which all persons interested in the commodity or security can rapidly communicate with one another.

(4) Existence and frequent publication of statistical and other information as to the present and probable future supply of the commodity or security.

Movements of prices.

The movements which take place in prices in any market, whether fully organized or not, depend largely on changes of opinion among buyers and sellers. The changes of opinion may be caused by erroneous as well as by correct information. They may also be the result of wrong inferences drawn from correct information. In markets for commodities of the first importance such as wheat, cotton, iron, and other articles which are dealt in daily, the state of opinion may vary much during a few hours. The broad characteristics of markets of this class are similar. There is a tendency in all of them to show phenomena of annual periodicity, due partly to the seasons, the activity of certain months being in normal years greater in the case of any given market than that of other months. This tendency was always liable to be interfered with by the special forces at work in particular years; and the great increase in the facilities of communication between dealers by telegraph, and of transportation of commodities between widely distant points, which was one of the marked features of the development of the economic organism in all actively commercial countries during the last thirty years of the 19th century, has still further interfered with it. Nevertheless, a tendency to annual periodicity is still perceptible, especially in markets for produce of the soil, the supply of which largely depends on the meteorological conditions of the areas where they are grown on a scale sufficient to furnish an appreciable proportion of the total produce.

Cycles.

Periodicity of another kind known as "cyclic," and due to a different set of causes, is believed to exist by many persons competent to form a judgment; but although the evidence for this view is, in the opinion of the present writer, very strong, the theory expounding it is not yet in a sufficiently advanced state to admit of its being regarded as established.

Phenomena of Markets.

Bagehot said of the money market that it is "often very dull and sometimes extremely excited." This classical description of the market for non-specialized wealth applies to a large extent to all markets.

Tendency to equilibrium.

Every market is at every moment tending to an equilibrium between the quantity of commodities offered and that of commodities desired; supposing equilibrium to have been attained in a given market, and that for some appreciable period it is not disturbed, the price for the commodity dealt in in the market will remain practically unchanged during that period. Not that there will be no transactions going on, but that the amounts offered daily will be approximately equal to the amounts demanded daily.

Disturbance of equilibrium.

We have briefly described the statical condition of a market; we must now briefly examine its dynamics. Disturbance may take place through a change in—

(1) Supply, or opinion as to future probable supply.
(2) Demand, or opinion as to future probable demand.
(3) In both simultaneously, but such a change that demand is increased or decreased more than the supply, or *vice versâ*.

A moderate disturbance caused by one of the above changes, or a combination of them, will produce an immediate effect on the price of the commodity, which again will tend to react on both the supply and the demand by altering the opinions of sellers and buyers. If no further change tending to disturb the market takes place, the market will gradually settle down again to a state of equilibrium. But if the disturbance has been considerable, a relatively long time may elapse before the market becomes quiet; and very likely the level of price at which the new equilibrium is established will be very different from that ruling before the disturbance set in. Further scientific investigation of the dynamics of a market is in any case very difficult, and is impossible without a complete analysis of the statical condition, such as is found at length in the text-books of mathematical economics; but it is possible to describe briefly certain dynamical phenomena of markets which are of a comparatively simple character, and are also of practical interest.

Future delivery.

Every great market is organized with a view not merely to the purchase and sale of a commodity at once, or "on the spot," but also with a view to the future requirements of buyers and sellers. This organization arises naturally from the necessities of business, since modern industry and commerce are carried on continuously, and provision has to be made for the requirements, say, of a spinning-mill, by arranging for the delivery of successive quantities of cotton, wool, or silk over a period of months "ahead." In the case of cotton "forward deliveries" can be purchased six or seven months in advance, and the person who undertakes to deliver the cotton at the times stated is said in the language of the market to "sell forward." If the quantity of cotton produced each year were always the same, no very remarkable results would follow from this mode of doing business except the economy resulting to the spinner from not being compelled to lock up part of his capital in raw material before he could use it. But as the cotton and other crops vary considerably from year to year, some curious consequences follow from the practice of "selling forward." The seller, of course, makes his bargain in the belief that he will be able to "cover" the sale he has made at a profit—that is, he hopes to be able to buy the cotton he has to deliver at a lower price than he undertook to deliver it at. If so, all is well for both parties, for the buyer has had the advantage of having insured a supply of cotton. But supposing something has happened to raise the price considerably, such as a great "shortage" of the crop, the seller may lose. If a great many other persons have taken the same mistaken view of the probabilities of the market, a condition of things may arise in which they may be "cornered."

"Corners."

A "corner" in an exchangeable article is an abnormal condition of the market for it, in which, owing to a serious miscalculation of probable supply, many traders who have made contracts to deliver at a certain date are unable to fulfil them. In most cases the fact that the market is "oversold" becomes known some time before the date for the completion of the contracts, and other traders take advantage of the position to raise the price against those who are "short" of the article. A corner is therefore usually a result of the failure of a speculation for the fall. Theoretically a trader who has undertaken to deliver 100 tons of an article, but cannot, after every endeavour, obtain more than 90 tons, could be made to pay his whole capital in order to be relieved from the bargain. In practice he gets off more easily than this. Frequently when many traders have sold largely "forward" other traders deliberately try to use that position as a basis for creating a "corner." Generally, however, they only succeed in causing great inconvenience to all parties, themselves included, for as a rule they are only able to make the "corner" effective by buying up so much of the article that when they have compelled their opponents to pay largely to be relieved of contracts to deliver, they are left with so big a stock of the article that they cannot sell it except at a loss, which is sometimes big enough to absorb the gain previously secured. In the case of very small markets "corners" may be complete, but in big markets they are never complete, something always happening to prevent the full realization of the operators' plans. The idea of a "corner" is, however, so fascinating to the commercial mind, especially in the United States, that probably no year passes without an attempt at some operation of the kind, though the conditions may in most cases prevent any serious result.

"Corners" have what is called a "moral" aspect. It is curious to note that the indignation of the "market" at the disturbance to prices which results from operations of this kind is generally directed against the speculators for the fall, while that of the public, including trade consumers, is directed against the operator for the rise. The operator for the fall, or "bear," is denounced for "selling what he has not got," a very inaccurate description of his action, while the "bull" or operator for the rise is spoken of by a much wider circle as a heartless person who endeavours to make a profit out of the necessities of others. From a strict ethical standpoint there is really nothing to choose between the two.

THE MONEY MARKET.

There is one market which presents features of so peculiar a character that it is necessary to describe it more particularly than other phenomena of the kind, and that is the money market. The term money is here used to denote *non-specialized wealth*, a form of wealth which has existed from early times, but not in great abundance until within the last two or three hundred years. Immense wealth has existed in certain countries at various epochs, owing to the fertility of the soil, success in trade, or the plunder of other communities, and all states which have been great have at the time of their greatness possessed wealth; but the wealth which the countries, or a few fortunate individuals belonging to them, owned consisted largely of what is still called real property—that is, land and buildings—and of the produce of the soil or of mines. The balance consisted partly of merchandise of various kinds and shipping, and to a large extent of the precious metals, in the form of coin or bullion, or of precious stones and jewellery. Where no settled government was established no one could become or remain very wealthy who was not in a position to defend himself by the strong hand, or allied with those who were; and as a rule the only people who could so defend themselves were possessors of large areas of rich land, who were able to retain the services of those who dwelt on it either through their personal military qualities or in virtue of habit and custom. The inhabitants of wealthy cities were able to protect themselves to some extent, but they nearly always found it necessary to ally themselves with the neighbouring land-owners, whom they aided with money in return for military support.

A money market in the modern sense of the word could only exist in a rudimentary form under these conditions. There was a sort of money market, for there was a changing rate of interest and a whole code of law relating to it (Macleod, *Banking*, 3rd ed. p. 174) in republican Rome; but although large lending and borrowing transactions were part of the daily life of the Roman business world, as well as of those of the Greek cities and of Carthage and its dependencies, none of these communities presented the phenomena of a highly organized market. Money-lending was also a regular practice in Egypt, Chaldea, and other ancient seats of civilization, as recent discoveries show. It was only in comparatively recent times, however, when Europe had formed itself into more or less organized states, with conditions fairly favourable to the steady growth of trade and industry, that organized money markets came into existence in places such as Venice, Genoa, Augsburg, Basel, the Hanse towns, and various cities in the Low Countries, Spain and Portugal, as well as in London. The financial strength of these rudimentary money markets was not very great, and as it depended a good deal on the possession by individuals of actual cash, the existence of these markets was precarious. "Hoarded ducats" were too often an attraction to needy princes, whose unwelcome attentions a rich merchant, even when an influential burgher of a powerful city, was less able to resist than the violence of a vulgar housebreaker, against whom strong vaults and well-secured chests situated in defensible mansions were a good protection. The necessitous potentate could often urge his desire for a "loan" by very persuasive methods. Occasionally, if his predecessors had acquired the confidence of the banking class sufficiently to induce them to place their cash reserves in one of his strong places "for safety," an unscrupulous ruler could help himself, as Charles II. helped himself to the stores of the London goldsmiths which were left in the Mint. The power of the banking class continued to grow, however, and a real market for money had come into existence in many cities of Europe by the middle of the 17th century. The Bank of England was founded in 1694. "Banks" of a sort had existed in various countries certainly since the beginning of the 15th century; and it is claimed for Child and Co. that they existed as a bank in 1559, and Martin's can trace their origin equally far as "goldsmiths." The Bank of Amsterdam was founded about 1614, and a bank was established in Barcelona in 1400 (Turner, *Bank of England*, p. 2); but until the 17th century it was difficult to distinguish merchants from bankers, who in England were usually known as goldsmiths. Readers who are interested in the early history of banking in London may be referred to Mr Hilton Price's *Handbook of London Bankers*, and Mr John B. Martin's *Grasshopper in Lombard Street*.

The early money market.

In the 18th century the "money market" consisted of the Bank of England and various banks and merchants, the distinction between the two being still not complete. Towards the end of that century arose an important class of dealers in credit, the bill-brokers, and with their appearance the modern money market of London may be said to have assumed its present form, for though the process of development has not ceased, the changes have been of the nature of growth and not of the acquisition of new organs. The formation of joint-stock banks and discount companies, however, and the reconstitution of the Bank of England by the Act of 1844, exercised an important influence on the way in which the money market of London has developed. It must be explained that in the everyday talk of the City "the market" has a special meaning, by which only the banks and discount houses are denoted, as in the phrases constantly seen in the daily reports published in the newspapers towards the end of a quarter, "the market has to-day borrowed largely from the Bank of England," or, "the market was obliged to renew part of the loans which fell due to the Bank to-day." But this use of the term in a special sense, thoroughly understood by those to whom it is habitual, and resulting in no ambiguity in practice, is not in accord with the requirements of economic analysis. It may be as well to add that the charge for interest on loans and for the discount of bills is always quoted as a rate per cent. per annum, and the sum actually payable is arrived at by calculating the number of days during which the loan, or bill, runs.

The modern money market of London.

The working organs of the money market of London at the beginning of the 20th century were:—

A. (1) The Bank of England.
   (2) Banks, joint-stock and private, including several great foreign banks.
   (3) Discount houses and bill-brokers.

B. (4) Certain members of the Stock Exchange.
   (5) Certain great merchants and finance houses.

The institutions included in group A are the most constantly active organs of the money market; those included in group B are intermittently active, but in the case of section (4), though their activity is greater at some times than others, they are never wholly outside the market. Even in the case of (5) a certain amount of qualification is needed, which is indicated by the fact that most of the great merchant houses are "registered" as bankers, though they do not perform the functions usually associated with that term in the United Kingdom. Several of the great houses were originally and still are nominally merchants, but are largely concerned with finance business—that is, with the making of loans to foreign governments and the issue of capital on behalf of companies. During the Boer war (1899–1902) their assistance was freely given to the British Government in order to provide funds for the military operations in South Africa. These powerful capitalists often have large amounts of money temporarily in their hands, and lend it in the money market or on the Stock Exchange; one or two of them are large buyers of bills from time to time, and generally the members of this group may be said to be in sufficiently close touch with the active organs of the money market to form part of it.

The working of the money market.

The actual working of the money market has been described by that original and powerful thinker Walter Bagehot in his *Lombard Street*, a work which has attained the rank of a classic. Most of what he said in 1873 is true now, but in certain minor respects developments have taken place, the most important being the greater extent to which money is "used up" every day, or rather every night. In Bagehot's time the discount houses only quoted "allowance" rates for "loans at call and short notice" based on the rate "allowed" by the banks for loans at seven days' notice; but since then the bill-brokers have been obliged (1) occasionally to fix their terms independently of the banks, and (2) to "allow" a rate for "money for the night." This latter practice became usual about 1888 or 1889. The change it introduced was not a vital one, but has some importance from the point of view of the historian. A good deal of the "money" thus dealt with is derived from the group of traders included in class (5). It is (*a*) money which is temporarily in the hands of houses or institutions which have just received subscriptions to loans or other capital offered to the public; (*b*) balances left temporarily with finance houses or banks on behalf of foreign governments or other parties who have payments to make in London. In the former case the "money" is almost invariably only available for a short time, probably only for a few days; in the latter case also it probably will be only available for a few days, but *may* be available for months. Money derived from either of these sources is usually to be had cheap, but is not in the slang of the City "good," because it is uncertain how long loans at call obtained from either of them will remain undisturbed. Nevertheless there has been at times so much "money" of this fugitive character, and derived from such varied sources since about 1888, that its cheapness has been an attraction to the less wealthy bill-brokers, who have occasionally been able to go on using it profitably for many continuous weeks or even months in their business. The risk run by employing it is, of course, the certainty that it will be "called" from the borrower sooner or later, and probably at a time when it is very inconvenient to repay it. The more wealthy houses take money of this kind when it suits them, but never rely on it as a basis for business.

The great banks.

Since Bagehot wrote, the growth of the big joint-stock banks has been enormous, not so much through the increased business done by banks generally, though the expansion in banking has been considerable, as by the absorption of a great number of small banks by three or four large institutions (see Banking). It will probably be found in the future that the growth of these large institutions will tend to facilitate combination for purposes of common concern among banks generally—*e.g.*, to support the Bank of England in maintaining its reserve, which is the sole reserve of all the banks, at a proper level, and thus render the money market more stable. Two or three of the banks have for a long time, owing to their large holding of bills, had much more influence than the Bank of England over the foreign exchanges, on which the foreign bullion movements chiefly depend; and since 1890 persons of weight in the joint-stock banking body have implicitly, though not explicitly, admitted a certain degree of responsibility in the matter on behalf of their institutions. It is, however, characteristic of British business arrangements that the question of the responsibility for the reserve of the Bank of England, the ultimate reserve of the whole country, is still in as nebulous a condition, so far as explicit acceptance of responsibility by any institution is concerned, as it was in 1870. There has been no improvement in theory, though in practice there has been real improvement, since Bagehot's time.

The following is a statement of the total deposits of the joint-stock banks of the United Kingdom (with one or two unimportant exceptions), and of such private banks as publish accounts, for the end of December 1901 (not including the deposits of the Bank of England); with the cash in hand and money at call and short notice held by them at the same date (taken from the banking supplement of the *Economist* of 17th May 1902); with the figures for corresponding dates at the end of 1896 and 1891, the reserve in the banking department of the Bank of England on 24th December 1901, 23rd December 1896, and 23rd December 1891, and the amounts cleared by the London Bankers' Clearing House in 1901, 1896, and 1891.

Deposits.

Banks.	December 1901.	December 1896.	December 1891.
	£	£	£
England and Wales . .	584,842,000	495,233,000	391,900,000
Scotland . .	107,321,000	95,695,000	92,368,000
Ireland . .	49,117,000	45,552,000	39,451,000
Total deposits	741,280,000	636,480,000	523,719,000

Cash in hand and at call.

Banks.	December 1901.	December 1896.	December 1891.
	£	£	£
England and Wales . .	153,943,000	115,870,000	91,038,000
Scotland . .	26,870,000	22,005,000	20,682,000
Ireland . .	10,797,000	9,423,000	9,520,000
Total cash in hand and at call . .	191,610,000	147,298,000	121,240,000
Reserve in the Banking Department of the Bank of England .	19,685,000	24,068,000	14,011,000
Amount of "paid clearing" of London clearing bankers .	9,561,169,000	7,574,853,000	6,847,506,000

With regard to the above figures, it may be pointed out that the proportion borne by the "cash in hand, &c.," to the total deposits was 25·8 per cent. in 1901, 23·1 per cent. in 1896, and 23·1 per cent. in 1891. The proportion of the reserve of the Bank of England to the total deposits was 2·7 per cent. in 1901, 3·8 per cent. in 1896, and 2·7 per cent. in 1891. The last return in December always shows a reserve below the average for the year. Although the proportion as shown by the above figures is the same as in 1891, there has really been some improvement, because the statement of deposits in that year does not include many banks, now included, which did not publish balance-sheets in the former year. The earlier proportion was therefore really smaller than it appeared to be. The Bank of England's average weekly reserve now is, moreover, much larger than it used to be before 1890. For 1889 the average weekly reserve was only £13,228,000, against liabilities probably nearly as great as those of 1891. (See Banking.) Of the "cash in hand, &c.," more than half, judging by the thirteen big banks whose accounts are analysed every month in *The Times*, must be in "cash in hand and at the Bank of England." It is to be regretted that all banks do not give this item separately from "cash at call and notice."

The discount houses.

The discount houses, though an important body of institutions, are not of so much importance as they were before 1866, when they suffered a serious blow through the failure of "Overend's," from which as a body they have never fully recovered. The five large concerns which still exist are, however, very powerful, and exercise considerable influence on the market. They hold considerable quantities of bills at all times; occasionally their holdings are very large; but they turn out the contents of their bill cases readily if they think fit. Their business is different in practice from that of the smaller "bill-brokers," who usually are what their name suggests, namely, persons who do not hold many bills, but find them for banks who need them, charging a small commission. The small bill-brokers borrow from the Bank of England much more freely than the big discount houses. The latter only "go to the bank" in ordinary times perhaps once or twice a year. During the South African war, which disturbed the money market very much, they obtained accommodation from the Bank more frequently than usual. The small brokers almost always have to borrow from the Bank at the end of every quarter, when money is scarce owing to the regular quarterly requirements of business, and also, to some extent, because certain of the banks make it a practice to call in loans at the end of each month in order to show a satisfactory cash reserve in their monthly balance-sheet. This practice is not approved by the best authorities, for although it does no great harm in quiet times, the banks who follow it might find it difficult, or even impossible, to call in their loans in times of severe stringency.

AUTHORITIES.—WALTER BAGEHOT. *Lombard Street.* Kegan Paul, Trench and Co.—ARTHUR ELLIS. *Rationale of Market Fluctuations.* Effingham Wilson.—ROBERT GIFFEN. *Stock Exchange Securities.* George Bell and Sons, 1879.—W. STANLEY JEVONS. *Theory of Political Economy*, 2nd edition, 1879, pp. 91 *sq.* Macmillan; *Investigations in Currency and Finance*, various passages. Macmillan.—HENRY SIDGWICK. *Principles of Political Economy*, book ii. chap. ii. Macmillan.—AUGUSTIN COURNOT. *Theory of Wealth* (1838), translated by Nathaniel T. Bacon. Macmillan, London and New York.—GEORGE CLARE. *A Money Market Primer and Key to the Exchanges.* Effingham Wilson.—JOHN STUART MILL. *Principles of Political Economy*, book iii. chaps. i.–vi. (W. HO.)

Market Harborough, a manufacturing and market-town and parish in the Harborough parliamentary division of Leicestershire, England, 14 miles south-east of Leicester by rail, traversed by the Grand Union Canal. There are malt-houses and boot, shoe, and stay factories. The town is also an important hunting centre. Population of urban district (Market Harborough with Great and Little Bowden) (1891), 5876; (1901), 7735.

Markham, Sir Clements Robert (1830- ——), English traveller, geographer, and author, son of the late Rev. David F. Markham, canon of Windsor, and of Catherine, daughter of Sir W. Milner, Bart., of Nunappleton, Yorkshire, was born on 20th July 1830 at Stillingfleet, near York, and educated at Westminster School. He entered the navy in 1844, and was appointed naval cadet on board H.M.S. *Collingwood.* He served under Sir George Seymour on the Pacific station, became midshipman in 1846, and passed for a lieutenant in 1851. In 1850–51 he served on the Franklin search expedition in the Arctic regions, under Captain Austin. He retired from the navy in 1852, and in 1852–54 travelled in Peru and the forests of the eastern Andes. He visited South America again in 1860–61, in order to arrange for the introduction of the cinchona plant into India, a service of the highest value to humanity. In 1865–66 he visited Ceylon and India, in order to inspect and report upon the Tinnevelly pearl-fishery and the cinchona plantations. On the Abyssinian expedition of 1867–68 he served as geographer, and was present at the storming of Magdala. In 1874 he accompanied the Arctic expedition under Sir George Nares as far as Greenland. In later years Sir Clements Markham travelled extensively over Europe, and also in western Asia and the United States. He also held various official and honorary positions at home. In 1855 he became a clerk in the Board of Control. From 1862-64 he was private secretary to Mr T. G. Baring, afterwards the earl of Northbrook. From 1867–77 he was in charge of the geographical department of the India Office. He was secretary to the Hakluyt Society from 1858–87, and became its president in 1890. From 1863–88 he acted as secretary to the Royal Geographical Society, and on his retirement received the society's gold medal for his distinguished services to geography. He was elected president of the same society in 1893, and took an active share in the work of the society and in increasing its usefulness in various directions. It was almost entirely due to his unwearied exertions, extending over several years, that the funds were obtained for the National Antarctic Expedition under Captain Robert Scott, which left England in the summer of 1901. He was president of the International Geographical Congress which met in London in 1895. Sir Clements Markham conducted the *Geographical Magazine* from 1872–78, when it became merged in the *Proceedings of the Royal Geographical Society.* Among his other publications may be mentioned the following: *Franklin's Footsteps*, 1852; *Cuzco and Lima*, 1856; *Travels in Peru and India*, 1862; *A Quichua Grammar and Dictionary*, 1863; *Spanish Irrigation*, 1867; *A History of the Abyssinian Expedition*, 1869; *A Life of the Great Lord Fairfax*, 1870; *Ollanta, a Quichua Drama*, 1871; *Memoir on the Indian Surveys*, 1871 (2nd ed. 1878); *General Sketch of the History of Persia*, 1873; *The Threshold of the Unknown Region*, 1874 (4 editions); *A Memoir of the Countess of Chinchon*, 1875; *Missions to Thibet*, 1877 (2nd ed. 1879); *Memoir of the Indian Surveys; Peruvian Bark*, 1880; *Peru*, 1880; *The War between Chili and Peru, 1879–81* (3rd ed. 1883); *The Sea Fathers*, 1885; *The Fighting Veres*, 1888; *Paladins of King Edwin*, 1896; *Life of John Davis the Navigator*, 1889; also lives of *Admiral Fairfax, Admiral John Markham, Columbus*, and *Major Rennell;* a *History of Peru;* editions with introductions of twenty works for the Hakluyt Society, of which fourteen were also translations; sixty-seven papers in the Royal Geographical Society's *Journal;* the *Reports on the Moral and Material Progress of India for* 1871–72 and 1872–73; *Memoir of Sir John Harington* for the Roxburghe Club, 1880; the Peruvian chapters for Winsor's *History of America*, and the chapters on discovery and surveying for Clowes's *History of the Navy.* Sir Clements Markham was elected a Fellow of the Royal Society in 1873, and became an honorary member of the principal geographical societies; he was created C.B. in 1871, and K.C.B. in 1896; in 1874 he was created a Commander of the Portuguese Order of Christ, and a Chevalier of the Brazilian Order of the Rose; in 1898, Commander (first-class) of the Swedish Order of the North Star.

Marlboro, a city of Middlesex county, Massachusetts, U.S.A., in the central part of the state, with an area of about 22 square miles, diversified with hills and ponds, and traversed by the Fitchburg, and the New York, New Haven and Hartford railways. In 1900 there were 142 manufacturing establishments, with a capital of $2,191,860, an average number of 2780 hands, and products valued at $4,986,399. The chief industry is the manufacture of boots and shoes. Marlboro was formerly a town, but was chartered as a city in 1890. Population (1890), 13,805; (1900), 13,609, of whom 3311 were foreign-born.

Marlborough, a municipal borough and market town in the Devizes parliamentary division (since 1885) of Wiltshire, England, 11 miles south by east of Swindon by rail. Marlborough College is now divided into three schools, the upper, modern, and lower. In the upper a classical education, preparatory for the universities, is mainly given; in the modern, mathematics, science, and modern languages are specially taught, and there are separate classes for army and navy pupils. Foundation scholarships preserve the original purpose of the school—that it should be for the education of the sons of clergymen. Several important additions have been made to the school buildings, including a museum (1883), a handsome chapel (1886), north classrooms (1893), and a memorial reading-room (1900). In 1901 the number of scholars was 600. Population (1891), 3012; (1901), 3046.

Marlow, Great, a town and railway station in the Wycombe parliamentary division (since 1885) of Buckinghamshire, England, 5 miles north by west of Maidenhead, on the Thames, which is here crossed by a pretty suspension bridge. It formerly returned two members to Parliament, but in 1885 its representation was merged in that of the county. Since 1896 it has been governed by an urban district council. Population of urban district (created 1893) (1891), 4212; (1901), 4526.

Marmande, chief town of arrondissement, department of Lot-et-Garonne, 35 miles north-west of Agen, on railway from Bordeaux to Cette. The church, a Gothic edifice, dating in part from the 13th century, contains a fine 17th-century altar-piece and some good modern glass. Local institutions comprise the communal college, hospital, library, tribunal of commerce, and consultative chamber of agriculture. Brandy and liqueurs are manufactured, and there is considerable commerce in grain, flour, wine, hemp, and prunes. The town, which dates from the 6th century, suffered severely during the war of the Albigenses. In 1214, and again in 1219, it surrendered to the De Montforts, and on the latter occasion many of the inhabitants were massacred in cold blood. Population (1881), 6117; (1901), 9184.

Marmier, Xavier (1809–1892), French author, was born at Pontarlier in 1809. He had a passion for travelling, and this he combined throughout his life with the production of literature. After journeying in Switzerland, Belgium, and Holland, he was attached in 1835 to the Arctic expedition of the *Recherche;* and after a couple of years at Rennes as professor of foreign literature, he visited (1842) Russia, (1845) Syria, (1846) Algeria, (1848–49) North and South America, and numerous volumes from his pen were the result. In 1870 he was elected to the Academy, and he was for many years prominently identified with the Sainte-Geneviève library. He died at Paris in 1892.

Marne, a department of the north-east of France, watered by the Marne.

Area, 3168 square miles. The population, 429,494 in 1886, had increased to 432,850 in 1901. In 1899 the deaths, numbering 9559, exceeded the births, 9544, of which 950 were illegitimate; marriages numbered 3260. There were in 1896, 1042 primary schools, with 64,000 pupils, the illiterate forming 3 per cent. of the population. The area under cultivation in 1896 amounted to 1,910,193 acres, of which 1,336,888 acres were plough-land and 34,595 acres vineyards. The land in wheat in 1899 yielded the value of £1,186,000; rye, £440,000; barley, £251,000; oats, £260,000; mangold-wurzel, £136,000. Green crops (trefoil, lucern, and sainfoin) yielded £260,000, and natural pastures £380,000. Of the industrial cultures, beetroot, producing the value of £189,000, is alone worth mentioning. The vine, however, notwithstanding the very limited surface it covers, yet by virtue of the quality of its wine (champagne) returned in 1899 the value of £1,612,000. The live stock in 1899 numbered 48,300 horses, 119,990 cattle, 294,150 sheep, and 64,410 pigs. Agriculture is the main occupation of this department. There is some peat-cutting (1300 metric tons in 1898), and some mining of iron and limestone. The metallurgic production is inconsiderable. The textile industry, however, particularly that of wool, is in a very forward state around Reims, the department counting 8000 power-looms and 270,000 spindles. Châlons, the capital, had a population in 1901 of 21,487; Reims, 107,773.

Marne, Haute-, a department of the east of France, watered by the Marne.

Area, 2416 square miles. The population, 247,781 in 1886, had decreased to 224,888 in 1901. In 1899, out of 4157 births, 260 were illegitimate; there were 5058 deaths; marriages numbered 1563. There were in 1896, 850 primary schools, with 32,000 pupils, not more than 1 per cent. of the population being illiterate. The area under cultivation amounted in 1896 to 1,453,032 acres, 800,649 acres in arable land and 32,124 acres in vines. A large extent of the department is covered with wood. The wheat crop of 1899 amounted to the value of £987,000; oats, £598,000; vines, 237,000; potatoes, £88,000; natural pastures, £280,000. In 1899 Haute-Marne owned 48,820 horses, 98,410 cattle, 122,330 sheep, and 99,900 pigs. The department possesses important iron mines, which in 1898 produced 147,000 metric tons. Its metallurgy (in a very forward state, especially around Langres) registered in 1898, 44,000 metric tons of cast iron, 67,500 tons of iron, and 32,400 tons of steel, of a total value of £975,000. The other industries are less important, the forges and blast furnaces consuming 6289 horse-power out of a total of 8697. Chaumont, the capital, had 14,622 inhabitants in 1901.

Marocco. See Morocco.

Marochetti, Carlo, Baron (1805–1867), Italian sculptor, was born at Turin in 1805. After studying under Bosio, he went in 1827 to France, and his statue of "A Young Girl playing with a Dog" won a medal in 1829 at Paris. His "Fallen Angel" was exhibited in 1831. In 1848 Marochetti removed to London, and there he lived till his death on 28th December 1867. Among his chief works were statues of Queen Victoria, Lord Clyde (the obelisk in Waterloo Place), Richard Cœur-de-Lion (Crystal Palace), Emmanuel Philebert (1833, Turin), the tomb of Bellini (Père la Chaise), and the altar in the Madeleine. His style was vigorous and effective, but rather popular than artistic. Marochetti, who was created a baron by the king of Sardinia, was also a Chevalier of the Legion of Honour.

Maros-Vásárhely, a municipality of Hungary, in the county of Maros-Torda, with 15,264 inhabitants in 1891 and 19,091 in 1901. It was once the capital of the "Székelys" (Siculians). In the beautiful Gothic Calvinist church, built about 1446, situated in the old fort, was held, in the presence of Prince John Sigismund, in the year 1571, the famous diet which, for the first time in Europe, enacted the perfect liberty of religion. In its Protestant college Farkas Bolyai, the celebrated mathematician, was a leader.

Marquardt, Joachim (1812–1882), German scholar, was born at Danzig, 19th April 1812. He studied at Berlin and Leipzig, held various educational appointments from 1833 onwards at Berlin, Danzig, and Posen, and became in 1859 head of the "gymnasium" in Gotha. His *Römische Staatsverwaltung* (1873–78) and *Privatleben der Römer* (1879–82), which formed a part of Mommsen and Marquardt's revised edition of Becker's *Handbuch der Römischen Alterthümer,* were widely recognized as valuable contributions to classical learning. He died at Gotha, 30th November 1882.

Marquesas Islands. See Tahiti.

Marquette, a city of Michigan, U.S.A., capital of Marquette county, on Marquette harbour, on the south shore of Lake Superior, in the upper peninsula, at an altitude of 621 feet. The city is irregularly laid out, is divided into eight wards, and is the terminus of branches of the Duluth, South Shore, and Atlantic railway. It is the principal shipping point for ports on the lower lakes, and for Pittsburg, Pa., of the iron ores of the Marquette district, the richest iron region in the world. For handling the ores cheaply many great ore docks have been constructed, by means of which railway cars are unloaded directly into the holds of vessels. There is also a large trade in lumber. Population (1890), 9093; (1900), 10,058, of whom 3460 were foreign-born and 62 were negroes. The death-rate in 1900 was 16·6.

Marrákesh, sometimes erroneously called Morocco City, the second imperial city of Morocco, lying at the foot of the Great Atlas, 96 miles east-south-east of Saffi. Scottish missionaries and a few European traders have become established here, but no other changes have taken place for centuries. Population, 50,000 to 60,000.

MARRIAGE.

I. UNITED KINGDOM AND EUROPEAN COUNTRIES.

General progress.

SINCE 1883, when the earlier volume of this Encyclopædia (ninth edition) containing the article on marriage was published, few subjects have been more discussed and few branches of the law have undergone such significant changes. From that year itself dates the coming into operation of the Married Women's Property Act of 1882, the great charter which now regulates the position of married women in England in regard to their property and their contractual capacity generally. It was the outcome of a long struggle which led first to the Act of 1870, a tentative enactment passed to secure married women's earnings against appropriation by the husband, and in 1874 to an amending Act for the protection of the husband against debts of his wife contracted prior to the marriage, and ultimately, in 1882, to the complete emancipation of the wife's property from marital control (see more fully below). In the course of ten years English legislation in the matter of married women's property progressed from perhaps the most backward to the foremost place in Europe. By a curious contrast, the only two other European countries where, in the absence of a settlement to the contrary, independence of the wife's property is recognized, are Russia and Italy (Italian Civil Code, Art. 1425 *et seq.*).

Among other countries, in France a law of 1881 empowered the married woman to open a deposit account at the Post Office Savings Banks, but inasmuch as the husband can lodge a caveat to prevent withdrawal of the money, and can lay hands on the money as soon as an application is made by the wife to take it out, the protection is illusory. It must not, however, be supposed that the position of married women in France in respect of their property is abnormally hard. Their position is only regulated from a different point of view, and in several respects it is an exceptionally privileged one. It is mainly owing to this that progress, in the sense of the recognition of separate property, will probably be slower in France than elsewhere. Thus, though by ante-nuptial marriage contract the paraphernal system of emancipation of the wife's property may be secured, it is seldom resorted to, because in the absence of an ante-nuptial marriage contract—and in France, as elsewhere, marriage contracts are uncommon among the mass of the population—the wife is owner of one-half of all property saved or personal property acquired by succession or otherwise, after the marriage, by either husband or wife. The husband during coverture certainly has the absolute control of the whole of this joint fortune, but on dissolution of the marriage the half of it can be claimed by the wife or her heirs and assigns.

This system of community of property is engrained in French institutions and custom as the common law of the country, and there is no movement to follow the example of Italy and adopt the paraphernal system as the common law in its place. Among the French middle class the wife, owing to her ownership of half the fortune acquired by her husband, takes a more active part in his business life and holds a higher business status generally than she does in other countries. She is her husband's partner in all his enterprises, and has an equal interest with him in all their proceeds. Sometimes wonder is expressed that the bulk of French women seem so indifferent to agitation for an increase of their independence, but isolated cases of hardship are not considered a ground for altering a law on which the whole social economy of the nation is based, and which gives the French married woman a position in her household and in her family surpassing in dignity and prestige that of women in any other country.

In Scandinavia there is a marked tendency towards contractual emancipation, but as yet it has not gone farther than the married woman's earnings. Sweden adopted a law on this subject in 1874, Denmark in 1880, Norway in 1888. Germany followed the Civil Code which came into operation in 1900 (Art. 1367), providing that the wife's wages or earnings shall form part of her *Vorbehaltsgut* or separate property, which a previous article (1365) placed beyond the husband's control. As regards property accruing to the wife in Germany by succession, will, or gift *inter vivos*, it is only separate property where the donor has deliberately stipulated exclusion of the husband's right.

In several other branches of the law of marriage the United Kingdom is not as much to the front. This applies to prohibition of marriage with a deceased wife's sister (see below), to breaches of promise of marriage, perhaps even to the facility generally with which marriage is contracted and the absence of specialized control through a civil authority which might introduce more order and system into the working of the chief social institution.[1] Still marriage holds its own, though severely criticized by different contemporary writers, and the number of those entering the state of matrimony does not diminish, in spite of warnings of its probable unhappiness. There is, in fact, no significant change in the proportion of those who marry to those who (acting on Mr Punch's advice) "don't." The following table shows that the tendency is to increase rather than diminish:—

Persons married in the United Kingdom—Annual Rates per Thousand of Population.

1890	14·5	1895	14·3
1891	14·6	1896	15·0
1892	14·5	1897	15·2
1893	13·9	1898	15·4
1894	14·2	1899	15·7

In other countries the aggregate experience of marriage seems no less favourable to it.

*Marriages in Chief Continental Countries—Annual Rates per Thousand.**

	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
France	7·3	7·4	7·5	7·5	7·5	7·4	7·5	7·6	7·5	..
German Empire	8·0	8·0	7·9	7·9	7·9	8·0	8·2	8·4	8·4	8·6
Russia	8·2	8·3	9·2	8·6	9·4	9·2	8·7	9·1	..	..
Austria	7·5	7·7	7·8	7·9	7·9	8·0	7·9	8·0	7·8	8·2
Hungary	8·2	8·6	9·2	9·3	9·3	8·4	8·1	8·2	8·3	9·0
Belgium	7·4	7·5	7·7	7·6	7·5	7·8	8·1	8·2	8·3	8·2
Holland	7·0	7·1	7·2	7·3	7·2	7·4	7·5	7·4	7·3	7·4
Switzerland	7·1	7·1	7·2	7·1	7·2	7·2	7·5	7·8	7·8	7·8
Italy	7·4	7·5	7·5	7·5	7·5	7·4	7·1	7·3	7·0	7·4
Spain	8·1	8.9	8.6	8·0	8·1	..	..	..	.	.
Portugal	7·1	6·8	6·9	6·6	6·4	6·3	6·2	6·8	..	..
Denmark	6·9	6·8	6·8	7·0	6·9	7·1	7·3	7·5	7·6	7·5
Norway	6·5	6·6	6·4	6·4	6·4	6·5	6·7	6·7	7·0	7·2
Sweden	6·0	5·8	5·7	5·7	5·7	5·9	5·9	6·1	6·1	6·3

* Compiled from British official abstracts.

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[1] The existing system of national registration was introduced by Lord John Russell's Act of 1836. Sir Spencer Walpole, in his *Life of Lord John Russell* (vol. i. p. 260), observes that "his own views were enlarged and strengthened by the experience of a long lifetime, and he lived to record his opinion that it will be a matter for consideration whether the future law, instead of recognizing the marriage registers of every Christian communion and every Jewish synagogue, should not be founded on the same principle as the laws of France and Italy, constituting civil marriages the only bond recognized by the State,

Here again the trend of the figures is towards increase. Comparing the British figures (which we must halve to bring them to the same term of comparison) with the Continental, Great Britain shows a fair average, higher than Scandinavia and lower than Germany, Austria, Hungary, and Russia.

Recent legislation concerning marriage generally.

In 1886 an Act was passed in the British Parliament to remove doubts which had been entertained as to the validity of certain marriages solemnized in England when one of the parties was resident in Scotland. In the same year an Act was passed extending the hours within which marriage may be lawfully solemnized from 8 A.M. to 12 to between 8 A.M. and 3 P.M. (For the Foreign Marriage Act of 1892, see below.) The Summary Jurisdiction (Married Women) Act of 1895 enabled a wife whose husband is convicted of an assault on her, or who has been deserted by him, or been obliged owing to his cruelty to live apart from him, to apply to the justices, who are empowered by the Act to make an order for separation and grant the wife the custody of children under 16 years of age. The justices may also make an order for payment by the husband to his wife of such weekly sum, not exceeding two pounds, as, having regard to the means both of husband and wife, they may consider reasonable. The Marriage Act, 1898, authorized the celebration of marriages in places of worship duly registered for the solemnization of marriages under the Marriage Act of 1836 without the presence of the registrar, on condition of their being solemnized in the presence of a person duly authorized by the governing body of the place of worship in question. It also made further provision for the due recording of all marriages in the general registers. Lastly, the Marriages Validity Act of 1899 removed doubts as to the validity of marriages in England on Irish banns and in Ireland on English banns. The next enactment will probably be one for the purpose of regulating the solemnization in England of marriages between English women and foreign men, which may be invalid in the country of the latter.

Married women's property.

The property of married women is now governed in England by the Married Women's Property Act, 1882. Under the common law of England all the personal property which devolved upon or was acquired by the wife passed to her husband, who could, immediately on its falling into possession, deal with it as his own. He was even entitled to the rents and produce of his wife's real property. The wife could not bind herself by contract except in a few special cases (*e.g.*, if she carried on trade within the City of London). Even her personal wages and earnings could be lawfully appropriated by her husband. "The very being or legal existence of woman is suspended during her marriage, or at least it is incorporated and consolidated into that of her husband, under whose wing, protection, and cover she performs everything," wrote a learned commentator on the old law. The Court of Chancery, it is true, protected trust dispositions securing to the wife the use of her separate property, but this afforded no protection to the great mass of married women, who continued to be the victims of antiquated principles of the old law till 1870, when the legislature made the first great breach in it. Half measure though it was, it went, as we have seen, as far as, if not farther than, most Continental legislatures ventured to advance up to 1902. It excluded the husband from control over the wife's personal wages and earnings, and the investments of such independent wages and earnings, and by it contractual capacity to the extent of this independent property was necessarily by implication granted to her. The Act of 1882 was practically the extension of the operation of this Act from one kind of married women's property to the whole of it. The married woman thenceforth became capable of acquiring, holding, and disposing by will or otherwise of all her real or personal property, as if she were unmarried, and without the intervention of any trustee, and her contractual capacity and liability were extended to the whole of her separate property. She also became liable, like anybody else, to the bankruptcy laws. As a consequence of these provisions, investments standing in the wife's name are deemed to form part of her separate property till the contrary is proved, and she can transfer her stock and receive the dividends or interest of it on her sole signature. This is the *régime* under which she now lives in Great Britain and Ireland.

Scottish Acts (40 and 41 Vict. c. 29, and 44 and 45 Vict. c. 21) placed her in a similar but not identical position in Scotland. The Married Women's Property (Scotland) Act, 1881, does not, in fact, give the wife as much independence as the English Act of 1882. It extends the operation of a previous one of 1877, which secured to her the sole and exclusive disposal of her earnings, to personalty owned by her at the date of her marriage or which may come to her by bequest, but, while giving her the disposal of the income of it, it precludes her from assigning the prospective income and from disposing of the fund itself without her husband's consent.

There is an unfortunate omission in the otherwise excellent English Act of 1882. It does not deal with the devolution of the wife's property on intestacy. The surviving husband's rights therefore remain unaltered, and he remains exclusively entitled to all her personal estate, though, no property acquired by the wife (since the Act of 1882) vesting in the husband, he has to take out letters of administration to get possession of it.

An Act of 1884 made husband and wife competent witnesses in criminal proceedings against each other under the 1882 Act.

A further Act in 1893 repealed two clauses in that of 1882, the exact bearing of which had been a subject of controversy. It provided specifically that every contract thereafter entered into by a married woman, otherwise than as an agent, should be deemed to be a contract entered into by her with respect to and be binding upon her separate property, whether she was or was not in fact possessed of or entitled to any separate property at the time when she entered into such contract, that it should bind all separate property which she might at any time or thereafter be possessed of or entitled to, and that it should be enforceable by process of law against all property which she might thereafter, while discovert, be possessed of or entitled to.

Married women's powers in appointment of guardians.

One of the most interesting and significant changes in the law affecting married women was that introduced by the Guardianship of Infants Act, 1886 (49 and 50 Vict. c. 27), providing that the mother of any infant may by deed or will appoint any person or persons to be guardian or guardians of her child after the death of herself and the father of such infant, and that where guardians are appointed by both parents they shall act jointly, and that the mother of any infant may by deed or will provisionally nominate some fit person or persons to act as guardian or guardians of such infant after her death jointly with the father of such infant. The Court, after her death, if it be shown to its satisfaction that the father is for any reason unfitted to be the sole guardian of his children, may confirm the appointment of such guardian

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and leaving to the parties concerned to add any religious ceremony or ceremonies they may think proper."

or guardians, who thereupon are authorized and empowered so to act. (See also Infants.)

Marriage with a deceased wife's sister.

In spite of active and ceaseless agitation on behalf of the legalization in England of marriage with a deceased wife's sister, the advocates of the abolition of the existing disability had not succeeded up to 1902 in carrying any measure for its removal through both Houses of Parliament. In all the self-governing colonies, on the other hand, with the exception of Newfoundland, the restriction has ceased to exist. The first Act legalizing marriage with a deceased wife's sister was adopted by South Australia. The royal assent, however, was not given till the Parliament of that state had five times passed the Bill. In quick succession similar statutes followed in Victoria, Tasmania, New South Wales, Queensland, New Zealand, West Australia, Barbados, Canada, Mauritius, Natal, and Cape Colony. As regards the Channel Islands, marriages of the kind in question were made legal some years ago in Jersey, but neither in the other islands, nor in the Isle of Man, has similar progress been made.

In England the Bill to render marriage with a deceased wife's sister valid was first adopted by the House of Commons in 1850, and rejected by the House of Lords in 1851. It was subsequently brought before the legislature in 1855, 1856, 1858, 1859, 1861, 1862, 1866, 1869, 1870, 1871, 1872, 1873, 1875, 1877 and 1878 (Colonial Bills), 1879 (6th May, when in the House of Lords the prince of Wales and the duke of Edinburgh voted in favour of it), 1880, 1882, 1883, 1884, 1886, 1888, 1889, 1890, 1891, 1896, and 1898 and 1900 (Colonial Bills). In most cases it has been passed by the House of Commons and rejected in the House of Lords. In fact, few subjects have such power of exciting interest among the Peers as the Marriage with a Deceased Wife's Sister Bill. It was observed that they mustered to deal with it as if the destiny of the nation depended on its rejection. (See *Annual Register*, 1901, p. 121.) The Bill of 1896, however, which was judiciously drafted to avoid the compulsory celebration by clergymen of marriages against which they had conscientious scruples, was carried in the Lords. Both the prince of Wales and the duke of York were among the "ayes." The prime minister and eighteen bishops, including the two archbishops, voted against the Bill, the Earl of Rosebery and Lord Kimberley for it. At the third reading the Bill was carried by 142 to 104 votes. Its promoters, however, did not succeed in getting an opportunity of bringing it before the House of Commons.

From 1896 to 1901 no further direct steps were taken, but in 1898 and again in 1900 (28th May) the subject was brought forward in the House of Lords by Lord Strathcona in the form of a Bill under which marriages with a deceased wife's sister contracted in any British colony should be deemed valid for all purposes within the United Kingdom. In 1898 the Bill was carried on the second reading by 129 to 46 votes, the prince of Wales, the duke of Devonshire, and most of the Liberal Unionist peers voting in the majority, and on the third reading without a dissentient vote. The House of Commons took no action. In 1900 the Bill was supported by Lord Carrington, a former colonial governor, and Lord Kimberley, a former colonial secretary, and in spite of the opposition of the Lord Chancellor and the archbishop of York, it was carried on the second reading by 116 to 31 votes, and on the third reading again without a dissentient vote. The House of Commons, however, again took no action. An Imperial Bill reached a second reading in the House of Commons in 1901 and again in 1902, but it was blocked by the opponents of the measure when attempts were made to get it to the committee stage (5th February and 6th June).

Private international law.

The Foreign Marriage Act, 1892, has consolidated the English law relating to marriages celebrated abroad, and brings it into harmony with the current tendencies of marriage law reform generally. Under it a marriage between British subjects on land abroad is as valid as a marriage duly solemnized in England (as heretofore), if celebrated in accordance with the local law or in the presence of a "marriage officer." "Marriage officers" are diplomatic or consular agents who are appointed to act as such. The old fiction of assimilation of a British embassy to British soil can no longer be relied upon to uphold a marriage at a British embassy solemnized by an ordained clergyman. An Order in Council of 28th October 1892, moreover, provides that in the case of any marriage under the Act, if it appears to the marriage officer that the woman about to be married is a British subject, and that the man is an alien, he must be satisfied that the marriage will be recognized by the law of the foreign country to which the alien belongs.

A marriage may be solemnized on board one of His Majesty's ships at a foreign station, provided a warrant of a secretary of state has authorized the commanding officer to be a marriage officer. At sea, marriages on British public or private ships seem still valid at common law, if performed by an episcopally-ordained minister. The Merchant Shipping Act, 1894 (sect. 240), provides that the master of a ship for which an official log is required shall enter in it every marriage taking place on board, with the names and ages of the parties.

Again, under the Foreign Marriage Act all marriages solemnized within the British lines by a chaplain or officer or other person officiating under the orders of the commanding officer of a British army serving abroad, are as valid in law as if they had been solemnized within the United Kingdom subject to due observance of all forms required by law.

The principle of the English law of marriage, that a marriage contracted abroad is valid if it has been solemnized according to the *lex loci*, may be now taken to apply just as much to a marriage in a heathen as in a Christian country. Whether the marriage has or has not been celebrated according to Christian laws has no bearing upon the question, provided it is a monogamous marriage—a marriage which prevents the man who enters into it from marrying any other woman while his wife continues alive.[1] In *Hyde* v. *Hyde and Wolmansee* Lord Penzance refused relief on the ground that Mormon marriages are polygamous, although both parties were single at the time the marriage was contracted; and in *Bethell* v. *Hildyard*, Stirling J. decided against the validity of the marriage on the ground that the marriage which Mr Bethell intended to contract was not a marriage in the Christian sense, but a marriage in the sense in which the term was used among the Barolongs, which implies the power of taking another wife—that it was, in fact, a polygamous marriage. In *Brinkley* v. *The Attorney-General*, on a petition to establish the validity of a marriage between a British subject, temporarily resident in Japan, and a Japanese woman in Japan, according to the forms required by the law of the latter country, the marriage was upheld, the President of the Court observing that the phrase "Christian marriage" had been used, only for convenience' sake, to express the idea that the only marriage recognized in Christian countries is marriage of the exclusive kind, which the Japanese marriage was proved to be.

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[1] Compare the duke of Argyll's somewhat tempestuous assertion, in the debate of 1896 on the Marriage with a Deceased Wife's Sister Bill, that marriage as understood all over the Christian world was the product of Christianity and of Christianity alone.

Authorities.—Eversley. *The Law of Domestic Relations*, 2nd ed. London, 1896.—Lush. *The Law of Husband and Wife.* London, 1896.—Crawley. *The Law of Husband and Wife.* London, 1892.—Geary. *Marriage and Family Relations.* London, 1892.—Griffiths. *Married Women's Property Acts.* London, 1891.—Vaizley. *Law of Settlements of Property made on Marriage.* London, 1887.—Bishop. (America) *Marriage, Divorce, and Separation.* Chicago, 1892.—David Murray. (Scotland) *The Law relating to the Property of Married Persons.* Glasgow, 1892.—Watkins. *Holy Matrimony.* 1895.—Hath. *Marriage of Near Kin.* London, 1887.—Lecky. *Democracy and Liberty*, vol. ii. London, 1896.—H. N. Hutchinson. *Marriage Customs in Many Lands.* London.—Joseph Cook. *Boston Monday Lectures.* Cambridge, U.S.A.—Thomas Barclay. *La femme anglaise.* Paris, 1896.—Publications of the Marriage Law Reform Association, 2 Dean's Yard, Westminster (Sec. Mr. F. Paynter Allen):—*The Bishops and Marriage with a Deceased Wife's Sister.* "*The Other Side.*"—Proceedings in the Colonial Conference, 14th April 1897. Subject: "Marriage with a Deceased Wife's Sister."—A Preliminary List of Distinguished Biblical Scholars and Authorities who have severally declared that Marriage with a Deceased Wife's Sister is not therein forbidden.—*One hundred and one Reasons for repealing the Law against Marriage with a Deceased Wife's Sister.* 1892.—*Opinions of the Hebrew and Greek Professors of Bible Revisers regarding Marriage with a Deceased Wife's Sister.* F. Paynter Allen, 1884.—House of Lords, 15th June 1894. Debate on the Second Reading of Deceased Wife's Sister Bill. Comments of the Press. (May 1895.)—*Deceased Wife's Sister Bill. Remarks on the Revised Edition.* 1885.—*Roman Catholic Clergy and the Marriages Bill.* 1873.—*Summary of the Chief Arguments for and against Marriage with a Deceased Wife's Sister.* 1883.—*Letter to Vice-Chancellor Sir W. P. Wood from the Rev. A. M'Caul, D.D.* Wertheim, Mackintosh, and Hunt.—F. Campbell Foster. *A Review of the Law of Marriage.* 1847.—Reginald Cust. *Marriage with a Deceased Wife's Sister.* Kegan Paul and Co., 1888.—*Extract from a Letter on the Law of Marriage addressed by the late Bishop of Dublin (Dr. Whately) to the Late Bishop of Norwich.*—*First Report of the Commissioners on the Law of Marriage.* Clowes and Sons.—*Speech of the Rt. Hon. Lord Grimthorpe on the Second Reading of Deceased Wife's Sister Bill, Thursday, 9th May 1889.* Hansard Publishing Co.—Mona Caird. "The Morality of Marriage," *Fortnightly Review*, March 1890.—Clementina Black. "On Marriage: a Criticism," *Fortnightly Review*, April 1890. (T. Ba.)

II. United States.

If we define marriage as a physical, legal, and moral union between man and woman in complete community of life for the establishment of a family,[1] it is possible to discriminate between three stages in the history of the institution—the animal or physical stage, the proprietary or legal stage, and the personal or moral stage. In the first or physical stage the relation of the sexes was unregulated, and in many cases of brief duration. In the second or legal stage greater permanence was secured in marriage by assigning the husband a property right in his wife or wives. In the last stage the proprietary relation falls more and more into the background, and the relation of husband and wife approximates that of two individuals entirely equal before the law. Although in the history of marriage these three stages have been roughly successive, the order of their entering the conscious experience of the individual is usually the reverse of their order in the development of the race; and in the solemnization of a marriage based upon affection and choice the growth of the relation begins with the moral, advances to the legal, and culminates in the physical union, each one of these deriving its meaning and its worth from the preceding. It seems probable that in the United States marriage has advanced into this personal or moral stage farther than it has in many countries, and certain of its characteristic features as a social relation flow from this fact. Thus it is probable that the equality of property rights between husband and wife is established in America more completely than in any other civilized country. Indeed, in many states the movement has gone so far as to give the wife in matters of property and in reference to divorce greater privileges than the husband. Thus a husband is often liable for a wife's debts where a wife would not be, *mutatis mutandis*, for a husband's; and a wife may usually obtain a decree of divorce for any ground on which one may be awarded to the husband, and, in addition, for neglect to provide sustenance or support. Emphasis on the personal or moral relation of the parties in marriage tends to throw into the background the legal aspects and requirements; and in the United States, where the separation of Church and State is probably as complete as in any civilized country, it tends also to minimize, so far as the State is concerned, the religious and sacramental aspect of marriage. In distinction from these two, the purely personal aspects of the relation are brought into the foreground. Marriage tends to become a relation established by parties between themselves, and one in which the consent of the parties becomes the only constitutive element. In the theory of American law no ceremony is essential to create the marriage relation. The dictates of social expediency find expression mainly in certain prohibitions, as upon the marriage of persons under a certain limit of age, of persons within certain degrees of relationship, of persons already married, or of persons incapable for any reason of entering into marriage. Under such a theory of the law, persons marry themselves, and it might be claimed as a legitimate corollary of this theory that they should be allowed to divorce themselves. But while in theory of law parties marry themselves, and a ceremony is unnecessary, this position has never been endorsed by any considerable proportion of the community, and in fact probably $\frac{9}{10}$ and perhaps $\frac{99}{100}$ of the marriages in the United States are contracted through some ceremony. In every state, too, some legal decree is necessary in order to terminate the marriage relationship, although in all but two a complete separation of the parties continued for from one to five years is a legal ground of divorce.

The prevalence of the institution of marriage in a community is best measured by the percentage of the population of marriageable age who are married. According to the United States census, the earlier limit of marriageable age is twenty; but in the best practice elsewhere it is fifteen, and in 1890 about 330,000 persons in the United States between fifteen and twenty were married. It seems wise therefore to assign fifteen as the earlier limit of marriageable age. Of all persons in the United States over fifteen in 1890, 55·3 per cent. were reported as married; if we add those who were reported as widowed or divorced, the percentage is raised to 63. As a measure of the prevalence of marriage these figures are too low, owing to the fact that a very large number of persons who are unmarried between fifteen and thirty marry in later years. Few marriages are contracted after the age of forty-five, and such as do occur are less important socially than those contracted earlier and when the likelihood of parentage is greater. Of the total population in the United States over the age of forty-five in 1890, 93 per cent. were or had been married. This proportion in the United States is greater than in any of the countries in Western Europe. In European countries generally the proportion of elderly spinsters is greater than the proportion of elderly bachelors, but in the United States the reverse is true. This difference is due mainly to the unequal distribution of the sexes. Among the adults in western Europe there is an excess of females, in the United States generally an excess of males; and therefore the likelihood of a man's marrying is somewhat greater in western Europe, and that of a woman's marrying is somewhat greater in the United States. The same difference appears within the limits of the United States itself, for in the states of the Atlantic coast women outnumber the men, while in the rest of the country the reverse is true. Consequently, states on the Atlantic coast from Maine to the Carolinas have the largest percentage of spinsters among the women between fifty-five and sixty-five, and the states west of the Mississippi have the smallest percentage. On the contrary, the percentage of bachelors among the men between fifty-five and sixty-five is largest in the Rocky Mountain states, in some of which it is nearly or quite one-third, and smallest in the southern states east of the Mississippi.

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[1] It is doubtless true, as anthropologists have pointed out, that in the history of the race "marriage is rooted in the family rather than the family in marriage" (Westermarck, *History of Human Marriage*, p. 22); but in that conscious experience of the individual with which law and ethics are especially concerned, this relationship is reversed, and the family originates in marriage.

Regarding the age of marriage in the United States we have little direct evidence. In Massachusetts the average age at which men marry for the first time was in 1897 rather over twenty-seven, and the average age at which women marry for the first time was 24½ years; but in other parts of the country, and especially in the southern states, marriage occurs much earlier. For in Massachusetts in 1890 the percentage of girls between fifteen and twenty who were married was less than 4, and below that of any other state, while in the states of the far south the percentage ranged from 15 to 20. In Massachusetts, of the men between twenty and twenty-five, about 15 per cent. were returned in 1890 as married, while in the states of the far south the ratio was more than twice as great. Nor is this due to the many coloured people in the southern states, for, although they marry earlier than the whites, the whites also marry earlier than the whites in the north. While the percentage of married persons in the United States is probably greater than in most countries of western Europe, the tendency in this as in most other social respects is for the conditions on the two sides of the Atlantic to approximate. So far as fragmentary returns from certain states enable one to judge, the percentage of persons over fifteen in the United States who are married tends to decrease, and the age at which marriage occurs tends to rise. In Massachusetts the percentage of married persons among those over fifteen decreased by 4 between 1875 and 1895, and the average age at which marriage occurred increased nearly a year for each sex between 1871 and 1897. One reason for the decreasing marriage-rate characteristic of most industrial countries calls for more attention than has thus far been given it by social students, and that is a tendency to establish a separation of the sexes whereby a decided excess of women is found in industrial or manufacturing towns, offset more or less completely by an excess of men in the rural districts. For example, in the United States there are more women than men in the 1522 cities of over 2500 inhabitants taken as a whole, and in nearly all states east of the Mississippi the excess is marked. In the rural districts, on the contrary, there are over a million and a half more males than females. Under such conditions a certain number of women in cities and of men in the country will be debarred from marriage.

One inference derivable from the figures of the census of 1890 is that in the large cities girls do not marry so early as they do in the rural districts of the same states. For example, in Chicago among the young women between fifteen and twenty years of age about 6 per cent. are married, but in the rest of the state the percentage of the married at those ages is about 7½. This early marriage of the young women in the rural districts is not paralleled by a similarly early marriage of young men, for in two-thirds of the largest cities in the country the proportion of married men between twenty and twenty-five years of age was smaller than in the state at large. The early marriage of women in the rural districts is probably closely connected with the excess of men, which makes women more in demand. The same influence may be traced in the differences between the several states. As one passes westwards, the percentage of males in the total population increases; and in a general way it is also true that as one passes west the percentage of women between fifteen and twenty who are married increases; while the percentage of men between twenty and twenty-five who are married diminishes—that is, the sex in the minority marries in larger numbers and at earlier ages than the sex which is in the majority. (W. F. W.)

Mars. See ASTRONOMY, vol. xxv.

Marsala, a seaport town of the province of Trapani, Sicily, Italy, on the west coast, 19 miles by rail south of Trapani. It is the centre of the production of "Marsala" wine, and has also iron works, cooperages, and macaroni factories. There is an export trade (declining) in wine (£227,000 to £533,000), wine lees, cheese, &c., to the average value of £465,000 annually; and an import trade to the annual value of £20,000 to £50,000. In 1899 the port was cleared by 1072 vessels of 230,400 tons. In 1898 the construction of a mole was begun to protect the harbour against west and south-west winds. Population (1881), 19,732; (1900), about 37,000.

Marseilles, capital of the department of the Bouches-du-Rhône, France, 516 miles from Paris by rail. It is the headquarters of the 15th army corps, of a rear-admiral in command of the local naval defences, and of an episcopal see.

Population.—The census of 1900 has shown that Marseilles, by distancing Lyons to the extent of 27,000 inhabitants, has become the second town of France. Of its 498,610 inhabitants, 98,835 are foreigners, comprising 91,536 Italians and 469 British subjects, including the Maltese and British seamen in the port.

Trade and Commerce.—Since the opening of the Suez Canal, Marseilles has been the French gate of the Far East, in addition to being the western emporium for the Levant trade. But, as large ships now discharge cargo at all small ports, Marseilles is no longer the storehouse for the western Mediterranean. It has also suffered from the competition of Genoa since the opening of the St Gothard railway route to Switzerland and Germany. But its local industries—its oil mills, soap manufactories, sugar refineries, and others of minor importance—provide commercial activity to its port. Marseilles has suffered from the monopolies of the Dock Company and the Paris-Lyons-Mediterranean Railway Company. The Dock Company's warehouses, built at a time when goods were stored for prolonged periods, are no longer needed, and the company's rates for working cargo are far in excess of the rates charged by the Chamber of Commerce on the free quays. This obstruction to the full development of trade is being met (1) by the gradual increase of the quay space under the control of the Chamber of Commerce; (2) by the gradual completion of the seventh dock, the Bassin de la Pinède; and (3) by the proposal to make the Old Port accessible to steamers drawing 24 feet. The Chamber of Commerce proposes to deepen it to 24 feet 7 inches, to widen the quays, and connect them with the Joliette dock by rail. The monopoly of the "P.L.M." Railway Company is to be met by the construction of a ship canal from Marseilles to the Rhône at Arles. The competition will bring about a reduction in the exorbitant railway rates. The Chamber of Deputies voted 91,400,000 francs for the canal in January 1902. A large anchorage basin is to be constructed to the west of the Bassin de la Pinède by utilizing the small stream of La Madrague. The proposed canal will start from this Bassin de la Madrague, and, communicating by a passage 100 metres long with the Bassin de la Pinède, will pass under the Estaque mountain range by a tunnel to Port de Bouc, on the famous Étang de Berre; thence to Arles on the Rhône. The canal which connects the Étang de Berre with the sea, near the mouths of the Rhône, will be enlarged, and the Étang de Berre will become a great port of refuge for the protection of naval and mercantile shipping in time of war. The utility of the Marseilles–Arles canal will be ultimately enormously enhanced by the construction of a canal parallel to the Rhône from Arles to Lyons. The Chamber has also voted 123,000,000 francs for the construction of a canal to connect the Rhône with the Loire, which will place Marseilles in connexion with the north of France. The canal to Arles was first planned by Vauban, and the terrain surveyed by skilled engineers in the early part of the 19th century, and mapped out as now proposed by Guerard in 1879. Owing to the unhealthy and swampy nature of the Rhône delta, Marseilles was not built at the mouth of that river, but on a sheltered bay facing west, a little to the east of the river mouth, separated from it by a high range of hills and a dangerous bit of sea round Cape Couronne. Hence the urgent need for this canal.

Education.—Marseilles has a lycée (grammar school) for boys and one for girls, a school of medicine, a law college, a higher school of commerce (with a colonial section and a mercantile marine section attached to it), and, since 1899, a lower-grade commercial school for the training of boys from 12 to 15.

Public Health.—Marseilles has for many years been free from the epidemics which in former days gave it an unenviable reputation. The extensive drainage works, on the *tout à l'égout* system, were completed in 1898, and the sewage is carried miles away to sea beyond Cape Croisette. The old harbour frequented by yachts is no longer polluted by drainage. Every house is fitted with sanitary appliances on the flush system, the adoption of which was rendered feasible by the completion of the Durance canal, which brings the water of that river across a range of granite mountains to Marseilles and its once arid suburbs. Marseilles has a Pasteur Anti-Rabic Vaccination Institute, and three large hospitals. But owing to the rapid increase of the population, hospital accommodation is still lamentably deficient.

Public Buildings.—The Roman Catholic cathedral, built in Byzantine style, and overlooking the Joliette dock, was opened for public worship in 1893. All Saints', an English church, has been built in the Rue de Belloi, close to the Cours Pierre Puget, the heart of the fashionable quarter of the town. The town has extended principally on the south-eastern slope of the Notre-Dame-de-la-Garde hill, between the southern end of the Rue Paradis and the Prado avenues, which is more protected than most other quarters from the mistral that blows down the Rhône valley, and where in summer the temperature is always a little lower than in the centre of the town.

Industries.—Marseilles produces sugar, soap, seed, oil, oil-cake, tiles and bricks, candles, flour, bran, macaroni and other pastes, semolina, and liqueurs. It exported during 1901, 4584 tons of almonds and nuts, 17,987 tons of bran, 10,618 tons of bricks and tiles, 4916 tons of candles, 1390 tons of dried and preserved fruits, 22,930 tons of grain and flour, 28,828 tons of semolina, 14,989 tons of crushed ochre, 7246 tons of castor oil, 5672 tons of cocoanut oil, 4149 tons of cotton-seed oil, 10,664 tons of olive oil, 54,364 tons of oil-cake, 24,146 tons of potatoes, 19,509 tons of soap, 52,360 tons of refined sugar, 12,748 tons of cotton tissues, 8,019,412 gallons of wine, 4436 tons of raw wool, &c. There were imported during 1901, 1,200,338 head of cattle and sheep, 1,110,262 tons of coal, 21,900 tons of coffee, 14,292 tons of raw cotton, 469,236 tons of grain, 16,602 tons of hides, 162 tons of indigo, 77,467 tons of maize, 37,375 tons of cotton-seed oil, 15,112 tons of palm oil, 26,866 tons of castor-oil seed, 80,468 tons of copra, 65,817 tons of gingelly, 126,976 tons of ground-nuts, 10,575 tons of linseed, 8825 tons of palm-nuts, 11,352 tons of rice, 4966 tons of raw silk, 5703 tons of floss silk, 31,969 tons of sugar, 1617 tons of sulphate of copper, 1278 tons of tea, 11,447,744 gallons of wine, 29,319 tons of wool, &c. Marseilles has also a branch of the Forges et Chantiers de la Méditerranée, where boilers and engines are turned out for the navy and merchant ships, and a shipbuilding yard, the Chantiers de Provence, where large liners are built.

Communications.—Marseilles is the terminus of three lines of railway, all forming part of the Paris–Lyons–Mediterranean system, viz., a main line to Paris, *viâ* Lyons; a main line to Nice and Italy; a branch line to Aix, Grenoble, and the Alps. There are five stations, three of which are practically confined to the service of the port. There are also four suburban stations. The station in the Old Port belongs to an English, the others to the "P.L.M." company. Thirty-six shipping companies make the city a port of call in their regular service, besides those whose headquarters are at Marseilles. The Messageries Maritimes has a fleet of 52 vessels, of a total tonnage of 96,517 net. Their mail boats leave for the Far East every fortnight, and twice monthly for Zanzibar, Madagascar, Réunion, and Mauritius; and there is a weekly service to the Levant, and also to London. Other well-known companies are the Fraissinet Company, the Société Générale des Transports Maritimes, and the Navigation Mixte Company. Of British companies touching at Marseilles the most important are the Peninsular and Oriental, the Orient-Pacific, the British India, the Anchor Line, and the Bibby Line.

Shipping.—Marseilles is the chief port of France, having accommodation for over 2500 vessels at one time. During 1901 the number of ships entered and cleared amounted to 16,478, whereof 11,558 were French, 1355 British, 1296 Italian, 801 Spanish, and 327 Austro-Hungarian. The total tonnage of ships entering and clearing during 1901 was 13,040,814 net, of which French shipping claimed only 6,573,373 tons, and foreign shipping 6,467,441 tons. British shipping amounted to 3,264,698 tons, more than a quarter of the total tonnage of the port, and half the tonnage of all foreign nations combined. The volume of merchandise loaded and discharged during 1902 amounted to 5,763,553 tons, whereof 1,085,701 went to the credit of British shipping. The water space available for shipping purposes at Marseilles comprises some 297 acres, inclusive of the various canals of communication between the different harbours. The length of quay space for purposes of loading and discharging cargo is 42,988 feet in all at present. Of this some 3000 feet belong to the Old Port. The Joliette dock has 5260 feet, the Lazaret and Arenc docks 7483 feet, the Gare Maritime dock 7000 feet, the National dock has 12,316 feet of quay space in length. For the storage of merchandise there are 3,400,000 square feet of space available. Of this total 261,383 feet are around the old harbour and the Canal des Douanes. The Joliette dock has 339,246 square feet; the "Stationnement" dock, annexed to it, another 25,000 feet; the Lazaret and Arenc docks have together 754,283 square feet; the Gare Maritime dock, 586,671 feet; the National dock, the most commodious of all, has 1,000,000 square feet; the graving dock, 50,000 square feet; and the outer harbour has 341,730. The Chamber of Commerce owns and works appliances for manipulating cargo on the Gare Maritime and National docks, and the old harbour. (M. C. G.)

Marsh, Othniel Charles (1831–1899), American palæontologist, was born in Lockport, New York, on 29th October 1831. He graduated at Yale College in 1860, and having from boyhood been deeply interested in collecting birds, insects, minerals, and fossils, spent five years after his college graduation in studying (in the Sheffield Scientific School, New Haven, and in Germany) geology, palæontology, and mineralogy. Becoming professor of vertebrate palæontology at Yale in 1866, he continued his researches, particularly in the fossil deposits of the western states, greatly aided by a private fortune from his uncle, George Peabody, whom he also induced to establish the Peabody Museum of Natural History (especially devoted to zoology, geology, and mineralogy) in the college. In May 1871 he discovered the first pterodactyle remains found in America, and in subsequent years he brought to light other important objects, most of which he described in monographs of periodical articles. His discovery in 1872 of remains of the toothed bird *Hesperornis* and of *Ichthyornis*, a cretaceous bird with biconcave vertebræ, and of various fossil mammalia in Wyoming, aroused active discussion, and in some cases led to real or alleged proof of the existence of hitherto unknown ancestors of extant mammalia, or to the establishment of extinct transitional links between existent birds and reptiles. Still more earnest discussion followed, in 1874 and in later years, on his discoveries of remains of peculiar fossil horses in America. On becoming vice-president of the American Association for the Advancement of Science in 1875 he gave an address on the "Introduction and Succession of Vertebrate Life in America," summarizing his conclusions, to that date, in the branch to which his life was devoted. He repeatedly organized, and often accompanied, scientific exploring expeditions in the Rocky Mountains, not infrequently at personal risk; and their results, as set forth in his writings, tended in an important degree to support the doctrines of natural selection and evolution. Although he failed to complete several works of importance, he published many papers in addition to those mentioned, and found time—besides that necessarily given to the accumulation and care of the most extensive collection of fossils in the world—to write *Odontornithes: A Monograph on the Extinct Toothed Birds of North America* (1880), and *Dinocerata: A Monograph on an Extinct Order of Gigantic Mammals* (1886). He was long in charge of the division of vertebrate palæontology in the United States Geological Survey, and received many scientific honours, medals, and degrees, American and foreign. He died in New Haven on 18th March 1899. (C. F. R.)

Marshall, a city of Missouri, U.S.A., capital of Saline county, on the high prairie, near the Salt Fork of Lamine river, a little west of the centre of the state, at an altitude of 570 feet. Its site is undulating and its plan regular. It is at the intersection of the Missouri Pacific and the Chicago and Alton railways. Marshall is the seat of Missouri River College, a Presbyterian institution, founded in 1889, which in 1899 had 14 instructors and 222 students, 95 of whom were women. Population (1890), 4297; (1900), 5086, of whom 129 were foreign-born and 724 were negroes.

Marshall, a city of Texas, U.S.A., capital of Harrison county, in the north-eastern part of the state, on the Texas and Pacific and the Texas Southern railways, at an altitude of 366 feet. It is in an agricultural and lumber region, and contains works of the Texas and Pacific railway, saw and planing mills, and other manufactories. It is the seat of Wiley University, a Methodist Episcopal institution, opened in 1873, which had in 1899 a faculty of 9 and an attendance of 54 students. Population (1890), 7207; (1900), 7855, of whom 258 were foreign-born and 3769 were negroes.

Marshall Islands, an island group in the North Pacific, belonging to Germany since 1886. The group consists of a number of atolls ranged in two almost parallel lines, which run from north-west to south-east, between 4° and 15° N. The north-east group, with fifteen islands, is called Ratak, the other, numbering eighteen, Ralik. These atolls are of coralline formation and of irregular shape. They rise but little above high-water mark. The highest elevation occurs on the island of Likieb, but is only 33 feet. The lagoon is scarcely more than 150 feet deep, and is accessible through numerous breaks in the reef. On the outward side the shore sinks rapidly to a great depth. The surface of the atolls is covered with sand, except in a few places where it has been turned into soil through the admixture of decayed vegetation. The reef in scarcely any instance exceeds 600 feet in width. The climate is moist and hot, the mean temperature being 80·50° Fahr. Easterly winds prevail all the year round. There is no difference between the seasons, which, though the islands belong to the northern hemisphere, have the highest temperature in January and the lowest in July. Vegetation, on the whole, is very poor. There are many cocoanut palms, bread-fruit trees (*Artocarpus incisa*), and pandanus, of which the natives eat the seeds. From the bark of another plant they manufacture mats. Animals are scarce. Pigs, cats, dogs, rats are imported. There are a few pigeons and aquatic birds, few butterflies and beetles. Crustacea and fish abound on the reefs. The natives are of dark brown colour, though lighter shades occur. They belong to the Micronesian races. Their hair is not woolly, but straight and long. They are expert navigators, and construct curious charts of little sticks. Their canoes carry sails, and are made of the trunk of the bread-fruit tree. The people are divided into four classes, of which only two are allowed to own land. They practise tattooing, and consequently wear few clothes. The islands lie entirely within the German sphere of interest, and the boundaries were agreed upon between Great Britain and Germany on the 10th April 1889. Their area is estimated at 150 square miles, with 15,000 inhabitants, who are apparently beginning to increase again, though the contrary was long believed. In 1899 there were 79 Europeans (50 German). The administrator of the islands is at present the Governor of German New Guinea, but a number of officials reside on the islands. There is no military force, the natives being of peaceful disposition. The chief island and seat of government is Jaluit. The most populous island is Majeru, with 2600 inhabitants. The natives are pagans. A Roman Catholic mission has been established, and the American Mission Board maintains coloured teachers on many of the islands. There is communication with Sydney by private steamer, and a steamer sails between Jaluit and Ponape to catch the French boats for Singapore. The islands belong to the Postal Union. The chief products for export are copra, tortoise-shell, mother-of-pearl, sharks' fins, and trepang. For consumption Nature offers the bread-fruit, various kinds of bananas, taro, yams, the bulbous roots of the *Tacca pinnatifida*, and the seeds of a pandanus. Cereals are entirely unknown. The natives plant cocoa-palms in yearly increasing numbers. Cattle do not thrive on these islands, and even fowl are scarce. The natives are clever boat-builders, and sell their canoes not only on their own but to neighbouring islands. They have made such progress in their art that they have even built seaworthy little schooners of from 30 to 40 tons. The only other things they make are a few shell ornaments. In 1898–99 the value of the imports was 465,700 marks; exports, 900,000 marks, mainly copra. (J. VON P.)

Marshall, John (1818–1891), British surgeon and physiologist, was born at Ely, 11th September 1818, his father being a lawyer of that city. He entered University College, London, in 1838 (M.R.C.S. 1844, F.R.C.S. 1849). In 1847 he was appointed assistant-surgeon at the hospital, and in 1866 surgeon and professor of surgery. He was professor of anatomy at the Royal Academy from 1873 till his death. In 1882 he was president of the College of Surgeons, also Bradshaw lecturer (on "Nerve-stretching for the relief or cure of pain"), Hunterian orator in 1885, and Morton lecturer in 1889. In 1867 he published his well-known text-book *The Outlines of Physiology* in two volumes. He died 1st January 1891. "Marshall's fame," wrote Sir W. Mac Cormac in his volume on the *Centenary of the College of Surgeons* (1900), "rests on the great ability with which he taught anatomy in relation to art, on the introduction into modern surgery of the galvano-cautery, and on the operation for the excision of varicose veins. He was one of the first to show that cholera might be spread by means of drinking water, and issued a report on the outbreak of cholera in Broad Street, St James's, 1854. He also invented the system of circular wards for hospitals, and to him are largely owing the details of the modern medical student's education."

Marshalltown, a city of Iowa, U.S.A., capital of Marshall county, on the Iowa river, near the centre of the state, at an altitude of 895 feet. It is at the intersection of the Chicago Great Western, the Chicago and North-Western, and the Iowa Central railways. It is in a rich agricultural region, and has grain elevators and varied manufactures. Population (1890), 8914; (1900), 11,544, of whom 1590 were foreign-born and 148 were negroes.

Marshfield, a city of Wood county, Wisconsin, U.S.A., in the central part of the state, on three railway lines. It is in a timber region, and has extensive manufactures of furniture, barrels, and other wooden goods. Population (1890), 3450; (1900), 5240, of whom 1161 were foreign-born.

Marsivan, or Merzifún, a town in the Amasia sanjak of the Sivás viláyet of Asia Minor, situated at the foot of the Tavshan Dagh. It is a centre of American missionary and educational enterprise, and is the seat of Anatolia College, a theological seminary, and schools. In November 1895 many Armenians were massacred. Population, 30,000, one-third Armenian.

Marston, Philip Bourke (1850–1887), English poet, was born in London on 13th August 1850. His father, John Westland Marston (1819–1890), of Lincolnshire origin, the friend of Dickens, Macready, and Charles Kean, was the author of a series of metrical dramas which held the stage in succession to the ambitious efforts of Tobin, Talfourd, Bulwer, and Sheridan Knowles. His chief plays were *The Patrician's Daughter* (1841), *Strathmore* (1849), *A Hard Struggle* (1858), and *Donna Diana* (1863). He was looked up to as the upholder of the outworn tradition of the acted poetic drama, but his plays showed little vitality, and Marston's reviews for the *Athenæum*, including one of Swinburne's *Atalanta in Calydon*, and his dramatic criticisms embodied in *Our Recent Actors* (2 vols. 1888) will probably claim a more enduring reputation. The son, Philip Bourke, was born in a literary atmosphere. His sponsors were Philip James Bailey and Dinah Mulock (Mrs Craik). At his father's house near Chalk Farm he met authors and actors of his father's generation, and subsequently the Rossettis, Swinburne, Arthur O'Shaughnessy, and Irving. From his earliest years his striking literary precocity was overshadowed by misfortunes which make his career one of the most pathetic in literary history. In his fourth year, in part owing to an accident, his sight began to decay, and he gradually became almost totally blind. His mother, who had devoted herself to him, died in 1870. His promised bride, Mary Nesbit, died in 1871; his closest friend, Oliver Madox Brown, in 1874; his sister Cicely, his amanuensis and second self, in 1878; in 1879 his remaining sister, Eleanor, who was followed to the grave after a brief interval by her husband, the poet O'Shaughnessy (1846–1881), and her two children. In 1882 the death of his chief poetic ally and inspirer, Rossetti, was followed closely by the tragedy of another kindred spirit, the sympathetic pessimist, James Thomson, who was carried dying from his blind friend's rooms, whither he had sought refuge from his latest miseries early in June of the same year. It is said that Marston came to dread making new friendships, for fear of evil coming to the recipients of his affection. In the face of such calamities it is not surprising that Marston's verse, in which a plaintive minor key was always apparent, became more and more persistently sorrowful and melancholy. The idyls of flower-life, such as the early and very beautiful "The Rose and the Wind," were succeeded by longing dreams of sleep and the repose of death. These qualities and gradations of feeling, reflecting the poet's successive ideals of action and quiescence, are traceable through his three published collections, *Songtide* (1871), *All in All* (1875), and *Wind Voices* (1883). The first and third, containing his best work, went out of print, but Marston's verse was collected in 1892 by Mrs Louise Chandler Moulton, a most loyal and devoted friend, and herself a poet. Marston read little else but poetry, and of poetic values, especially of the intenser order, his judgment could not be surpassed in sensitiveness. As a creative artist he rarely approached supreme excellence, though in delicate facility and melodious prettiness and, it must be added, diffuseness, he was a prince among minor poets. He was saturated with Rossetti and Swinburne, and his imitative power was most remarkable. His tendency was ever to transpose into a minor key, and there was an absence of the "masculine bass" in all that he wrote. In his later years he endeavoured to make a little money by writing short stories, and succeeded in finding a market for them in *Home Chimes* and other American magazines, through the agency of Mrs Chandler Moulton. His popularity in America far exceeded that in his own country. With an outlook more and more sombre owing to the loss of friends, the narrowing of resources, and the development of insomnia, Marston gradually lost the buoyancy which he had retained through grievous misfortunes. His health showed definite signs of collapse from 1883; in January 1887 he lost his voice, and suffered intensely from the failure to make himself understood. He died on 13th February 1887 at his lodgings, 191 Euston Road, and, like his friend "B. V." (Thomson), he was by express desire buried in unconsecrated ground in Highgate cemetery. He was commemorated in Dr Gordon Hake's "Blind Boy," and in a fine sonnet by Swinburne, commencing "The days of a man are three score years and ten." There is an intimate sketch of the blind poet by a friend, Mr Coulson Kernahan, in *Sorrow and Song* (1894), p. 127. (T. SE.)

Martel de Janville [Sibylle-Gabrielle-Marie-Antoinette de Riqueti de Mirabeau], Comtesse de (best known as "Gyp"), French writer, was born in 1850 at Koëtsal in the Morbihan. Her father, who was grandson of Mirabeau *Tonneau*, and great-nephew of the orator, served in the Papal Zouaves, and died during the campaign of 1860. Her mother, the comtesse de Mirabeau, in addition to some graver compositions, contributed to the *Figaro* and the *Vie Parisienne*, under various pseudonyms, papers in the manner successfully developed by her daughter. Under the pseudonym of "Gyp" Madame de

Martel, who was married in 1869, sent to the *Vie Parisienne*, and later to the *Revue des Deux Mondes*, a large number of social sketches and dialogues, afterwards reprinted in volumes. Her later work includes stories of a more formal sort, essentially differing but little from the shorter studies. The following list includes some of the best known of Madame de Martel's publications, nearly seventy in number: *Petit Bob* (1882); *Autour du mariage* (1883); *Ce que femme veut* (1883); *Le monde à côté* (1884); *Sans voiles* (1885); *Autour du divorce* (1886); *Dans le train* (1886); *Mademoiselle Loulou* (1888); *Bob au Salon* (1888–89); *L'education d'un prince* (1890); *Passionette* (1891); *Ohé! La grande vie* (1891); *Une election à Tigre-sur-Mer* (1890), an account of "Gyp's" experiences in support of a Boulangist candidate; *Mariage civil* (1892); *Ces bons docteurs* (1892); *Du haut en bas* (1893); *Mariage de chiffon* (1894); *Leurs âmes* (1895); *Le cœur d'Ariane* (1895); *Le bonheur de Ginette* (1896); *Totote* (1897); *Lune de miel* (1898); *Israel* (1898); *L'entrevue* (1899); *Le pays des champs* (1900); *Trop de chic* (1900); *Le Friquet* (1901). From the first "Gyp," writing of a society to which she belonged, displayed all the qualities which have given her a distinct, if not pre-eminent, position among writers of her class. Those qualities included an intense faculty of observation, much skill in innuendo, a mordant wit combined with some breadth of humour, and a singular power of animating ordinary dialogue without destroying the appearance of reality. Her Parisian types of the spoiled child, of the precocious schoolgirl, of the young bride, and of various masculine figures in the gay world, have become almost classical, and may probably survive as faithful pictures of luxurious manners in the 19th century. Some later productions, inspired by a violent anti-Semitic and Nationalist bias, deserve little consideration. An earlier attempt to dramatize *Autour du mariage* was a failure, not owing to the audacities which it shares with most of its author's works, but from lack of cohesion and incident. "Gyp's" successes are indeed all achieved without a trace of dramatic faculty. In 1901 Madame de Martel furnished a sensational incident in the Nationalist campaign during the municipal elections in Paris. She was said to have been the victim of a kidnapping outrage or piece of horseplay provoked by her political attitude, but though a most circumstantial account of the outrages committed on her and of her adventurous escape was published, the affair was never clearly explained or verified.

Martello Tower.—The name is a corruption of Mortella, and the large adoption of towers so styled for purposes of coast defence is due to incidents in the war of the French Revolution. In September 1793, Commodore Linzee, in command of the line-of-battle ships *Alcide*, *Courageux*, *Ardent*, with the frigates *Lowestoffe* and *Nemesis*, was ordered by Lord Hood, then in possession of Toulon, to support the Corsican insurgents under General Paoli, who had sought British assistance. Linzee determined to attack Fornielli, and in the first place to take a tower on Cape Mortella which commanded the only secure anchorage in the Gulf of San Fiorenzo. This tower, according to James, was named "after its inventor"; but the real derivation appears to be the name of a wild myrtle which grew thickly on the spot. The tower, which mounted one 24-pounder and two 18-pounders on its top, was bombarded for a short time by the *Lowestoffe* and *Nemesis* frigates, was then deserted by its little garrison, and occupied by a landing party of 30 men under Lieutenants Gibbs and Annesley. The attack on Fornielli failed, and the tower was abandoned, and afterwards retaken by the French from the Corsicans. So far it had done nothing to justify its subsequent reputation. Early in 1794, however, a fresh attempt was decided upon by Lord Hood and Major-General Dundas, to support the Corsican insurgents. On the 7th February, 1400 troops were landed in a bay to the west of Cape Mortella, and the tower was attacked by land and sea on the following day. The *Fortitude* and *Juno* kept up a bombardment for $2\frac{1}{2}$ hours and then hauled off, the former being on fire, and having 62 men killed and wounded. The fire from the batteries on shore produced no impression, until a hot shot set fire to the "bass junk with which to the depth of 5 feet the immensely thick parapet" of the tower "was lined." The garrison of 33 men under Ensign Le Tellier then surrendered. The armament was found to consist only of two 18-pounders and one 6-pounder, and the strong resistance offered by these three guns seems to have led to the conclusion that towers of this description were specially formidable. There appears to be nothing in the circumstances to justify this conclusion. As a result of the invasion scares which it was Napoleon's policy to promote and maintain, Martello towers were built in large numbers, and at heavy expense, along the shores of England, especially on the southern and eastern coasts, which in certain parts are lined with these species of fortification placed at short intervals. Their principal characteristics are solid masonry containing vaulted rooms in the interior for the garrison, and providing a platform at the top for two or three guns, firing over a low masonry parapet. Access, as in the far older Irish towers, is provided by a wooden ladder, communicating with a door about 20 feet above the ground. In some cases a deep ditch is provided around the base of the tower; in others, the ditch is absent. It is interesting to note that the towers of Linz begun in 1833 by the Archduke Maximilian were similar in conception, as also was the Malakoff tower built by subscription among the merchants of Sebastopol, which was the one completed example of permanent fortification existing on the south side when the Allies commenced the siege. The Malakoff tower proved a positive disadvantage to the defence by adding greatly to the losses of the defenders of the extemporized redoubt which was built round it. While the Martello tower owes its reputation as a work of defence and its widespread adoption in Great Britain to the misconception arising out of a single incident of war, the round masonry structure entered by a single door raised high above the base is far older than the events of 1794. Such structures are to be found in many lands, and are amongst the earliest examples of masonry fortification. (G. S. C.)

Martensen, Hans Larsen (1808–1884), Danish bishop and theologian, was born at Flensburg on 19th August 1808. He was ordained in the Danish Church, and ultimately became professor of theology at Copenhagen, as well as court preacher. His life was uneventful, but his contributions to theological literature were neither few nor unimportant. Among them were treatises on Christian ethics and dogmatics, on moral philosophy, on baptism, and a sketch of the life of the celebrated mystic Jacob Böhme, who exercised so marked an influence on the mind of the great English theologian of the 18th century, William Law. Martensen was a distinguished preacher, and his works were translated into various languages. His treatises on Christian ethics and dogmatics, in particular, have been widely read in Great Britain. He was made bishop of Zealand in 1854, and died at Copenhagen on 4th February 1884. He was a man of original mind, departed in many ways from the strict standards of Lutheran orthodoxy, and showed a disposition towards mysticism in many of his works. The "official" eulogy he pronounced upon Bishop Mynster, on the death of this dignitary in 1854, brought down upon his head the scathing invectives which the philosopher Kierkegaard poured forth on the text, "A witness of the truth." (J. J. L*.)

Martial Law.—"Martial law" is an unfortunate term, and in a sense a misnomer. It describes a suspension of ordinary law, rendered necessary by circumstances of war or rebellion. The confusion arose from the fact that the Marshal's Court administered military law before the introduction of articles of war, which were in their turn merged in the Army Act. But martial law is not a law in the proper sense of the term. It is the exercise of the will of the military commander, who takes upon himself the responsibility of suspending ordinary law in order to ensure the safety of the State. It is declared, by a proclamation issued by the executive, that ordinary law is inadequate to cope with the actual circumstances, and provides exceptional means of arrest and punishment of persons who resist the Government, or who aid and abet the enemy. But such a proclamation, whilst it is invariably issued in order to give publicity to the suspension of ordinary law, does not invest the step with the force of law. In short, martial law arises out of the will of the commander, and he acts from necessity, and in order to deal more summarily with civilians. It is simply military authority exercised in accordance with the laws and usages of war, and is limited by military necessity. Yet in reality it is part of common law which justifies acts done by necessity for the defence of the Commonwealth when there is war. Halleck in his work on International Law (vol. i. p. 544), says, "Martial law originates either in the prerogative of the Crown, as in Great Britain, or from the exigency of the occasion, as in other states: it is one of the rights of sovereignty, and is essential to the existence of a state, as is the right to declare or to carry on war."

Definition.

This opinion, however, must be read, as regards the British Empire, with the passage in the Petition of Right which is reproduced in the preamble of each annual Army Act, and asserts the illegality of martial law in time of peace in the following terms:—"No man shall be forejudged or subjected in time of peace to any kind of punishment within this realm by martial law." Therefore, whilst martial law is declared illegal in time of peace, it is indirectly declared lawful in time of war and intestinal commotion when the courts are closed, or when there is no time for their cumbrous action. Clode, in *Military Forces of the Crown*, argues that the words of the Petition of Right and of the Military Act since the reign of Anne are plain in this respect "that . . . the Crown possesses the right of issuing commissions in war and rebellion." But he rightly adds that the military commander may permit the usual courts to continue their jurisdiction upon such subjects as he thinks proper. Legislative enactments have also sanctioned this special jurisdiction at various times, notably in 1798, 1799, 1801, and in 1803. These enactments lay down that exceptional powers may be exercised "whether the ordinary courts shall or shall not be open." As an invariable rule an Act of Indemnity has been passed on the withdrawal of martial law, but that has been done only to protect any person in charge of the execution of martial law who has exceeded his powers in good faith, honestly believing his action was necessary for the safety of the country.

There has been much discussion as to whether, in districts where martial law has not been proclaimed, a person can be sent for trial from such district into a district where martial law was in operation. It is argued that if the ordinary courts were open and at work in the non-proclaimed district recourse should be had to them. The Privy Council in 1902 (*re* Marais) refused leave to appeal where the Supreme Court of Cape Colony had declined to issue a writ of Habeas Corpus in these circumstances. Mr Justice Blackburn in his charge in *Queen* v. *Eyre* says, "I have come to the conclusion that, looking at what martial law was, the bringing of a person into the proclaimed district to be tried might, in a proper case, be justified." The learned judge admits that there should be a power of summary trial, observing all the substantials of justice, in order to stamp out an insurrection by speedy trial.

Whilst martial law is the will of the commanders, and is only limited by the customs of war and the discretion of those who administer it, still, as far as practicable, the procedure of military law is followed, and a military court is held on the same lines as a court-martial. Charges are simply framed without technicalities. The prisoner is present, the evidence of prosecution and prisoner is taken on oath, the proceedings are recorded, and the sentence of the court must be confirmed according to the rules of the Army Act. Sentences of death and penal servitude must be referred to headquarters for confirmation. In the South African war (1899–1902) these limits of procedure were observed, and when possible will always be.

Entering more into detail, the term martial law has been employed in several senses:—(1) As applied to the military forces of the Crown, apart from the military law under the old Mutiny Acts, and the present annual Army Acts. (2) As applied to the enemy. (3) As applied to rebels. (4) As applied to civilian subjects who are not in rebellion, but in a district where the ordinary course of civil life cannot be maintained owing to war or rebellion.

Different applications of martial law.

1. In regard to the military forces of the Crown, the superseding of justice as administered under the Army Act could only occur in a time of great need; *e.g.*, mutiny of five or six regiments in the field, with no time to take the opinion of any executive authority. The officer in command would then be bound to take measures for the purpose of suppressing such mutiny, even to putting soldiers to death if necessary. It would be a case where necessity forced immediate action.

2. Martial law as applied to the enemy or the population of the enemy's country is, in the words of the duke of Wellington, "the will of the general of the army, though it must be administered in accordance with the customs of war."

3, 4. But it is as affecting the subjects of the Crown in rebellion that the subject of martial law really obtains its chief importance; and it is in this sense that the term is generally used; *i.e.*, the suspension of ordinary law and the temporary government of the country, or parts of it, or all of it, by military tribunals. It has often been laid down that martial law in this sense is unknown to the law of England. Mr Dicey, for instance, restricts martial law to only another expression for "the common right of the Crown and its servants to repel force by force, in the case of invasion, insurrection, or riot, or generally of any violent resistance." But more than this is understood by the term martial law.

When the proposition was laid down that martial law in this sense is unknown to the law of England, it is to be remembered that fortunately in England there never had been a state at all similar to that prevailing in Cape Colony in 1900–1902, and it may perhaps be questioned whether the statement would have been made with such certainty if similar events had been present to the writers' minds.

In the charge delivered by Mr Justice Blackburn in the Jamaica case, which has already been cited, the law as affecting the general question of martial law is well set out.

> "By the laws of this country," said Mr Justice Blackburn, "beginning at Magna Charta and getting more and more established, down to the time of the Revolution, when it was finally and completely established, the general rule was that a subject was not to be tried or punished except by due course of law; all crimes are to be determined by juries subject to the guidance of the judge; that is the general rule, and is established law. But from the earliest times there was this also which was the law, and is the law still, that when there was a foreign invasion or an insurrection, it was the duty of every good subject, in obedience to the officers and magistrates, to resist the rebels, . . . in such a case as that of insurrection prevailing so far that the courts of law cannot sit, there must really be anarchy unless there is some power to keep the people in order, . . . before that principle the Crown claimed the prerogative to exercise summary proceedings by martial law . . . in time of war when this disturbance was going on, over others than the army. And further than that, the Crown made this further claim against the insurgents, that whilst it existed, pending the insurrection and for a short time afterwards, the Crown had . . . the power to proclaim martial law in the sense of using summary proceedings, to punish the insurgents and to check and stop the spread of the rebellion by summary proceedings against the insurgents, so as . . . to stamp out the rebellion. Now no doubt the extent to which the Crown had power to do that has never been yet decided. Our law has been declared from time to time and has always been a practical science, that is, the judges have decided so much as was necessary for the particular case, and that has become part of the law. But it never has come to be decided what this precise power is."

So far as the United Kingdom is concerned, the need has never arisen. It has always been found possible to employ the ordinary courts directly the rebels have been defeated in the field and have been made prisoners or surrendered. "Fortunately in England only three occasions have arisen since the Revolution when the authority of the civil power was for a time, and then only partially, suspended," 1715, 1745 and 1780. Clode, *Military Forces*, vol. ii. p. 163, says: "Upon the threat of invasion followed by rebellion in 1715, the first action of the Government was to issue a proclamation authorizing all officers, civil and military, by force of arms (if necessary) to suppress the rebellion." This, therefore, would only seem to fall within the limited sense in which Mr Dicey understands martial law to be legal, "the right of the Crown and its servants to repel force by force." There was no attempt to bring persons before courts-martial who ought to be tried by the common law, and all the extraordinary acts of the Crown were sanctioned by Parliament. After the rebellion had been suppressed two statutes were passed, one for indemnity and the other for pardon. Before the revolution of 1745 similar action was adopted, a proclamation charging civil magistrates to do their utmost to prevent and suppress all riots, and Acts of Parliament suspending Habeas Corpus, providing for speedy trials; and of indemnity. In the Gordon Riots of 1780 a very similar course was pursued, and nothing was done which would not fall within Mr Dicey's limitation. No prisoners were tried by martial law.

In Ireland the ordinary law was suspended in 1798–1801 and in 1803. In 1798 an Order in Council was issued to all general officers commanding H.M. forces to punish all persons acting in, aiding, or in any way assisting the rebellion, according to *martial law*, either by death or otherwise, as to them should seem expedient for the suppression and punishment of all rebels; but the order was communicated to the Irish Houses of Parliament, who expressed their approval by addresses to the viceroy. It was during the operation of this order that Wolfe Tone's case arose. Tone, a subject of the king, was captured on board a French man-of-war, and condemned to death by a court-martial. Curran, his counsel, applied to the King's Bench at Dublin for a Habeas Corpus, on the grounds that only when war was raging could courts-martial be endured, not while the Court of King's Bench sat. The court granted his application; but no ultimate decision was ever given, as Tone died before it could be arrived at.

In 1799 application was made to Parliament for express sanction to martial law. The preamble of the Act declared that "The Rebellion still continues . . . and stopped the ordinary course of justice and of the common law; and that many persons . . . who had been taken by H.M. forces . . . had availed themselves of such partial restoration of the ordinary course of the common law to evade the punishment of their crimes, whereby it had become necessary for Parliament to interfere." The Act declared that martial law should prevail and be put in force whether the ordinary courts were or were not open, &c. And nothing in the Act could be held to take away, abridge, or eliminate the acknowledged prerogative of war, for the public safety to resort to the exercise of martial law against open enemies or traitors, &c.

After the suppression of the rebellion an Act of Indemnity was passed in 1801.

In 1803 a similar Act was passed by the Parliament of the United Kingdom as it was after the Act of Union. In introducing it Mr Pitt stated, "The Bill is not one to enable the Government in Ireland to declare martial law in districts where insurrection exists, for that is a power which His Majesty already possesses—the object will be to enable the Lord Lieutenant, when any persons shall be taken in rebellion, to order them to be tried immediately by a court-martial."

During the 19th century martial law was proclaimed by the British Government in the following places:—

1. Barbados, 1805–16.
2. Demerara, 1823.
3. Jamaica, 1831–32—1865.
4. Canada, 1837–38.
5. Ceylon, 1817 and 1848.
6. Cephalonia, 1848.
7. Cape of Good Hope, 1834—1849–51.
8. St Vincent, 1863.
9. Jamaica, 1865.
10. South Africa, 1899–1901.

The proclamation was always based on the grounds of necessity, and where any local body of a representative character existed it would seem that its assent was given, and an Act of Indemnity obtained after the suppression of the rebellion. (Jno. S.)

Martin, Bon Louis Henri (1810–1883), French historian, was born on the 20th of February 1810 at St Quentin (Aisne), where his father was a judge. Trained as a notary, he followed this profession for a while, but having by his twentieth year achieved success with a historical romance, *Wolfthurm* (1830), applied himself seriously to historical research. Becoming associated with Paul Lacroix ("le Bibliophile Jacob"), he planned with him a history of France, which was to consist of excerpts from the chief chroniclers and historians, with original matter filling up the gaps in the continuity. The first volume, which appeared in 1833, encouraged the author to make the work his own, and his *Histoire de France*, in fifteen volumes (1833–36), was the result. This *magnum opus*, rewritten and further elaborated (1837–54), gained for the author in 1856 the first prize of the Academy, and in 1869 the grand biennial prize of 20,000 francs. A popular abridgment in seven volumes was published in 1867. This, together with the continuation, *Histoire de France moderne depuis 1789 jusqu'à nos jours*, gives a complete history of France, and superseded Sismondi's *Histoire des Français*. Henri Martin's reputation is that of a conscientious, impartial, and scrupulously accurate writer, although he can hardly be ranked among the world's great historians. He sat in the Assembly as deputy for Aisne in 1871, and was elected life senator for the same province in 1878, but he did not leave any real mark as a politician. He died in Paris on 14th December 1883.

Among minor works which proceeded from his pen may be mentioned . *De la France, de son génie et de ses destinées* (1847), *La Russie et l'Europe* (1866), *Les Napoléon et les frontières de la France* (1874).

Martin, Helena Saville (1817–1898), English actress, best known under her maiden name as HELEN FAUCIT, was born in London in 1817. Her stage *début* was made in January 1836 at Covent Garden Theatre, as Julia in *The Hunchback.* Her success in this was so definitely confirmed by her subsequent acting of such parts as Juliet, Lady Teazle, Beatrice, Imogen, and Hermione, that within eighteen months from her first appearance she was engaged by Macready as leading lady at Covent Garden. There, besides appearing in several Shakespearian characters, she "created" the heroine's part in Lytton's *Duchess de la Vallière* (1836), *Lady of Lyons* (1838), *Richelieu* (1839), *The Sea Captain* (1839), *Money* (1840), and Browning's *Strafford* (1837). After a visit to Paris and a short season at the Haymarket Theatre, she joined the Drury Lane company under Macready early in 1842. At Drury Lane she played for the first time the parts of Lady Macbeth, Constance in *King John,* Desdemona and Imogen, and took part in the first production of Westland Marston's *Patrician's Daughter* (1842) and Browning's *Blot in the 'Scutcheon* (1843). The next two years were occupied with tours in England, Scotland, and Ireland, her acting meeting everywhere with unstinted praise, and a visit to Paris (in the winter of 1844–45), when she acted with Macready in several Shakespearian plays. After six more years passed almost entirely in acting in various parts of the United Kingdom, she was married in August 1851 to Mr (afterwards Sir) Theodore Martin. She did not relinquish her profession after marriage, but appeared on the stage at frequent intervals during the next twenty years, until her definite retirement in 1871. After that she would only consent to act in public for charitable purposes. In 1881 there appeared in *Blackwood's Magazine* the first of her *Letters on Some of Shakespeare's Heroines,* which were ultimately published in book form (under the title of *On Some of Shakespeare's Female Characters*) in 1885. The latter years of her life were spent in a seclusion which increased as her health declined, but was marked by numerous marks of honour and admiration from the highest personages and the greatest intellects in the land. She died at her home in Wales on 31st October 1898. (R. F. S.)

Martin, Sir Theodore (1816–——), author and translator, the son of a solicitor, was born in Edinburgh on 16th September 1816, and educated at the Royal High School and the University, from which he subsequently received the honorary degree of LL.D. He practised for some time as a solicitor in Edinburgh, but in 1846 went to London, where he became senior partner in the firm of Martin and Leslie, parliamentary agents. He early contributed to *Fraser's Magazine* and *Tait's Magazine,* under the signature of "Bon Gaultier," and in 1856, in conjunction with Professor Aytoun, he published the *Book of Ballads* under the above pseudonym. This work at once obtained popular favour. In 1858 he published a volume of translations of the *Poems and Ballads of Goethe,* and this was followed by a rendering of the Danish poet Henrik Hertz's noble lyric drama, *King René's Daughter.* The principal character in this drama, Iolanthe, was sustained by Miss Helen Faucit, who in 1851 became the author's wife. Martin's translations of Öhlenschläger's dramas, *Correggio* (1854), and *Aladdin, or the Wonderful Lamp* (1857), widened the fame of the great Danish poet in England, and materially assisted in familiarizing readers with his dramatic masterpieces. In 1860 appeared Martin's metrical translation of the *Odes of Horace;* and in 1870 he wrote a volume on Horace for the series of "Ancient Classics for English Readers." In 1882 his Horatian labours were concluded by a translation of the poet's whole works, with a life and notes, in two volumes. A poetical translation of *Catullus* was published in 1861, followed by a privately printed volume of *Poems, Original and Translated,* in 1863. Then came translations of the *Vita Nuova* of Dante, and the first part of Goethe's *Faust.* A metrical translation of the second part of *Faust* appeared in 1866. Martin wrote a memoir of his friend Aytoun in 1867, and while engaged upon this work he was requested by Queen Victoria to undertake the *Life of His Royal Highness the Prince Consort.* The first volume of this well-known work was published in 1874. In 1878 Martin's translation of Heine's *Poems and Ballads* appeared. Two years later the *Life of the Prince Consort* was brought to a successful conclusion by the publication of the fifth volume. A knighthood was then conferred upon Martin, whose association with the Queen added to the influence which his literary position had already achieved. In the following November he was elected Lord Rector of the University of St Andrews. Martin's *Life of Lord Lyndhurst,* based on papers furnished by the family, was published in 1883. In 1889 appeared *The Song of the Bell, and other Translations from Schiller, Goethe, Uhland, and Others;* in 1894 *Madonna Pia, a Tragedy, and three other Dramas,* and in 1900 he published a biography of his accomplished wife. All Sir Theodore Martin's translations are distinguished for their singular fidelity to the originals, but perhaps the finest and most spirited are those from Goethe and Horace.

Martin, Sir William Fanshawe (1801–1895), British admiral, son of Admiral of the Fleet Sir Thomas Byam Martin, Comptroller of the Navy, and grandson, on the mother's side, of Captain Robert Fanshawe, who commanded the *Namur* under Rodney on 12th April 1782, was born on 5th December 1801. Entering the navy at the age of twelve, his father's interest secured his rapid promotion: he was made a lieutenant on 15th December 1820; on 8th February 1823 he was promoted to be commander of the *Fly* sloop, his good service in which in support of the interests of British merchants at Callao during one of the continually recurring civil wars gave the Admiralty a legitimate excuse—if one had been needed—for promoting him to be captain on 5th June 1824. He afterwards served in the Mediterranean and on the home station, but without any opportunities of distinction, though known in the navy as a good officer. In 1849–52 he was commodore commanding the Channel squadron, and at once gave evidence of a remarkable aptitude for command—of being a man who knew what he wanted and how to get it done. He was made rear-admiral in May 1853, and for the next four years was superintendent of Portsmouth dockyard. He was made vice-admiral in February 1858, and after a year as a Lord of the Admiralty, was appointed commander-in-chief in the Mediterranean. The discipline of the navy was just then at a very low ebb. It was an evil tradition, sprung from the wholesale shipment of gaol-birds during the old war, that the men were to be treated as brute beasts; and though the practice was better than the theory, it was still very bad. At this time, too, the ships had been largely filled up with "bounty men"—men who had been bought into the service with a £10 note, without being sailors or having even an elementary notion of cleanliness or obedience. Out of this very unpromising material Martin formed the fleet which was at the time the ideal of excellence, and may be said to have laid the foundations of the magnificent organization of a later day. It is solely in this connexion that his name stands out among the naval officers of the century, for he had no war service, and, beyond the Italian disturbance of 1860–61, no opportunity for showing any diplomatic ability. But his memory will deservedly live as that of the reformer of discipline and the originator of a comprehensive system of steam manœuvres. He became an admiral in November 1863, and on 4th December succeeded to the baronetcy which had been originally conferred on his grandfather. His last appointment was the command at Plymouth, 1866–69, and in 1870 he was put on the retired list. In 1873 the G.C.B. was conferred on him, and in 1878 he was made rear-admiral of the United Kingdom. He died at Upton Grey, near Winchfield, on 24th March 1895. He was twice married, and left, besides daughters, one son, who succeeded to the baronetcy. (J. K. L.)

Martineau, James (1805–1900), English philosopher and divine, was born at Norwich, 21st April 1805, the seventh child of Thomas Martineau and Elizabeth Rankin, the sixth, his senior by almost three years, being his sister Harriet (*Ency. Brit.* vol. xv. pp. 583–584). He was descended from Gaston Martineau, a Huguenot surgeon and refugee, who married in 1693 Marie Pierre, and settled soon afterwards in Norwich. His son and grandson—respectively the great-grandfather and grandfather of James Martineau—were surgeons in the same city, while his father was a manufacturer and merchant. Affinity of faith made the French Huguenot an English Presbyterian, and the Martineaus could not fail to share the discipline, the culture, and the intellectual changes of the society within which they lived. James was educated at Norwich Grammar School under Edward Valpy, as elegant a classic and as fastidious a scholar as his better-known brother Richard. But the boy proving too sensitive for the rough-and-tumble life of a public day school, was sent to Bristol to the private academy of Dr Lant Carpenter, a conscientious master, an earnest philanthropist, and a laborious divine, well known for his part in the Socinian controversies of the day, under whom he studied for two years. On leaving there he was apprenticed to a civil engineer at Derby, where he acquired "a store of exclusively scientific conceptions,"[1] but where he also experienced the hunger of mind which forced him to look to religion for satisfaction. Hence came his "conversion," and the sense of vocation for the ministry which impelled him in 1822 to enter Manchester College, then lodged at York. Here he "woke up to the interest of moral and metaphysical speculations." Of his teachers, one, the Rev. Charles Wellbeloved, was, Martineau said, "a master of the true Lardner [*Ency. Brit.* vol. xiv. p. 313] type, candid and catholic, simple and thorough, humanly fond indeed of the counsels of peace, but piously serving every bidding of sacred truth." "He never justified a prejudice; he never misdirected our admiration; he never hurt an innocent feeling or overbore a serious judgment; and he set up within us a standard of Christian scholarship to which it must ever exalt us to aspire."[2] The other, the Rev. John Kenrick, he described as a man so learned as to be placed by the late Dean Stanley "in the same line with Blomfield and Thirlwall,"[3] and as "so far above the level of either vanity or dogmatism, that cynicism itself could not think of them in his presence."[4]

On leaving the college in 1827 Martineau returned to Bristol to teach in the school of Lant Carpenter; but in the following year he was ordained for a Unitarian church in Dublin whose senior minister was a relative of his own. But his career there was in 1832 suddenly cut short by difficulties growing out of the "Regium donum," which had on the death of the senior minister fallen to him. He conceived it as "a religious monopoly," to which "the nation at large contributes" while "Presbyterians alone receive," and which placed him in "a relation to the State" so "seriously objectionable" as to be "impossible to hold."[5] The invidious distinction it drew between Presbyterians on the one hand, and Catholics, Friends, freethinking Christians, unbelievers, and Jews on the other, who were compelled to support a ministry they "conscientiously disapproved," offended his always delicate conscience; while possibly the intellectual and ecclesiastical atmosphere of the city proved uncongenial to his liberal magnanimity. From Dublin he was called to Liverpool, and there for a quarter of a century he exercised extraordinary influence as a preacher, and achieved a high reputation as a writer in religious philosophy. In 1840 he was appointed professor of mental and moral philosophy and political economy in Manchester New College, the seminary in which he had himself been educated, and which had now removed from York to the city after which it was named. This position he held for forty-five years. In 1853 the college removed to London, and four years later he followed it thither. In 1858 he was called to occupy the pulpit of Little Portland Street Chapel in London, which he did at first for two years in conjunction with the Rev. J. J. Tayler, who was also his colleague in the college, and then for twelve years alone. In 1866 the chair of the philosophy of mind and logic in University College, London, fell vacant, and Martineau became a candidate. But potent opposition was offered to the appointment of a minister of religion, and the chair went to George Croom Robertson—then an untried man—between whom and Martineau a cordial friendship came to exist. From 1869 to 1880 he was one of the most active, as he was possibly the most distinguished philosophical, member of the famous Metaphysical Society, which, though it might contribute little to thought or knowledge, yet accomplished the immense indirect good of making eminent men, who held diverse views in religion and philosophy, personally acquainted. In 1885 he retired, full of years and honours, from the principalship of the college he had so long served and adorned. It ought to be recorded, were it only as significant of the happier spirit of the time, that Martineau, who was in his youth denied the benefit of a university education, yet in his age found famous universities eager to confer upon him their highest distinctions. He was made LL.D. of Harvard in 1872, S.T.D. of Leyden in 1874, D.D. of Edinburgh in 1884, D.C.L. of Oxford in 1888, and D.Litt. of Dublin in 1891. He died in London on 11th January 1900.

The life of Martineau was so essentially the life of the thinker, and was so typical of the century in which he lived and the society within which he moved, that he can be better understood through his spoken mind than through his outward history. He was a man happy in his ancestry: he inherited the dignity, the reserve, the keen and vivid intellect, and the picturesque imagination of the French Huguenot, though they came to him chastened and purified by generations of Puritan discipline exercised under the gravest ecclesiastical disabilities, and of culture maintained in the face of exclusion from academic privileges. He had the sweet and patient temper which knew how to live, unrepining and unsoured, in the midst of the most watchful persecution, public and private; and it is wonderful how rarely he used his splendid rhetoric for the purposes of invective against the spirit and policy from which he must have suffered deeply, while, it may be added, he never hid an innuendo under a metaphor or a trope. He had the advantage of being educated by men who had no inducement to seek knowledge, save such as came from love of truth; and though he knew how much he had lost by never having lived within a learned society full of the great traditions of ancient and modern scholarship, yet he would have been the first to claim that he who has had to follow in feebleness, and amid storm and stress, the truth that drew him on, has received an education that may do more than the discipline of any college to dignify the conscience, to quicken the intellect, and to enrich the imagination. For these and similar reasons he was lifted above the temptations which beset the mere scholar or the thinker bound to maintain his formulated beliefs. He was fundamentally too much a man of strong convictions to be correctly described as open-minded, for if nature ever determined any man's faith, it was his; the root of his whole intellectual life, which was too deep to be disturbed by any superficial change in his philosophy, being the feeling for God. He has, indeed, described in graphic terms the greatest of the more superficial changes he underwent; how he had "carried into logical and ethical problems the maxims and postulates of physical knowledge," and had moved within the narrow lines drawn by the philosophical instructions of the classroom "interpreting human phenomena by the analogy of external nature"; how he served in willing captivity "the 'empirical' and 'necessarian' mode of thought," even though "shocked" by the dogmatism and acrid humours "of certain distinguished representatives";[1] and how in a period of "second education" at Berlin, "mainly under the admirable guidance of Professor Trendelenburg," he experienced "a new intellectual birth" which "was essentially the gift of fresh conceptions, the unsealing of hidden openings of self-consciousness, with unmeasured corridors and sacred halls behind; and, once gained, was more or less available throughout the history of philosophy, and lifted the darkness from the pages of Kant and even Hegel."[2] But though this momentous change of view illuminated his old beliefs and helped him to re-interpret and re-articulate them, yet it made him no more of a theist than he had been before. And as his theism was, so was his religion and his philosophy. Certainly it was true of him, in a far higher degree than of John Henry Newman, that the being of God and himself were to his mind two absolutely self-luminous truths—though both his God and his self were almost infinitely remote from Newman's. And as these truths were self-evident, so the religion he deduced from them was sufficient, not only for his own moral and intellectual nature, but also for man as he conceived him, for history as he knew it, and for society as he saw it.

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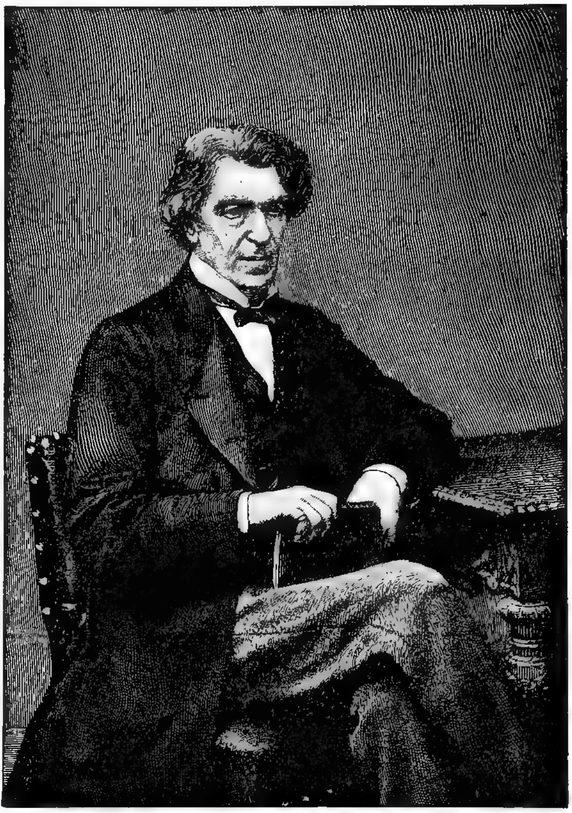
[1] *Types of Ethical Theory*, i. 8.

[2] *Essays, Reviews, and Addresses*, ix. 54.

[3] *Ibid.* i. 397.

[4] *Essays, Reviews, and Addresses*, i. 419.

[5] Martineau's "Letter to the Dissenting Congregation of Eustace Street" (Dublin).



James Martineau.
(*From a photograph by Elliott and Fry, London.*)

We may, alternatively, describe Martineau's religion as his applied philosophy, or his philosophy as his explicated religion, and both as the expression of his singularly fine ethical and reverent nature. But to understand these in their mutual and explanatory relations, it will be necessary to exhibit the conditions under which his thought grew into consistency and system. His main function made him in his early life a preacher even more emphatically than a teacher. In all he said and all he thought he had the preacher's end in view. He was, indeed, no mere orator or speaker to multitudes. He addressed a comparatively small and select circle, a congregation of thoughtful and devout men, who cultivated reverence and loved religion all the more that their own beliefs were limited to the simplest and sublimest truths. He felt the majesty of these truths to be the greater that they so represented to him not only the most fundamental of human beliefs, but also all that man could be reasonably expected to believe, though to believe with his whole reason. Hence the beliefs he preached were never to him mere speculative ideas, but rather the ultimate realities of being and thought, the final truths as to the character and ways of God interpreted into a law for the government of conscience and the regulation of life. And so he became a positive religious teacher by virtue of the very ideas that made the words of the Hebrew prophets so potent and sublime. But he did more than interpret to his age the significance of man's ultimate theistic beliefs, he gave them vitality by reading them through the consciousness of Jesus Christ. His religion was what he conceived the personal religion of Jesus to have been; and He was to him more a person to be imitated than an authority to be obeyed, rather an ideal to be revered than a being to be worshipped.

Martineau's mental qualities fitted him to fulfil these high interpretative functions. He had the imagination that invested with personal being and ethical qualities the most abstruse notions. To him space became a mode of divine activity, alive with the presence and illumined by the vision of God: time was an arena where the divine hand guided and the divine will reigned. And though he did not believe in the Incarnation, yet he held deity to be in a sense manifest in Humanity; its saints and heroes became, in spite of innumerable frailties, after a sort divine; man underwent an apotheosis, and all life was touched with the dignity and the grace which it owed to its source. The 19th century had no more reverent thinker than Martineau; the awe of the Eternal was the very atmosphere that he breathed, and he looked at man with the compassion of one whose thoughts were full of God.

To his function as a preacher we owe some of his most characteristic and stimulating works, especially the discourses by which it may be said he won his way to wide and influential recognition—*Endeavours after the Christian Life*, 1st series, 1843; 2nd series, 1847; *Hours of Thought*, 1st series, 1876; 2nd series, 1879; the various hymn-books he issued at Dublin in 1831, at Liverpool in 1840, in London in 1873; and the *Home Prayers* in 1891. But besides the vocation he had freely selected and assiduously laboured to fulfil, two more external influences helped to shape Martineau's mind and define his problem and his work; the awakening of English thought to the problems which underlie both philosophy and religion, and the new and higher opportunities offered for their discussion in the periodical press. The questions which lived in the earlier and more formative period of his life concerned mainly the idea of the Church, the historical interpretation of the documents which described the persons who had created the Christian religion, especially the person and work of its Founder; but those most alive in his later and maturer time chiefly related to the philosophy of religion and ethics. In one respect Martineau was singularly happy; he just escaped the active and, on the whole, belittling period of the old Socinian controversy. When his ministry began its fires were slowly dying down, though the embers still glowed. We feel its presence in his earliest notable work, *The Rationale of Religious Enquiry*, 1836; and may there see the rigour with which it applied audacious logic to narrow premisses, the tenacity with which it clung to a limited literal supernaturalism which it had no philosophy to justify, and so could not believe without historical and verbal authority. This traditional conservatism survived in the statement, which, while it caused vehement discussion when the book appeared, was yet not so much characteristic of the man as of the school in which he had been trained, that "in no intelligible sense can any one who denies the supernatural origin of the religion of Christ be termed a Christian," which term, he explained, was used not as "a name of praise," but simply as "a designation of belief."[1] He censured the German rationalists "for having preferred, by convulsive efforts of interpretation, to compress the memoirs of Christ and His apostles into the dimensions of ordinary life, rather than admit the operation of miracle on the one hand, or proclaim their abandonment of Christianity on the other."[2] The echoes of the dying controversy are thus distinct and not very distant in this book, though it also offers in its larger outlook, in the author's evident uneasiness under the burden of inherited beliefs, and his inability to reconcile them with his new standpoint and accepted principles, a curious forecast of his later development, while in its positive premisses it presents a still more instructive contrast to the conclusions of his later dialectic. Nor did the sound of the ancient controversy ever cease to be audible to him. In 1839 he sprang to the defence of Unitarian doctrine, which had been assailed by certain Liverpool clergymen, of whom Fielding Ould was the most active and Hugh M'Neile the most famous. As his share in the controversy, Martineau published five discourses, in which he discussed "the Bible as the great autobiography of human nature from its infancy to its perfection," "the Deity of Christ," "Vicarious Redemption," "Evil," and "Christianity without Priest and without Ritual."[3] He remained to the end a keen and vigilant apologist of the school in which he had been nursed. But the questions proper to the new day came swiftly upon his quick and susceptible mind—enlarged, deepened, and developed it. Within his own fold new light was breaking. To Channing, whom Martineau had called "the inspirer of his youth," Theodore Parker had succeeded, introducing more radical ideas as to religion and a more drastic criticism of sacred history. Blanco White, "the rationalist à Kempis," who had dared to appear as "a religious sceptic in God's presence," had found a biographer and interpreter in Martineau's friend and colleague, John Hamilton Thom. Within the English Church men with whom he had both personal and religious sympathy rose—Whately, of whom he said, "We know no living writer who has proved so little and disproved so much";[4] and Arnold, "a man who could be a hero without romance";[5] Maurice, whose character, marked by "religious realism," sought in the past "the witness to eternal truths, the manifestation by time-samples of infinite realities and unchanging relations";[6] and Kingsley, "a great teacher," though one "certain to go astray the moment he becomes didactic."[7] Beside these may be placed men like Pusey, and Newman, whose mind Martineau said was "critical, not prophetic, since without immediateness of religious vision," and whose faith is "an escape from an alternative scepticism, which receives the *veto* not of his reason but of his will,"[8] as men for whose teachings and methods he had a potent and stimulating antipathy. The philosophic principles and religious deductions of Dean Mansel he disliked as much as those of Newman, but he respected his arguments more. Apart from the Churches, men like Carlyle and Matthew Arnold—with whom he had much in common—influenced him; while Herbert Spencer in England and Comte in France afforded the antithesis needful to the dialectical development of his own views. He came to know German philosophy and criticism, especially the criticism of Baur and the Tübingen school, which affected profoundly his construction of Christian history. And these were strengthened by French influences, notably those of Rénan and the Strasburg theologians. The rise of evolution, and the new scientific way of looking at nature and her creative methods, compelled him to rethink and reformulate his theistic principles and conclusions, especially as to the forms under which the relation of God to the world and His action within it could be conceived. Under the impulses which came from these various sides Martineau's mind lived and moved, and as they successively rose he promptly, by appreciation of criticism, responded to the dialectical issues which they raised.

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[1] *Types of Ethical Theory*, i. pp. vii.–ix.

[2] *Ibid.* p. xiii.

In the discussion of these questions the periodical press supplied him with the opportunity of taking an effective part. At first his literary activity was limited to sectional publications, and he addressed his public, now as editor and now as leading contributor, in *The Monthly Repository*, *The Christian Reformer*, *The Prospective*, *The Westminster*, and *The National Review*. Later, especially when scientific speculation had made the theistic problem urgent, he was a frequent contributor to the literary monthlies. And when in 1890 he began to gather together the miscellaneous essays and papers written during a period of sixty years, he expressed the hope that, though "they could lay no claim to logical consistency," they might yet show "beneath the varying complexion of their thought some intelligible moral continuity," "leading in the end to a view of life more coherent and less defective than was presented at the beginning."[9] And though it is a proud as well as a modest hope, no one could call it unjustified. For his essays are fine examples of permanent literature appearing in an ephemeral medium, and represent work which has solid worth for later thought as well as for the speculation of their own time. There is hardly a name or a movement in the religious history of the century which he did not touch and illuminate. It was in this form that he criticized the "atheistic mesmerism" to which his sister Harriet had committed herself, and she never forgave his criticism. But his course was always singularly independent, and, though one of the most affectionate and most sensitive of men, yet it was his fortune to be so fastidious in thought and so conscientious in judgment as often to give offence or create alarm in those he deeply respected or tenderly loved.

The theological and philosophical discussions which thus appeared he later described as "the tentatives which gradually prepared the way for the more systematic expositions of the *Types of Ethical Theory* and *The Study of Religion*, and, in some measure, of *The Seat of Authority in Religion*."[10] These books expressed his mature thought, and may be said to contain in what he conceived as a final form the speculative achievements of his life. They appeared respectively in 1885, 1888, and 1890, and were without doubt remarkable feats to be performed by a man who had passed his eightieth year. Their literary and speculative qualities are indeed exceptionally brilliant; they are splendid in diction, elaborate in argument, cogent yet reverent, keen while fearless in criticism. But they have also most obvious defects: they are unquestionably the books of an old man who had thought much as well as spoken and written often on the themes he discusses, yet who had finally put his material together in haste at a time when his mind had lost, if not its dialectic vigour, yet its freshness and its sense of proportion; and who had been so accustomed to amplify the single stages of his argument that he had forgotten how much they needed to be reduced to scale and to be built into an organic whole. In the first of these books his nomenclature is unfortunate; his division of ethical theories into the "unpsychological," "idiopsychological," and the "hetero-psychological," is incapable of historical justification; his exposition of single ethical systems is, though always interesting and suggestive, often arbitrary and inadequate, being governed by dialectical exigencies rather than historical order and perspective. In the second of the above books his idea of religion is somewhat of an anachronism; as he himself confessed, he "used the word in the sense which it invariably bore half a century ago" as denoting "belief in an ever-living God, a divine mind and will ruling the universe and holding moral relations with mankind." As thus used, it was a term which governed the problems of speculative theism rather than those connected with the historical origin, the evolution and the organization of religion. And these are the questions which are now to the front. These criticisms mean that his most elaborate discussions came forty years too late, for they were concerned with problems which agitated the middle rather than the end of the 19th century. But if we pass from this criticism of form to the actual contents of the two books, we are bound to confess that they constitute a wonderfully cogent and persuasive theistic argument. That argument may be described as a criticism of man and his world used as a basis for the construction of a reasoned idea of nature and being. Man and nature, thought and being, fitted each other. What was implicit in nature had become explicit in man; the problem of the individual was one with the problem of universal experience. The interpretation of man was therefore the interpretation of his universe. Emphasis was made to fall on the reason, the conscience, and the will of the finite personality; and just as these were found to be native in him they were held to be immanent in the cause of his universe. What lived in time belonged to eternity; the microcosm was the epitome of the macrocosm; the reason which reigned in man interpreted the law that was revealed in conscience and the power which governed human destiny, while the freedom which man realized was the direct negation both of necessity and of the operation of any fortuitous cause in the cosmos.

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[1] *Rationale*, 2nd ed., preface, p. vii.

[2] *Ibid.* p. 133.

[3] They stand as Lectures ii., v., vi., xi., xii. in the volume *Unitarianism Defended*, 1839.

[4] *Essays, Reviews, and Addresses*, vol. ii. p. 10.

[5] *Ibid.* i. p. 46.

[6] *Ibid.* i. pp. 258, 262.

[7] *Ibid.* ii. p. 285.

[8] *Ibid.* i. p. 233.

[9] *Essays, Reviews, and Addresses*, i., iii.

[10] *Ibid.* iii., preface, p. vi.

It was not possible, however, that the theistic idea could be discussed in relation to nature only. It was necessary that it should be applied to history and to the forces and personalities active within it. And of these the greatest was of course the Person that had created the Christian religion. What did Jesus signify? What authority belonged to Him and to the books that contain His history and interpret His person? This was the problem which Martineau attempted to deal with in *The Seat of Authority in Religion.* The workmanship of the book is very unequal: historical and literary criticism had never been Martineau's strong point; for years he had deserted it, and when as an old man he returned to it he found its problems changed from what they had been in his earlier manhood. Nor did he allow himself time to digest the new material; indeed, he had lost the inclination to occupy the later points of view or follow the exacter critical methods. In its speculative parts the book is quite equal to those that had gone before, but in its literary and historical parts it is in an even higher degree than they the book of an old man in whom a long-practised logic had become a rooted habit. It does not represent a mind that had throughout its history lived and worked in the delicate and judicial investigations he here tried to conduct.

Martineau's theory of the religious society or Church was that of a dreamer rather than of a statesman or practical politician. He stood equally remote from the old Voluntary principle, that "the State had nothing to do with religion," and from the sacerdotal position that the clergy stood in an apostolic succession, and either constituted the Church or were the persons into whose hands its guidance had been committed. He hated two things intensely, a sacrosanct priesthood and an enforced uniformity. He may be said to have believed in the sanity and sanctity of the State rather than of the Church. Statesmen he could trust as he would not trust ecclesiastics. And so he would have rejoiced in any scheme that would have repealed uniformity, taken the Church out of the hands of a clerical order, and allowed the co-ordination of sects or churches under the State. Not that he would have allowed the State to touch doctrine, to determine polity or discipline; but he would have had it to recognize historical achievement, religious character and capacity, and endow out of its ample resources those societies which had vindicated their right to be regarded as making for religion. His ideal may have been academic, but it was the dream of a mind that thought nobly both of religion and of the State. (A. M. F.)

Martinique, a French West Indian colony, one of the Antilles, 50 miles from St Vincent, 33 miles south of Dominica and 22 miles north of St Lucia. It has an area of about 390 square miles, and was considered, previously to the disaster of 1902 (see below), one of the most fertile parts of the West Indies; it was regarded almost as a pet colony by the French. Apart from other circumstances, Martinique is historically interesting as being the birthplace and early home of the Empress Josephine, and also the residence for some years of Françoise d'Aubigné, who married Scarron, and was afterwards celebrated as Madame de Maintenon. The island has had more than an ordinary share of tropical visitations. In 1767, 1600 persons perished in a terrible hurricane, whereby M. de la Pagerie, the father of the empress, was practically ruined; on 11th January 1839 the island experienced another severe storm; and in 1891, on 18th August, a hurricane devastated town and country, with the loss of 600 lives; and within recent years an epidemic of small-pox and several large fires have added to its misfortune. The greatest disaster of all, however, was that caused by the eruption of Mont Pelée in May 1902, by which the entire town of St Pierre and some 30,000 persons were destroyed in an incredibly short space of time. An account of this disaster is given below. Martinique is administered by a governor, assisted by a privy council, and controlled by an elective general council of 36 members. According to the state of things before May 1902 there was a court of appeal at Fort de France, and an assize court was held at St Pierre; there are two tribunals of first instance, and nine justices of the peace. The local budget for 1900 balanced at £229,190, the expenditure of France being £101,230. At Fort de France there is a law school; at St Pierre there was a *lycée* for boys and one for girls, and in the island there are primary schools with 11,500 pupils. Between 1893 and 1902 the bishop resided at St Pierre. The island is divided into 2 arrondissements—Fort de France and St Pierre—9 cantons, and 32 communes, regulated by the French law of 1884.

In 1888 the population was estimated at 175,863; in 1894 it was 187,692; and in 1902, 203,781. The number of Indian labourers had fallen from 13,000 in 1883 to 4700 in 1898; the women numbered 67,000; in the whole population blacks and half-breeds predominate. The towns, with their populations in the latter year, were Fort de France (17,274), with a harbour, said to be the finest in the Antilles, defended by three forts; St Pierre (25,792), the commercial town of the island (see below); Laurentin (10,854), Pilote River (7092), François (10,310), Robert (8056). About 180 square miles, or rather less than half the island, are under cultivation. The most important product is the sugar-cane. In 1875 the yield of sugar amounted to 50,000 tons; but the output afterwards decreased, as in all the Antilles, and in 1898 the quantity was between 37,000 and 38,000 tons. There were in 1901 in all 564 sugar works, of which 88 employed steam power. Sugar growing and refining in 1901 contributed about 85 per cent. of the exports, and even after the disasters of May 1902 it was estimated that 80 per cent. of the plantations and factories remained intact. About 38,000 acres are devoted to cereal crops. The yield of cocoa has since 1887 amounted annually to about 500 tons; but that of coffee fell to about 5½ tons. The cocoa plantations in the north of the island were overwhelmed by the eruption of 1902, but the coffee plantations were mostly uninjured. Tobacco and cotton are no longer grown, but indigo, mahogany, cinnamon, plums, and cherries figure among the products of the island. An agricultural laboratory was instituted at St Pierre in 1884. The cultivation of caoutchouc is being encouraged. The difficulty of transport is a serious hindrance to the cutting of the forests. The island contains about 50,000 head of live-stock, of which 20,000 are cattle, 20,000 pigs, and the remainder sheep, horses, and mules. The industries, besides the preparation of sugar, comprise the manufacture of arrack and rum (about 2½ millions of gallons), and of tiles and earthenware. The trade in 1882 amounted to £2,360,000; in 1898 to £7,868,540, the imports from France being of the value of £476,000, and the exports to France £752,000, the combined value being £1,228,000, the lowest during the century. After France, the United States carries on the most active trade with Martinique. In 1901 the total imports amounted to £1,078,940, and the total exports to £953,100. In 1898 the shipping entered and cleared with cargoes consisted of 168 vessels, aggregating 67,000 tons. Of the vessels, 81 were foreign. The roads are 165 miles long. As yet there is no railway. Fort de France is connected by regular monthly services with Bordeaux, St Nazaire, Marseilles, and Colon or Cayenne; there is also an English service connecting it with Southampton, and an American with New York. A cable connects Fort de France with the United States and with South America; a French cable was laid in 1890 between Martinique and Guadeloupe.

The following contemporary account of the eruption of Mont Pelée and the destruction of St Pierre in May 1902 was given in a letter to *The Standard* by Mr F. H. Watkins, the Commissioner of Montserrat. We quote from it in this article as giving the best available story of the disaster in the circumstances. From the geological point of view the conditions still remained to be investigated, but at the date when it was necessary for this volume to go to press no scientific report was to hand.

> "St Pierre, nearly a mile in length, lay to the north-east of the island, in a cup-shaped valley enclosed by well-defined spurs of hills running down to the sea. It contained a fine cathedral, a bishop's palace, a governor's residence, and spacious barracks. Towering over the back of St Pierre rose the lofty, solitary, and majestic peak, Mont Pelée (4428 feet high). For three months prior to the great outburst signs of active disturbance were manifest, and on 25th April 1902, at 8 A.M., the neighbourhood was darkened as by a total eclipse of the sun. A shower of fine white ashes fell steadily for two hours, covering the district north of St Pierre to the depth of nearly half an inch. When the fall of ashes ceased the weather remained gloomy and calm, and the crater still continued to emit smoke. Excessive heat was experienced throughout the West Indies at this time. The volcano increased in activity until 2nd and 3rd May, when a tremendous outburst of fire and lava overwhelmed the large Guérin sugar estate situated to the north of St Pierre, burying, it is estimated, more than 150 persons. Although the fall of ashes did not cease and some of the inhabitants left for St Lucia, most persons in Martinique were in hopes that this was the culminating effort of Mont Pelée; and these hopes were heightened on Wednesday, 7th May, by the news that the St Vincent *soufrière* was in eruption, and by the thought that the Martinique volcano would thereby be relieved. After the destruction of the Guérin and other estates to the north the terrified and destitute labourers crowded into St Pierre to the number of 5000, thus adding considerably to those destined to meet their fate in the crowning act of destruction.
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> "The morning of 8th May dawned on St Pierre with nothing to distinguish it from the others of the previous week. With the exception of smoke issuing from Mont Pelée, no signs of impending disaster was apparent. Being Ascension Day, a *fête d'obligation*, the stores and shops were closed. In the roadstead lay about seventeen vessels of different sizes, among them being the *Roraima*, a fine steamer of the Quebec line. To the north, opposite what had been the Guérin estate, the cable-ship *Grappler* was busily restoring telegraphic communication with the northern islands. About seven o'clock the Scrutton steamer *Roddam* steamed up, but owing to some quarantine difficulties she was ordered to the place set apart for ships in quarantine, and one anchor had been let go about eight o'clock. By being thus moored slightly out of the full force of the eruption the *Roddam* probably escaped the fate of the other vessels. In a moment, without warning, came the awful catastrophe. Those who survived stated that the whole side of the mountain seemed to gape open, and from the fissure belched a lurid whirlwind of fire, wreathing itself into vast masses of flame as it descended with terrible speed upon the doomed town. Before the true extent of their peril could be grasped the fiery mass swept like a river over the town, and, pushing the very waters of the sea before it, set the ships ablaze. In a few seconds, when the flames of the volcano had spent themselves, molten masses of lava and ashes, accompanied by a dense sulphurous vapour, asphyxiated those who had escaped death by fire and shock. The sulphurous fumes hung over the town for some minutes before being dissipated by a faint breeze, and then succeeded utter darkness, illumined by the burning houses and ships, from which proceeded the shrieks of the few survivors. The *Grappler* was the first vessel to catch fire, and was soon seen to turn over and disappear, capsized probably by a sort of tidal wave caused by the force of the explosion. Some of those down in the hold and in the forepart of the *Roraima* managed to escape, but the steamer was burned to a mere shell. The *Roddam* alone escaped. Soon after her anchoring in the quarantine ground the eruption took place, and immediately afterwards molten lava fell on the ship. In a few minutes a second explosion took place, causing the sea to become a raging cauldron, and this appears to have parted her anchor and caused her to drift. On board were fifteen labourers from Grenada looking after the cargo, seven of whom were roasted alive on the deck, and eight jumped overboard. The chief engineer, the first and second officers, and the supercargo lost their lives. Of forty persons who left St Lucia only ten or twelve returned alive, after taking nine hours to steam about 40 miles. Severely burned on his hands and face, Captain Freeman managed to bring his vessel to port.
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> "The French cruiser *Suchet* landed search parties at 1 A.M. on the 9th, but they were unable to penetrate into the town, which was still in flames. Some of the streets were lined with corpses. The only person in the town reported to be saved was a prisoner condemned for murder, who was discovered two days afterwards in his cell."

Consternation was caused not only in the West Indies, but in France and throughout the world, by this awful occurrence, and at first it was seriously suggested that the island should be totally evacuated, but no countenance was lent to this proposal by the French Government. Relief measures were at once undertaken, voluntary subscriptions raised, and it was considered probable in July 1902 that, with subsidies from the Government, the effects of the disaster might gradually be repaired. The material losses were estimated at £4,000,000; but, though St Pierre was destroyed, only one-tenth part of the island had been devastated, and the economic situation was fairly reassuring. The Bank of Martinique (which actually profited by the destruction of a large amount of its bank-notes) was sound, and in the absence of further eruptions or similar disasters the agricultural resources of the island bade fair to reassert themselves in time. During July, however, further activity was reported on the part of the volcano, and more destruction was done, and it remained doubtful what the future of the island was to be.

See HENRIQUE. *Les Colonies Françaises.* Paris, 1890.—HENRI MOUET. *La Martinique.* Paris, 1892.—LEVASSEUR. *La France*, t. ii. Paris, 1893.—*L'Année Coloniale*, 1900. (P. L.)

Martinsburg, a city of West Virginia, U.S.A., capital of Berkeley county, in the Shenandoah valley, in the north-eastern part of the state, on the Baltimore and Ohio and the Cumberland Valley railways, at an altitude of 435 feet. It has railway repair works and varied manufactures, with (1900) a capital of $1,633,024, 1105 wage-earners, and products valued at $1,410,514. Population (1890), 7226; (1900), 7564, of whom 197 were foreign-born and 678 were negroes.

Martins Ferry, a city of Belmont county, Ohio, U.S.A., on the Ohio river, opposite Wheeling, West Virginia, in the eastern part of the state, at an altitude of 658 feet. It is on the Cleveland, Lorain and Wheeling, the Pennsylvania, the Wheeling and Lake Erie, and the Wheeling Terminal railways. Its manufactures, which are extensive, consist mainly of iron and steel goods. The city has also a large river trade. Population (1890), 6250; (1900), 7760, of whom 1033 were foreign-born and 253 were negroes.

Martin Vaz. See TRINIDAD (Brazil).

Martos, a town of Spain, in the province of Jaen, to the south-west of the town of that name. Its much-frequented sulphurous springs and bathing establishment have been improved. The local trade is almost exclusively agricultural, and in the neighbourhood much live stock is reared. Population (1887), 16,356; (1897), 17,086.

Martos, Christino (1830–1893), Spanish politician, was born at Granada 13th September 1820. He was educated in his native town, and at Madrid University, where his Radicalism soon got him into trouble, and he narrowly escaped being expelled for his share in student riots and other demonstrations against the governments of Queen Isabella. He distinguished himself as a journalist on *El Tribuno*. He joined O'Donnell and Espartero in 1854 against a revolutionary cabinet, and shortly afterwards turned against O'Donnell to assist the Democrats and Progressists under Prim, Rivero, Castelar, and Sagasta in the unsuccessful movements of 1866, and was obliged to go abroad. His political career had not prevented Martos from rising into note at the bar, where he was very successful for forty years. After remaining abroad three years, he returned to Spain to take his seat in the Cortes of 1869 after the revolution of 1868. Throughout the revolutionary period he represented in cabinets with Prim, Serrano, and Ruiz Zorilla, and lastly under King Amadeus, the advanced Radical tendencies of the men who wanted to give Spain a Democratic monarchy. After the abdication of Amadeus of Savoy Martos played a prominent part in the proclamation of the federal republic, in the struggle between the executive of that republic and the permanent committee of the Cortes, backed by the generals and militia, who very nearly put an end to the executive and republic in April 1873. When the republicans triumphed Martos retired into exile, and soon afterwards into private life. He reappeared for a few months after General Pavia's *coup d'état* in January 1874, to join a coalition cabinet formed by Marshal Serrano, with Sagasta and Ulloa. Martos again returned to the bar in May 1874, and quietly looked on when the restoration took place at the end of that year. He stuck to his Democratic ideals for some years, even going to Biarritz in 1881 to be present at a sort of republican congress presided over by Ruiz Zorilla. Shortly afterwards Martos joined the dynastic Left organized by Marshal Serrano, General Lopez Dominguez, and Moret, Becerra, Balaguer, and other quondam Revolutionaries. He sat in several parliaments of the reign of Alphonso XII. and of the regency of Queen Christina, joined the dynastic Liberals under Sagasta, and gave Sagasta not a little trouble when the latter allowed him to preside over the House of Deputies. Having failed to form a rival party against Sagasta, Martos subsided into political insignificance, despite his great talent as an orator and debater, and died in Madrid 16th January 1893. (A. E. H.)

Marx, Heinrich Karl (1818–1883), the greatest theorist of modern revolutionary Socialism, and head of the International Working Men's Association, was born on the 5th of May 1818 in Trèves (Rhenish Prussia). His father, a Jewish lawyer, in 1824 went over to Christianity, and he and his whole family were baptized as Christian Protestants. The son went to the high grammar school at Trèves, and from 1835 to the universities of Bonn and Berlin. He studied first law, then history and philosophy, and in 1841 took the degree of doctor of philosophy. In Berlin he had close intimacy with the most prominent representatives of the young Hegelians—the brothers Bruno and Edgar Bauer and their circle, the so-called "Freien." He at first intended to settle as a lecturer at Bonn University, but his Radical views made a university career out of the question, and he accepted work on a Radical paper, the *Rheinische Zeitung*, which expounded the ideas of the most advanced section of the Rhenish Radical *bourgeoisie*. In October 1842 he became one of the editors of this paper, which, however, after an incessant struggle with press censors, was suppressed in the beginning of 1843. In the summer of this year Marx married Jenny von Westphalen, the daughter of a high government official. Through her mother Jenny von Westphalen was a lineal descendant of the earl of Argyle, who was beheaded under James II. She was a most faithful companion to Marx during all the vicissitudes of his career, and died on the 2nd of December 1881, he outliving her only fifteen months.

Already in the *Rheinische Zeitung* some Socialist voices had been audible, couched in a somewhat philosophical strain. Marx, though not accepting these views, refused to criticize them until he had studied the question thoroughly. For this purpose he went in the autumn of 1843 to Paris, where the Socialist movement was then at its intellectual zenith, and where he, together with Arnold Ruge, the well-known literary leader of Radical Hegelianism, was to edit a review, the *Deutsch-Französische Jahrbücher*, of which, however, only one number appeared. It contained two articles by Marx—a criticism of Bruno Bauer's treatment of the Jewish question, and an introduction to a criticism of Hegel's philosophy of the law. The first concluded that the social emancipation of the Jews could only be achieved together with the emancipation of society from Judaism, *i.e.*, commercialism. The second declared that in Germany no partial political emancipation was possible; there was now only one class from which a real and reckless fight against authority was to be expected, namely, the proletariate. But the proletariate could not emancipate itself except by breaking all the chains, by dissolving the whole constituted society, by recreating man as a member of the human society in the place of established states and classes. "Then the day of German resurrection will be announced by the crowing of the Gallican cock." Both articles thus relegated the solution of the questions then prominent in Germany to the advent of Socialism, and so far resembled in principle other Socialist publications of the time. But the way of reasoning was different, and the final words of the last quoted sentence pointed to a political revolution, to begin in France as soon as the industrial evolution had created a sufficiently strong proletariate. In contradistinction to most of the Socialists of the day, Marx laid stress upon the political struggle as the lever of social emancipation. In some letters which formed part of a correspondence between Marx, Ruge, Ludwig Feuerbach, and Michael Bakounine, published as an introduction to the review, this opposition of Marx to Socialistic "dogmatism" was enunciated in a still more pronounced form: "Nothing prevents us," he said, "from combining our criticism with the criticism of politics, from participating in politics, and consequently in real struggles. We will not, then, oppose the world like doctrinarians with a new principle: here is truth, kneel down here! We expose new principles to the world out of the principles of the world itself. We don't tell it: 'Give up your struggles, they are rubbish, we will show you the true war-cry.' We explain to it only the real object for which it struggles, and consciousness is a thing it *must* acquire even if it objects to it."

In Paris Marx met Friedrich Engels, from whom the *Deutsch-Französische Jahrbücher* had two articles—a powerfully written outline of a criticism of political economy, and a letter on Carlyle's *Past and Present*. Engels, the son of a wealthy cotton-spinner, was born in 1820 at Barmen. Although destined by his father for a commercial career, he attended a classical school, and during his apprenticeship and whilst undergoing in Berlin his one year's military service, he had given up part of his free hours to philosophical studies. In Berlin he had frequented the society of the "Freien," and had written letters to the *Rheinische Zeitung*. In 1842 he had gone to England, his father's firm having a factory near Manchester, and had entered into connexion with the Owenite and Chartist movements, as well as with German communists. He contributed to Owen's *New Moral World* and to the Chartist *Northern Star*, gave up much of his abstract speculative reasoning for a more positivist conception of things, and took to economic studies. Now, in September 1844, on a short stay in Paris, he visited Marx, and the two found that in regard to all theoretical points there was perfect agreement between them. From that visit dates the close friendship and uninterrupted collaboration and exchange of ideas which lasted during their lives, so that even some of Marx's subsequent works, which he published under his own name, are more or less also the work of Engels. The first result of their collaboration was the book *Die heilige Familie oder Kritik der kritischen Kritik, gegen Bruno Bauer und Konsorten*, a scathing exposition of the perverseness of the high-sounding speculative Radicalism of Bauer and the other Berlin "Freie." By aid of an analysis, which though not free from exaggeration and a certain diffuseness, bears testimony to the great learning of Marx and the vigorous discerning faculty of both the authors, it is shown that the supposed superior criticism—the "critical criticism" of the Bauer school, based upon the doctrine of a "self-conscious" idea, represented by or incarnated in the critic—was in fact inferior to the older Hegelian idealism. The Socialist and working-class movements in Great Britain, France, and Germany are defended against the superior criticism of the "holy" Bauer family.

In Paris, where he had very intimate intercourse with Heinrich Heine, who always speaks of him with the greatest respect, and some of whose poems were suggested by Marx, the latter contributed to a Radical magazine, the *Vorwärts*, but in consequence of a request by the Prussian Government, nearly the whole staff of the magazine soon got orders to leave France. Marx now went to Brussels, where he shortly afterwards was joined by Engels. In Brussels he published his second great work, *La misère de la philosophie*, a sharp rejoinder to the *Philosophie de la misère ou contradictions économiques* of J. P. Proudhon. In this he deals with Proudhon, whom in the former work he had defended against the Bauers, not less severely than with the latter. It is shown that in many points Proudhon is inferior to both the middle-class economists and the Socialists, that his somewhat noisily proclaimed discoveries in regard to political economy were made long before by English Socialists, and that his main remedies, the "constitution of the labour-value" and the establishment of exchange bazaars, were but a repetition of what English Socialists had already worked out much more thoroughly and more consistently. Altogether the book shows remarkable knowledge of political economy. In justice to Proudhon, it must be added that it is more often his mode of speaking than the thought underlying the attacked sentences that is hit by Marx's criticism. In Brussels Marx and Engels also wrote a number of essays, wherein they criticized the German literary representatives of that kind of Socialism and philosophic Radicalism which was mainly influenced by the writings of Ludwig Feuerbach, and deduced its theorems or postulates from speculations on the "nature of man." They mockingly nicknamed this kind of Socialism "German or True Socialism," and ridiculed the idea that by disregarding historical and class distinctions a conception of society and Socialism superior to that of the English and French workers and theorists could be obtained. Some of these essays were published at the time, two or three, curiously enough, by one of the attacked writers in his own magazine; one, a criticism of Feuerbach himself, was in a modified form published by Engels in 1885, but others have remained in manuscript. They were at first intended for publication in two volumes as a criticism of post-Hegelian German philosophy, but the revolution of 1848 postponed for a time all interest in theoretical discussions.

In Brussels Marx and Engels came into still closer contact with the Socialist working-class movement. They founded a German workers' society, acquired a local German weekly, the *Brüsseller Deutsche Zeitung*, and finally joined a communistic society of German workers, the "League of the Just," a secret society which had its main branches in London, Paris, Brussels, and several Swiss towns. For this league, which till then had adhered to the rough-and-ready communism of the gifted German workman Wilhelm Weitling, but which now called itself "League of the Communists," and gave up its leanings towards conspiracy and became an educational and propagandistic body, Marx and Engels at the end of 1847 wrote their famous pamphlet, *Manifest der Kommunisten*. It was a concise exposition of the history of the working-class movement in modern society according to their views, to which was added a critical survey of the existing Socialist and communist literature, and an explanation of the attitude of the communists towards the advanced opposition parties in the different countries. Scarcely was the manifesto printed when, in February 1848, the Revolution broke out in France, and "the crowing of the Gallican cock" gave the signal for an upheaval in Germany such as Marx had prophesied. After a short stay in France, Marx and Engels went to Cologne in May 1848, and there with some friends they founded the *Neue Rheinische Zeitung*, with the sub-title "An Organ of Democracy," a political daily paper on a large scale, of which Marx was the chief editor. They took a frankly revolutionary attitude, and directed their criticism to a great extent against the middle-class democratic parties, who, by evading all decisive issues, delayed the achievement of the upheaval. When in November 1848 the king of Prussia dissolved the National Assembly, Marx and his friends advocated the non-payment of taxes and the organization of armed resistance. Then the state of siege was declared in Cologne, the *Neue Rheinische Zeitung* was suspended, and Marx was put on trial for high treason. He was unanimously acquitted by a middle-class jury, but in May 1849 he was expelled from Prussian territory. He went to Paris, but was soon given the option of either leaving France or settling at a small provincial place. He preferred the former, and went to England. He settled in London, and remained there for the rest of his life.

At first he tried to reorganize the Communist League; but soon a conflict broke out in its ranks, and after some of its members had been tried in Germany and condemned for high treason, Marx, who had done everything to save the accused, dissolved the Communist League altogether. Nor was a literary enterprise, a review, also called the *Neue Rheinische Zeitung*, more successful; only six numbers of it were issued. It contained, however, some very remarkable contributions; and a series of articles on the career of the French Revolution of 1848, which first appeared there, was in 1895 published by Engels in book form under the title of *Die Klassenkämpfe in Frankreich von 1848* "by Karl Marx." Carlyle's *Latter Day Pamphlets*, published at that time, met with a very vehement criticism in the *Neue Rheinische Zeitung*. The endeavours of Ernest Jones and others to revive the Chartist movement were heartily supported by Marx, who contributed to several of the Chartist journals of the period, mostly, if not wholly, without getting or asking payment. He lived at this time in great financial straits, occupied a few small rooms in Dean Street, Soho, and all his children then born died very young. At length he was invited to write letters for the *New York Tribune*, whose staff consisted of advanced democrats and Socialists of the Fourierist school. For these letters he was paid at the rate of a guinea each. Part of them, dealing with the Eastern Question and the Crimean war, were republished in 1897 (London, Sonnenschein). Some were even at the time reprinted in pamphlet form. The co-operation of Marx, who was determinedly anti-Russian, since Russia was the leading reactionary power in Europe, was obtained by David Urquhart and his followers. A number of Marx's articles were issued as pamphlets by the Urquhartite committees, and Marx wrote a series of articles on the diplomatic history of the 18th century for the Urquhartite *Free Press* (Sheffield and London, 1856–57). When in 1859 the Franco-Austrian war about Italy broke out, Marx denounced it as a Franco-Russian intrigue, directed against Germany on the one hand and the revolutionary movement in France on the other. He opposed those democrats who supported a war which in their eyes aimed at the independence of the Italian nation and promised to weaken Austria, whose superiority in Germany was the hindrance to German unity. Violent derogatory remarks directed against him by the well-known naturalist Karl Vogt, gave occasion to a not less violent rejoinder, *Herr Vogt*, a book full of interesting material for the student of modern history. Marx's contention, that Vogt acted as an agent of the Bonapartist clique, seems to have been well founded, whilst it must be an open question how far Vogt acted from dishonourable motives. The discussions raised by the war also resulted in a great estrangement between Marx and Ferdinand Lassalle. Lassalle had taken a similar view of the war to that advocated by Vogt, and fought tooth and nail for it in letters to Marx. In the same year, 1859, Marx published as a first result of his renewed economic studies the book *Zur Kritik der politischen Oekonomie.* It was the first part of a much larger work planned to cover the whole ground of political economy. But Marx found that the arrangement of his materials did not fully answer his purpose, and that many details had still to be worked out. He consequently altered the whole plan and sat down to rewrite the book, of which in 1867 he published the first volume under the title *Das Kapital.*

In the meantime, in 1864, the International Working Men's Association was founded in London, and Marx became in fact, though not in name, the head of its general council. All its addresses and proclamations were penned by him and explained in lectures to the members of the council. The first years of the International went smoothly enough. Marx was then at his best. He displayed in the International a political sagacity and toleration which compare most favourably with the spirit of some of the publications of the Communist League. He was more of its teacher than an agitator, and his expositions of such subjects as education, trade unions, the working day, and co-operation were highly instructive. He did not hurry on extreme resolutions, but put his proposals in such a form that they could be adopted by even the more backward sections, and yet contained no concessions to reactionary tendencies. But this condition of things was not permitted to go on. The anarchist agitation of Bakounine, the Franco-German war, and the Paris Commune created a state of things before which the International succumbed. Passions and prejudices ran so high that it proved impossible to maintain any sort of centralized federation. At the Congress of The Hague, September 1872, the general council was removed from London to New York. But this was only a makeshift, and in July 1876 the rest of the old International was formally dissolved at a conference held in Philadelphia. That its spirit had not passed away was shown by subsequent international congresses, and by the growth and character of Socialist labour parties in different countries. They have mostly founded their programmes on the basis of its principles, but are not always in their details quite in accordance with Marx's views. Thus the programme which the German Socialist party accepted at its Congress in 1875 was very severely criticized by Marx. This criticism, reprinted in 1891 in the review *Die Neue Zeit*, is of great importance for the analysis of Marx's conception of Socialism.

The dissolution of the International gave Marx an opportunity of returning to his scientific work. He did not, however, succeed in publishing further volumes of *Das Kapital.* In order to make it, and especially the part dealing with property in land, as complete as possible, he took up, as Engels tells us, a number of new studies, but repeated illness interrupted his researches, and on the 14th of March 1883 he passed quietly away.

From the manuscripts he left Engels compiled a second and a third volume of *Das Kapital* by judiciously and elaborately using complete and incomplete chapters, rough copies and excerpts, which Marx had at different times written down. Much of the copy used dates back to the 'sixties, *i.e.*, represents the work as at first conceived by Marx, so that, *e.g.*, the matter published as the third volume was in the main written much earlier than the matter which was used for compiling the second volume. The same applies to the fourth volume. Although the work thus comprises the four volumes promised in the preface to the book, it can only in a very restricted sense be regarded as complete. In substance and demonstration it must be regarded as a torso. And it is perhaps not quite accidental that it should be so. Marx, if he had lived longer and had enjoyed better health, would have given the world a much greater amount of scientific work of high value than is now the case. But it seems doubtful whether he would have brought *Das Kapital*, his main work, to a satisfactory conclusion.

Das Kapital proposes to show up historically and critically the whole mechanism of capitalist economy. The first volume deals with the processes of producing capital, the second with the circulation of capital, the third with the movements of capital as a whole, whilst the fourth gives the history of the theories concerning capital. Capital is, according to Marx, the means of appropriating *surplus-value* as distinguished from ground rent (rent on every kind of terrestrial property, such as land, mines, rivers, &c., based upon the monopolist nature of such property). Surplus-value is created in the process of production only, it is this part of the value of the newly created product which is not given to the workman as a return—the *wage*—of the labour force he expended in working. If at first taken by the employer, it is in the different phases of economic intercourse split up into the profit of industrial enterprise, commercial or merchants' profit, interest, and ground rent. The value of every commodity consists in the labour expended on it, and is measured according to the time occupied by the labour employed on its production. Labour in itself has no value, being only the measure of value, but the labour-force of the workman has a value, the value of the means required to maintain the worker in normal conditions of social existence. Thus, in distinction to other commodities, in the determination of the value of labour-force, besides the purely economical, a *moral* and *historical* element enter. If to-day the worker receives a wage which covers the bare necessaries of life, he is underpaid—he does not receive the real value of his labour-force. For the value of any commodity is determined by its socially necessary costs of production (or in this case, maintenance). "Socially necessary" means, further, that no more labour is embodied in a commodity than is required by applying labour-force, tools, &c., of average or normal efficiency, and that the commodity is produced in such quantity as is required to meet the effective demand for it. As this generally cannot be known in advance, the market value of a commodity only gravitates round its (abstract) value. But in the long run an equalization takes place, and for his further deductions Marx assumes that commodities exchange according to their value.

That part of an industrial capital which is employed for installations, machines, raw and auxiliary materials, is called by Marx *constant capital*, for the value of it or of its wear and tear reappears in equal proportions in the value of the new product. It is otherwise with labour. The new value of the product must by necessity be always higher than the value of the employed labour-force. Hence the capital employed in buying labour-force, *i.e.*, in wages, is called *variable capital.* It is the tendency of capitalist production to reduce the amount spent in wages and to increase the amount invested in machines, &c. For with natural and social, legal and other limitations of the working day, and the opposition to unlimited reduction of wages, it is not possible otherwise to cheapen production and beat competition. According to the proportion of constant to variable capital, Marx distinguishes capitals of *lowest average* and *highest composition*, the highest composition being that where proportionately the least amount of variable (wages) capital is employed.

The ratio of the wages which workmen receive to the surplus-value which they produce Marx calls the *rate of surplus-value*; that of the surplus-value produced to the whole capital employed is the *rate of profit*. It is evident, then, that at the same time the rate of surplus-value can increase and the rate of profit decrease, and this in fact is the case. There is a continuous tendency of the rates of profit to decrease, and only by some counteracting forces is their decrease temporarily interrupted, protracted, or even sometimes reversed. Besides, by competition and movement of capitals the rates of profit in the different branches of trade are pressed towards an *equalization* in the shape of an *average rate of profits*. This average rate of profits, added to the actual cost price of a given commodity, constitutes its *price of production*, and it is this price of production which appears to the empirical mind of the business man as the value of the commodity. The real law of value, on the contrary, disappears from the surface in a society where, as to-day, commodities are bought and sold against money and not exchanged against other commodities. Nevertheless, according to Marx, it is also to-day this law of value ("labour-value") which in the last resort rules the prices and profits.

The tendency to cheapen production by increasing the relative proportion of constant capital—the fixed capital of the classical economist plus that portion of the circulating capital which consists of raw and auxiliary materials, &c.—leads to a continuous increase in the size of private enterprises, to their growing concentration. It is the larger enterprise that beats and swallows the smaller. The number of dependent workmen—"proletarians"—is thus continually growing, whilst employment only periodically keeps pace with their number. Capital alternately attracts and repels workmen, and creates a constant surplus-population of workmen—a *reserve-army* for its requirements—which helps to lower wages and to keep the whole class in economic dependency. A decreasing number of capitalists usurp and monopolize all the benefits of industrial progress, whilst the mass of misery, of oppression, of servitude, of depravation, and of exploitation increases. But at the same time the working class continuously grows in numbers, and is disciplined, united, and organized by the very mechanism of the capitalist mode of production. The centralization of the means of production and the socialization of the mode of production reach a point where they will become incompatible with their capitalist integument. Then the knell of capitalist private property will have been rung. Those who used to expropriate will be expropriated. Individual property will again be established, based upon co-operation and common ownership of the earth and the means of production produced by labour.

These are the principal outlines of *Das Kapital*. Its purely economic deductions are dominated throughout by the *theory of surplus-value*. Its leading sociological principle is the *materialist conception of history*. This theory is in *Das Kapital* only laid down by implication, but it has been more connectedly explained in the preface of *Zur Kritik* and several works of Engels. According to it the material basis of life, the manner in which life and its requirements are produced, determines in the last instance the social ideas and institutions of the time or historical epoch, so that fundamental changes in the former produce in the long run also fundamental changes in the latter. A set of social institutions answers to a given mode of production, and periods where the institutions no longer answer to the mode of production are periods of social revolution, which go on until sufficient adjustment has taken place. The main *subjective* forces of the struggle between the old order and the new are *the classes* into which society is divided after the dissolution of the communistic or semi-communistic tribes and the creation of states. And as long as society is divided into classes a class war will persist, sometimes in a more latent or disguised, sometimes in a more open or acute form, according to circumstances. In advanced capitalist society the classes between whom the decisive war takes place are the capitalist owners of the means of production and the non-propertied or wage-earning workers, the "proletariate." But the proletariate cannot free itself without freeing all other oppressed classes, and thus its victory means the end of exploitation and political repression altogether. Consequently the state as a repressive power will die out, and a free association will take its place.

Almost from the first *Das Kapital* and the publications of Marx and Engels connected with it have been subjected to all kinds of criticisms. The originality of its leading ideas has been disputed, the ideas themselves have been declared to be false or only partially true, and consequently leading to wrong conclusions; and it has been said of many of Marx's statements that they are incorrect, and that many of the statistics upon which he bases his deductions do not prove what he wants them to prove. In regard to the first point, it must be conceded that the *disjecta membra* of Marx's value theory and of his materialist conception of history are already to be found in the writings of former Socialists and sociologists. It may even be said that just those points of the Marxist doctrine which have become popular are in a very small degree the produce of Marx's genius, and that what really belongs to Marx, the methodical conjunction and elaboration of these points, as well as the finer deductions drawn from their application, are generally ignored. But this is an experience repeated over and over again in the history of deductive sciences, and is quite irrelevant for the question of Marx's place in the history of Socialism and social science.

It must further be admitted that in several places the statistical evidence upon which Marx bases his deductions is insufficient or inconclusive. Moreover, and this is one of the most damaging admissions, it repeatedly happens that he points out all the phenomena connected with a certain question, but afterwards ignores some of them and proceeds as if they did not exist. Thus, *e.g.*, he speaks at the end of the first volume, where he sketches the historical tendency of capitalist accumulation, of the decreasing number of magnates of capital as of an established fact. But all statistics show that the number of capitalists does not decrease, but increase; and in other places in *Das Kapital* this fact is indeed fully admitted, and even accentuated. Marx was, as the third volume shows, also quite aware that limited liability companies play an important part in the distribution of wealth. But he leaves this factor, too, quite out of sight, and confuses the concentration of private enterprises with the centralization of fortunes and capitals. By these and other omissions, quite apart from developments he could not well foresee, he announces a coming evolution which is very unlikely to take place in the way described.

In this and in other features of his work a *dualism* reveals itself which is also often observable in his actions in life—the alternating predominance of the spirit of the scholar and the spirit of the Radical revolutionary. Marx originally entitled his great social work *Criticism of Political Economy*, and this is still the sub-title of *Das Kapital*. But the conception of *critic* or *criticize* has with Marx a very pronounced meaning. He uses them mostly as identical with fundamentally opposing. Much as he had mocked the "critical criticism" of the Bauers, he is in this respect yet of their breed and relapses into their habits. He retained in principle the Hegelian dialectical method, of which he said that in order to be rationally employed it must be "turned upside down," *i.e.*, put upon a materialist basis. But as a matter of fact he has in many respects contravened against this prescription. Strict materialist dialectics cannot conclude much beyond actual facts. Dialectical materialism is revolutionary in the sense that it recognizes no finality, but otherwise it is necessarily positivist in the general meaning of that term. But Marx's opposition to modern society was fundamental and revolutionary, answering to that of the proletarian to the *bourgeois*. And here we come to the main and fatal contradiction of his work. He wanted to proceed, and to a very great extent did proceed, scientifically. Nothing was to be deduced from preconceived ideas; from the observed evolutionary laws and forces of modern society alone were conclusions to be drawn. And yet the final conclusion of the work, as already noted, *is* a preconceived idea; it is the announcement of a state of society logically opposed to the given one. Imperceptibly the dialectical movement of *ideas* is substituted for the dialectical movement of facts, and the real movement of facts is only considered so far as is compatible with the former. Science is violated in the service of speculation. The picture given at the end of the first volume answers to a conception arrived at by speculative socialism in the 'forties. True, Marx calls this chapter "the historical tendency of capitalist accumulation," and "tendency" does not necessarily mean realization in every detail. But on the whole the language used there is much too absolute to allow of the interpretation that Marx only wanted to give a speculative picture of the goal to which capitalist accumulation would lead if unhampered by Socialist counteraction. The epithet "historical" indicates rather that the passage in question was meant to give in the main the true outline of the forthcoming social revolution. We are led to this conclusion also by the fact that, in language which is not in the least conditional, it is there said that the change of capitalist property into social property will mean "only the expropriation of a few usurpers by the mass of the people." In short, the principal reason for the undeniable contradictions in *Das Kapital* is to be found in the fact that where Marx has to do with details or subordinate subjects he mostly notices the important changes which actual evolution had brought about since the time of his first Socialist writings, and thus himself states how far their presuppositions have been corrected by facts. But when he comes to general conclusions, he adheres in the main to the original propositions based upon the old uncorrected presuppositions. Besides, the complex character of modern society is greatly underestimated, so that, *e.g.*, such important features as the influence of the changes of traffic and aggregation on modern life are scarcely considered at all; and industrial and political problems are viewed only from the aspect of class antagonism, and never under their administrative aspect. With regard to the theory of surplus-value and its foundation, the theory of labour-value, so much may be safely said that, its premisses accepted, it is most ingeniously and most consistently worked out. And since its principal contention is in any case so far true that the wage-earning workers as a whole produce more than they receive, the theory has the great merit of demonstrating in an admirably lucid way the relations between wages and surplus-produce and the growth and movements of capital. But the theory of labour-value as the determining factor of the exchange or market value of commodities can with justification be disputed, and is surely not more true than those theories of value based on social demand or utility. Marx himself, in placing in the third volume what he calls the *law of value* in the background and setting out the formation of the "price of production" as the empirical determinator of prices in modern society, justifies those who look upon the conception of labour-value as an abstract formula which does not apply to individual exchanges of commodities at all, but which only serves to show an imagined typical example of what in reality to-day is only true with regard to the production of the whole of social wealth. Thus understood, the conception of labour-value is quite unobjectionable, but it loses much of the significance attributed to it by most of the disciples of Marx and occasionally by Marx himself. It is a means of analysing and exemplifying surplus labour, but quite inconclusive as to the proof of the surplus value, or as an indication of the degree of the exploitation of the workers. This becomes the more apparent the more the reader advances in the second and third volumes of *Das Kapital*, where commercial capital, money capital, and ground rent are dealt with. Though full of fine observations and deductions, they form, from a revolutionary standpoint, an anti-climax to the first volume. It is difficult to see how, after all that is explained there on the functions of the classes that stand between industrial employers and workers, Marx could have returned to those sweeping conclusions with which the first volume ends.

The great scientific achievement of Marx lies, then, not in these conclusions, but in the *details* and yet more in the *method* and *principles* of his investigations in his *philosophy of history*. Here he has, as is now generally admitted, broken new ground and opened new ways and new outlooks. Nobody before him had so clearly shown the *rôle* of the productive agencies in historical evolution; nobody so masterfully exhibited their great determining influence on the forms and ideologies of social organisms. The passages and chapters dealing with this subject form, notwithstanding occasional exaggerations, the crowning parts of his works. If he has been justly compared with Darwin, it is in these respects that he ranks with that great genius, not through his value theory, ingenious though it be. With the great theorist of biological transformation he had also in common the indefatigable way in which he made painstaking studies of the minutest details connected with his researches. In the same year as Darwin's epoch-making work on the origin of species there appeared also Marx's work *Zur Kritik der politischen Ökonomie*, where he explains in concise sentences in the preface that philosophy of history which has for the theory of the transformation or evolution of social organisms the same significance that the argument of Darwin had for the theory of the transformation of biological organisms.

The main writings of Karl Marx and Friedrich Engels are as follows (we give only the titles of the original works and of their English translations):—1. Of Karl Marx alone: *La misère de la philosophie, réponse à La philosophie de la misère de M. Proudhon*, Paris, 1847, new edition, 1892; English edition, *The Poverty of Philosophy*, London, 1900. *Lohnarbeit und Kapital*, pamphlet, written 1848, new edition, Berlin, 1891; English edition, *Wage-Labour and Capital*, London, 1900. *Die Klassenkämpfe in Frankreich, 1848 to 1850*, Berlin, 1895. *Der Achtzehnte Brumaire des Louis Bonaparte*, New York, 1852, 3rd edition, Hamburg, 1889; English edition, New York, 1889. *Enthüllungen über den Kölner Kommunistenprozess*, Basel, 1852; new edition, Zürich-Berlin, 1885. *European Revolutions and Counter-Revolutions* (reprints from the *New York Tribune*, 1851–1852), London, 1896. *The Eastern Question* (reprints from the *New York Tribune*, 1853–56), London, 1898. *Zur Kritik der politischen Ökonomie*, Berlin, 1859; new edition, Stuttgart, 1897. *Herr Vogt*, London, 1860. *Inaugural Address of the International Working Men's Association*, London, 1864. *Value, Price, and Profit;* written 1865, published London, 1898. *Das Kapital, Kritik der politischen Ökonomie*, 3 vols., Hamburg, 1867, 1885, and 1895; English edition of 1st vol. 1886. *The Civil War in France*, 1871, London, 1871; new edition, 1894. *L'Alliance de la democratie socialiste*, London, 1873. Articles printed or reprinted in *Rheinische Zeitung*, 1842–43; *Deutsch-Französische Jahrbücher*, Paris, 1844; *Das Westphälische Dampfboot*, Bielefeld und Paderborn, 1845–48; *Der Gesellschaftsspiegel*, Elberfeld, 1846; *Deutsche Brüsseler Zeitung*, Bruxelles, 1847; *Neue Rheinische Zeitung* (daily), Cologne, 1848–49 (monthly), Hamburg, 1850. *The People*, London, 1852–58; *The New York Tribune*, New York, 1853–60; *The Free Press*, Sheffield and London, 1856–57; *Das Volk*, London, 1859; *Der Vorbote*, Geneva, 1866–75; *Der Volkstaat*, Leipzig, 1869–76; *Die Neue Zeit*, Stuttgart, 1883, *sqq.; Sozialistische Monatschefte*, Berlin, 1895, *sqq.*—2. Of Friedrich Engels alone: *Die Lage der arbeitenden Klassen in England*, Leipzig, 1845, new edition, Stuttgart, 1892; English edition, London, 1892. *Zur Wohnungsfrage*, Leipzig, 1873–74; new edition, Zürich–Berlin, 1887. *Herrn Eugen Dührings Umwälzung der Wissenschaft*, Leipzig, 1877; 3rd edition, Stuttgart, 1894. Three chapters of the first-named are published in English under the title *Socialism, Utopian and Scientific*, London, 1892. *Der Ursprung des Eigenthums, der Familie und des Staates*, Zürich and Stuttgart, 1885 and 1892. *Ludwig Feuerbach und der Ausgangder Klassischen deutschen Philosophie*, Stuttgart, 1886. Introductions to most of the posthumous works of K. Marx and articles in the same periodicals as Marx.—3. Of Karl Marx and Friedrich Engels together: *Die Heilige Familie oder Kritik der Kritischen Kritik*, Frankfurt, 1845. *Manifest der Kommunistischen Partei*, London, 1848; English edition, 1848 and 1888.—4. With regard to Marx generally, his theory and his school, see J. Stammhammer, *Bibliographie des Sozialismus und Kommunismus*, Jena, 1893; and Th. G. Masaryk, *Die philosophischen und soziologischen Grundlagen des Marxismus*, Vienna, 1899. Much biographical and bibliographical information on Marx and Engels is to be found in Dr Franz Mehring, *Geschichte der deutschen Sozialdemokratic*, Stuttgart, 1897–98, and in the collection, edited also by Dr Fr. Mehring, *Aus dem literarischen Nachlass von Karl Marx, Friedrich Engels und Ferdinand Lassalle*, Stuttgart, 1902. Of the criticisms of Marx's economics, one of the most comprehensive is E. von Boehm-Bawerk's *Karl Marx and the Close of his System*, London, 1898. Marx's historic theory is, apart from Masaryk, very exhaustively analysed by R. Stammler in *Wirthschaft und Recht*, Leipzig, 1896. (E. Bn.)

Maryborough, town, Queensland, Australia, in the county of March, 25 miles from the mouth of the river Mary, about 180 miles north of Brisbane by rail. It is the port of shipment for a wide agricultural district yielding maze and sugar, and also for the Gympie goldfield. Large smelting works are 5 miles distant, in which ore from all the states is treated. There are also foundries and a large shipbuilding yard. Population (1891), 9700; (1901), 10,159.

Maryborough, a borough of Victoria, Australia, in the county of Talbot, 112 miles by rail north-west of Melbourne. It is an important railway centre, and has extensive railway workshops. The gold-mining of the district is deep alluvial. Population (1901), 5623.

Maryland, one of the original states of the American Union, bounded on the N. by Pennsylvania and Delaware, on the E. by Delaware and the Atlantic Ocean, and on the S. and W. by Virginia and West Virginia. It is divided into three physiographic areas known as the Coastal Plain, the Piedmont Plateau, and the Appalachian Region. The Coastal Plain, embracing about 5000 square miles, represents in its formations the various epochs of geological history from the late Jurassic or early Cretaceous to the present time. The trough of the Chesapeake Bay was cut across the Coastal Plain by the predecessor of the present Susquehanna river, the bay being only the submerged lower valley of that stream. The Piedmont Plateau borders this plain on the west, and, extending to the base of the Catoctin Mountain, includes about 2500 square miles. The most widely extended formation of this area is the gneiss, enfolded with which are quartz-schist and marble bands and several types of igneous rocks. The Appalachian Region extends from the Piedmont Plateau to the western limits of the state, and comprises about 2000 square miles. This region is divided into three distinct physiographic districts based upon clearly defined geological differences, *i.e.*, an eastern (Blue Ridge and Great Valley), a central (Alleghany Ridges), and a western (Alleghany Plateau) division. Dr William Bullock Clark says the "Great Appalachian Valley, commonly known in Maryland as the Hagerstown Valley, is underlain by the Shenandoah limestone of late Cambrian and early Silurian age, which also outcrops to the east of the Catoctin Mountain in the Frederick Valley. Beyond the Great Valley there is a succession of sharp ridges and deep valleys formed of the folded sediments of Silurian, Devonian, and Carboniferous age, the Silurian and Devonian rocks predominating in the eastern ridges, and the Devonian and Carboniferous in the west. The coal deposits of the Carboniferous occupy a succession of troughs to the west of Cumberland, and are the most important geological deposits from a commercial standpoint within the limits of the state."

The total area of Maryland is 12,210 square miles, of which 2350 are water. The total land area is 9860 square miles, and is divided among the counties of the state as follows:—

County.	Square Miles.	County.	Square Miles.
Allegany .	442	Harford .	388
Anne Arundel .	425	Howard .	240
Baltimore	656	Kent	281
Baltimore City .	30	Montgomery .	490
Calvert .	222	Prince George's	482
Caroline .	320	Queen Anne's .	376
Carroll	437	St Mary's .	372
Cecil	360	Somerset .	362
Charles .	451	Talbot .	286
Dorchester	608	Washington	458
Frederick .	662	Wicomico	365
Garrett .	660	Worcester	487

Population.—The figures of the decennial census from 1880 to 1900 are as follows for the whole state:—

Year.	Population.	Increase.	Percentage of Increase.
1880	934,943	154,049	19·7
1890	1,042,390	107,447	11·5
1900	1,188,044	145,654	14·1

In 1900 the total white population amounted to 952,424, of whom 473,119 were male and 479,305 female. The total negro population at the same date was 235,064, of whom 115,617 were male and 119,447 female. There were also 544 Chinese, 9 Japanese, and 3 Indians taxed. The native-born population amounted to 1,094,110; the foreign-born to 93,934. There were within the state only five cities with a population in 1900 of over 6000—namely, Baltimore, 508,957; Cumberland, 17,128; Hagerstown, 13,591; Frederick, 9296; and Annapolis, 8525. The urban population was 46·9 per cent. of the total population. The average number of persons to the square mile was 120·7 in 1900, as compared with 105·7 in 1890. In 1901 the registered voters of the state (males twenty-one years of age and over) numbered 272,231, as against 293,389 voters in 1900.

Education.—Maryland has an excellent system of free public schools supported by state, county, and municipal taxation. In 1899 the number was as follows:—Schools in Baltimore city, 185; in the counties, 2334; pupils in Baltimore city, 80,146; in the counties, 142,227; teachers in Baltimore city, 1802; in the counties, 3314; cost of maintenance in Baltimore city, $1,218,734; in the counties, $1,469,063. Total number of schools, 2519; total number of pupils, 222,373; total number of teachers, 5116; total cost, $2,687,797. The State Normal School, St John's College, Western Maryland College, Maryland Agricultural College, Washington College, Frederick School for the Deaf and Dumb, St Mary's Female Seminary, Charlotte Hall Academy, and Maryland Institute, with a total of 1353 students and 110 teachers, received from the state in 1899 an aggregate of $139,400. Thirteen other schools and academies, with a total of 1289 students, received aid from the state to the amount of $6900. The chief educational institution of the state is the Johns Hopkins University (including a graduate school, a college, and a medical school), which had (in 1900) 131 professors and instructors and 651 enrolled students. Also situated in Baltimore city are the Woman's College, the City College, the University of Maryland (including a law school, a medical school, and a school of dental surgery), the College of Physicians and Surgeons, College of Dental Surgery, Baltimore Medical College, &c.

Libraries.—The Peabody Library in Baltimore contains 135,000 volumes, designed especially for students, and is well catalogued. It is open daily, without charge. The Enoch Pratt Free Library, also in Baltimore (income $50,000 per annum), is a free circulating library, with branches throughout the city, and numbers upwards of 200,000 volumes. There are also in Baltimore the library of the Johns Hopkins University, 94,000 volumes; the Maryland Historical Society's Library, 30,000 volumes; the New Mercantile Library, 50,000 volumes; the Bar Library, 17,000 volumes; the Medical and Chirurgical Library, 14,000 volumes; and the library of the Maryland Institute, 23,000 volumes. The State Library at Annapolis contains 60,000 volumes.

Charities.—The Maryland Hospital for the Insane at Catonsville treats and cares for an average of 535 patients, and reports 4 per cent. of cures of those treated. The second hospital for the insane, situated in Sykesville, annually treats an average of 206 patients. These two institutions received from the state $50,000 in 1900. The State Lunacy Commission reports a total of 2531 insane confined in almshouses, gaols, penitentiary, public and private institutions, in 1899. The Sheppard and Enoch Pratt Hospital for Mental and Nervous Diseases was founded by Moses Sheppard, and became the residuary legatee of the estate of Enoch Pratt. The design of the founder, based on the belief that many cases of curable insanity become chronic through lack of proper care and treatment, was for a home treatment on the principle of non-restraint, and the removal of all features suggestive of an asylum. By reason of the plan, the scope is necessarily limited. From 1892 to 1899, 553 patients were admitted and 462 discharged, of whom 99 were cured and 166 greatly improved. The Maryland Asylum and Training School for Feeble-Minded, at Owings Mills, cares for an average of 100 annually. A large number of the leading charitable institutions—hospitals, asylums, and training schools—are private corporations, which are made the almoners of the state's charity by annual legislative appropriations, while they are supported in part by endowments of their own and by private subscription. In 1900 the state gave $263,000 to 48 institutions of this character.

Penal Institutions.—The new penitentiary, completed at a cost of $1,000,000, is a model of its kind. Its inmates number 918 men and 48 women. The institution is self-supporting, and annually yields a surplus to the state treasury. In addition to learning trades, all convicts are allowed to work overtime, and the amount thus made is credited to them when they leave the institution. In 1899 the convicts earned for themselves in this way $22,697. The Maryland House of Correction, a prison for minor offences, is supported by an annual legislative appropriation of $25,000 and the labour of the inmates. The average number of committals yearly is 1483. The House of Refuge at Baltimore had, in 1900, 223 boys committed. Manual training is given to all inmates. The female House of Refuge had 127 inmates, who are taught useful occupations, and are supplied with homes at the expiration of their detention.

Banks.—The national banks presented the following statement of their condition in September 1900:—

	Number.	Capital Stock paid in.	Individual Deposits.
Counties . .	53	$4,014,400	$13,912,473
Baltimore . .	19	11,108,260	29,029,006

Seventeen state banks reported in 1900 shares of stock assessed at $1,718,130, and owned real estate valued at $226,442. The aggregate deposits of the 35 savings banks amounted in 1899 to $56,140,168. The real estate owned by these banks was assessed at $1,045,271. The bank clearances in Baltimore city amounted in 1887 to $659,346,471, rose in 1896 to $720,089,733, and in 1899 to $1,209,777,742.

Agriculture.—The total number of farms in 1900 was 46,012; occupied by owners, 30,565, occupied by tenants, 15,447. The total value of farms was $204,645,407. Total acreage of farms, 5,170,075; improved, 3,516,352; unimproved, 1,653,723. Value of implements, &c., $8,611,220; live stock, $20,855,877. Value of farm products (1899), $43,823,419. Horses (1900), 179,486; mules, 19,325; neat cattle on farms, 292,646; sheep, 194,076; swine, 359,812. Amount paid to farm labourers, $5,715,520.

Coal Mining.—The total production of coal in the state in 1901 was 4,481,403 long tons, and the value of mines and equipments was $20,000,000; paid for labour, $1,464,826. In 1898 the shipments of coal by the companies operating in George's Creek region amounted to 4,120,870 tons, and the number of men employed was 4651.

Oysters.—During the season of 1898–99 the quantity of oysters officially inspected was 5,547,793 bushels, but this did not include all the products of the beds of Chesapeake Bay.

Tobacco.—The tobacco received for inspection at the state warehouses in 1898 amounted to 36,219 hogsheads.

Manufactures.—The number of manufacturing establishments reporting in 1900 was 9880, with an aggregate capital of $163,422,260. Number of labourers, 108,361. Total wages, $38,761,551. Salaried employés, 7589; salaries paid, $7,383,263. Cost of materials used, $144,539,680. Value of products, $242,752,990. The greater part of the manufacturing is carried on in Baltimore. There were in this city 6361 manufacturing establishments, with a capital of $117,869,175, products valued at $161,945,811, and 79,084 wage-earners (exclusive of salaried officials, clerks, &c.), who received wages amounting to $29,304,520.

Commerce.—The size of the foreign commerce is seen in the following statistics relating to Baltimore city, the chief port:—

Exports for the year ending 30th June 1901	$106,239,081
Imports ,, ,, ,,	18,899,473
Custom house receipts, 1898	$1,870,038
,, ,, 1899	2,549,725
Internal revenue collections, 1898	6,657,360
,, ,, 1899	8,667,652
Immigration through Baltimore, 1898	12,853
,, ,, 1899	20,233

Finances.—The funded debt amounted on 1st January 1899 to $6,009,326. As an offset to this the state held interest-bearing securities and cash to the credit of the sinking funds amounting in value to $3,121,283, leaving the net debt $2,888,043. The value of the property assessed for taxation in 1899 was $611,539,646. In 1890 this value was $482,184,824.

History, &c.—Since 1895 the two great parties—Democratic and Republican—have been nearly equal in numbers, and the control of the state government is sometimes with one and sometimes with the other. The statutory law of the state was codified in 1888, and a supplement to the code, embracing the subsequent statutes, was adopted in 1900. The most important work relating to the history of the state is the Maryland Archives, published by the Maryland Historical Society under the authority of the legislature (1882 to date). Twenty volumes have so far appeared, containing principally the proceedings of the executive and legislative departments in the 17th and 18th centuries. The annual reports of the Maryland Geological Survey, beginning in 1897, convey the result of much original investigation relating to the soils and the physical features.

(W. T. B.)

Maryport, market-town and seaport in the Cockermouth parliamentary division of Cumberland, England, at the mouth of the river Ellen, 25 miles west-south-west of Carlisle by rail. The harbour is easy of access, and with the river offers 3800 feet of quayage. In 1892 it became an independent port with Workington, Whitehaven, and Millom subordinate to it. In 1888, 1459 vessels of 239,981 tons entered and 1456 of 244,501 tons cleared; in 1898, 3171 vessels of 606,922 tons entered and 3164 of 612,022 tons cleared. The registered shipping in 1898 totalled 26 vessels of 17,826 tons. Steel rails and coal are exported; timber, iron-ore, and grain imported. Population (1891), 12,410; (1901), 11,896.

Mascara, a town of Algeria, department of Oran, 60 miles south-east of the town of Oran. The principal industry is wine, for which it has a high repute. Over 3000 acres in the neighbourhood have been planted with vines, and, notwithstanding an attack of phylloxera, the area of vineyards is extending. Population (1886), 15,400; (1896), 20,410, of whom 10,104 were French.

Maseru. See BASUTOLAND.

Mashonaland. See RHODESIA (SOUTH).

Mason City, a city of Iowa, U.S.A., capital of Cerro Gordo county, on the Shell Rock river, in the northern part of the state, at an altitude of 1132 feet. It is on the Chicago, Milwaukee, and St Paul, the Iowa Central, the Mason City and Fort Dodge, the Mason City and Clear Lake, and the Chicago and North-western railways. It is in a rich agricultural region, for which it serves as a collecting and distributing point. Population (1890), 4007; (1900), 6746, of whom 914 were foreign-born and 55 were negroes.

Massa, a town, bishop's see, and capital of the province of Massa and Carrara, Tuscany, Italy, situated near the Mediterranean coast, 27 miles north-west of Pisa by rail. Like Carrara, it is a centre of the marble industry, in which some 1100 men were employed in 1898. It also carries on the manufacture of cotton, silk, and tobacco. Population (1881), 16,246; (1901), 26,325.

Massachusetts, one of the New England states of the American Union, bounded on the N. by New Hampshire and Vermont, on the W. by New York, on the S. by Connecticut and Rhode Island, and on the E. by the Atlantic.

Population.—The population in 1890 was 2,238,943, and in 1900 it was 2,805,346, an increase during 1890–1900 of 25·2 per cent. With the exception of Rhode Island, it is the most densely settled state in the Union, the average number of persons to the square mile at the census of 1900 being 348·9, and the urban population being 76·0 per cent. of the total population. In 1900 females constituted 51·3 per cent. of the total population. Only 1·3 per cent. of the population was coloured. The percentage of the population that was foreign-born in 1885 was 27·13, and in 1900 it was 30·2. Ireland contributed the largest proportion of the foreign-born population, although since 1875 the numbers born in that country and living in Massachusetts have increased but slowly. The Irish-born proportion of the population of the state, which in 1875 was $14\frac{2}{10}$ per cent., was in 1895, $10\frac{3}{10}$ per cent. In 1895 a very nearly similar percentage were immigrants from British America. These were chiefly of French origin, and large numbers of them found employment in the textile industries. Other countries which in 1895 contributed more than 15,000 each to the population were England, Sweden and Norway, Germany, Scotland, and Italy, in the order named. During the period 1885–90 the largest proportional increase from any foreign country was from Italy. For the year ending 30th September 1899 the number of passengers arriving from foreign ports was 72,682. Of these there were aliens from the Dominion of Canada to the number of 24,084, and aliens from transatlantic ports to the number of 20,065. A large part of the transatlantic immigrants pass speedily to permanent homes in the West, but by far the greater part of the Canadian influx remains, and may become citizens. According to the census of 1900, there were 33 incorporated cities in Massachusetts, of which 8 had between 12,000 and 20,000 inhabitants; 5 between 20,000 and 25,000; 10 between 25,000 and 50,000; 7 between 50,000 and 100,000; and 3 more than 100,000 inhabitants, namely, Boston (560,892), Worcester (118,421), and Fall River (104,863). In 1890 the urban population (classing as such all persons in places of more than 8000 inhabitants) was 69·9 per cent. of the total population; in 1900 it was 76 per cent. The aggregate number of state, city, and town poor (including the insane) remaining in institutions was, on 30th September 1899, 12,795. The total number of prisoners was 6772, a reduction of 679 from the year before. The birth-rate in 1895 was 27·02 per thousand, and was the highest in any census year since 1860. In 1898 it is estimated to have been 27·37. Of all the children born in Massachusetts in 1898, 32·35 per cent. were of native-born parents, 48·24 per cent. were of foreign-born parents, 19·02 per cent. were of parents of whom one was foreign-born, and ·39 per cent. were of unreported parentage. The death-rate in 1895 was 19·01 per thousand, which is less than in any census year since 1870. The death-rate of 1900 was 17·7.

Politics.—Since 1820 the payment of at least a poll-tax had been one of the pre-requisites to the exercise of the suffrage, but this requirement was annulled by a constitutional amendment adopted by the people in 1891. An educational test is exacted for the privilege of voting, every voter being required to read the constitution of the commonwealth in the English language, and to write his name. The number of legal voters in 1895 was 560,802. In the Presidential election of 1896, when an unprecedentedly large vote was cast, the number of voters registered was 490,554, or nearly 20 per cent. of the population, and of these 401,568 actually voted, or nearly 82 per cent. Massachusetts is one of the only two states in the Union in which elections for state officers are now held annually. In 1896 two amendments to the constitution, establishing biennial elections of state officers and of members of the general court, were defeated by a large majority. At all elections official ballots are furnished, and are marked and cast by the voter under provisions of the so-called Australian Ballot Act, which ensure absolute secrecy. A limited suffrage was conferred upon women in 1879. At the present time every female citizen having the qualifications of a male voter may vote in the city and town elections for members of the school committee. This privilege has not been very generally exercised. In 1899 there were 36,110 registered women voters, and of these only 35$\frac{6}{10}$ per cent. voted, whereas of the registered male voters 77½ per cent. voted. In the city of Boston, however, where much interest was felt in the election, 67$\frac{3}{10}$ of the registered women voted, a larger proportion than that of men who voted at the state election a month earlier. Efforts are annually made to extend female suffrage to the election of other municipal officers and to state officers, but these efforts have not proved successful. In 1895 all persons qualified to vote for the school committee were given an opportunity to vote upon the question, "Is it expedient that municipal suffrage be granted to women?" with the following results:—

	Yes.	No.
Male voters . .	87,000	186,976
Female ,, . .	22,204	861

Since 1880, with the exception of 1883, and of 1891–94, Massachusetts has annually elected a Republican governor, and the majority of the Republican party in both branches of the legislature has usually been very large. The division in the Democratic party, due to its declaration in favour of the free coinage of silver at the ratio to gold of 16 to 1, has tended to increase the Republican preponderance.

Liquor Laws.—In 1881 a local option law was passed, providing for the granting of licences for the sale of liquor only in cities and towns voting at the annual election to authorize their issue. In 1888 the number of licences which may be granted in municipalities voting in favour of their issue was limited to one for each 1000 inhabitants, except in Boston, where one licence may be issued for every 500 inhabitants. The vote varies from year to year, and it is not unusual for a certain number of municipalities to change from "licence" to "no licence," and *vice versâ.* The general result has been that centres of population, especially where the foreign element is large, usually vote "Yes," while those in which native population predominates, as well as the smaller towns, usually vote "No." Through a growing acquiescence in the operation of the local option law, the relative importance of the vote of the Prohibition party has of late years diminished.

Patents and Post.—The number of patents for inventions issued was in 1898 one to every 1428 persons in the population, this ratio being exceeded in Connecticut only. The total postal receipts for 1898 were $5,759,154, an amount exceeded in Illinois, New York, and Pennsylvania only.

Finances.—The aggregate valuation made by local assessors of property, real and personal, was, in 1899, $2,876,021,222. Certain descriptions of personal property—of which the largest items are the taxable excess of the valuation of corporations over their visible and tangible property which is locally taxed, and the taxable savings banks deposits—are not subject to valuation by municipal assessors, but are made to contribute to the revenues of the commonwealth. If these descriptions of property are included, the valuation in 1899 was: real estate, $2,247,094,547; personal property, $1,515,605,757; total, $3,762,700,304. The total valuation of the capital stock of corporations in 1899 was $707,183,138, an increase of $81,588,118 over that of 1898. The aggregate net state debt, *i.e.*, after deduction of the several sinking funds, has increased rapidly from $6,140,380 in 1896 to $16,869,171 in 1900. This increase has been chiefly due to the erection of important public buildings, to the construction of state highways and metropolitan park roadways, to the improvement of Boston harbour, to the abolition of grade crossings of railways, and to the expenses incurred in the Spanish war of 1898. The aggregate net debt of the municipalities was, in 1899, $128,051,487, or 4$\frac{4}{10}$ per cent. of the local valuation, a proportion greater than that in any other year subsequent to 1879, when it was the same.

Banks.—The increase in savings banks deposits in 1899 over those of the previous year was $29,559,124, the greatest gain in any year since 1834, when reports were first required by law. In 1895 the average deposit to each account was $337, and to each person of the population, $175; both of these proportions are steadily mounting, and furnish an accurate test of the general prosperity and thrift. In 1899, when the deposits aggregated $518,202,048, there were 1,477,447 accounts, with an average of $350 to each. The number of national banks in operation in Massachusetts on 31st October 1899 was 250, a number exceeded only in New York, Pennsylvania, and Ohio. The paid-up capital of these banks was $80,827,500, second only to the amount so invested in New York. There are 36 trust companies transacting business, with deposits of $129,652,632 and total assets of $156,337,419.

Railways.—The total length of railway lines within the commonwealth in 1899 was 2107. The total length of main track of street railways worked by electricity was 1537, and is increasing rapidly. The aggregate capital stock of the 46 railway corporations, 30th June 1899, was $213,255,282. The aggregate capital stock of the 116 street railway companies, 30th September 1899, $41,380,143.

Commerce.—In the magnitude of its foreign commerce Boston is the second port in the United States, being surpassed only by New York. For the year ending 30th June 1900, the total value of exports was $143,708,232, or nearly one-tenth of the total exports of the United States. The total value of imports for the same period was $61,452,370.

Manufactures.—In 1900 Massachusetts ranked third among the states of the Union in the amount of capital invested in manufactures and in the number of hands employed, and fourth in the value of manufacturing products. In the textile industry Massachusetts continues to be the foremost state in the Union. In 1900 its textile products exceeded those of Pennsylvania, the state ranking next to it, by 35·2 per cent. The growth of manufactures during the decade 1890–1900 is shown by the following general statistics:—

	1890.	1900.	Per cent. of Increase.
Number of establishments . . .	26,923	29,180	8·4
Capital . . .	$630,032,341	$823,264,287	30·7
Salaried officials, clerks, &c. . .	37,912[1]	27,860	26·5[2]
Salaries . . .	33,826,172[1]	$31,257,630	7·6[2]
Wage-earners . .	447,270	497,448	11·2
Total wages . .	$205,844,337	$228,240,442	10·9
Miscellaneous expenses	$63,083,782	$73,209,015	16·1
Cost of materials used	$473,199,434	$552,717,955	16·8
Value of products .	$888,160,403	$1,035,198,989	16·6

The following table shows the statistics of the principal manufacturing industries, with the number of establishments, capital, average number of wage-earners (exclusive of salaried officials, clerks, &c.), and the value of products:—

Industries.	Number of Establishments.	Capital.	Wage-earners.	Value of Products.
Boot and shoe cut stock .	270	$5,476,277	4,390	$18,238,922
Boots and shoes, factory product	640	37,577,630	58,645	117,115,243
Boots and shoes, rubber .	6	13,157,321	5,250	16,490,015
Carriages and waggons .	888	5,594,939	3,164	6,118,121
Clothing, men's . . .	194	3,793,174	3,833	9,830,954
,, women's . .	119	1,616,991	3,443	5,201,650
Confectionery .	249	2,212,389	2,942	7,014,532
Cordage and twine . .	19	7,697,434	3,303	9,635,571
Electrical apparatus and supplies	54	8,259,612	5,202	10,490,361
Foundry and machine-shop products	825	62,498,989	32,234	56,290,159
Furniture, factory product .	120	10,987,220	6,092	11,244,503
Iron and steel .	8	13,738,593	6,125	13,491,159
Jewellery	138	4,917,105	5,696	10,315,334
Leather — tanned, curried, and finished . . .	119	15,317,940	7,010	26,067,714
Liquors, malt . . .	40	18,136,623	1,651	11,255,613
Lumber	696	10,373,208	5,202	12,818,511
Paper and wood pulp .	93	26,692,922	9,061	22,141,461
Printing and publishing	981	19,325,956	10,859	28,964,680
Rubber and elastic goods .	70	11,818,650	5,944	13,885,059
Slaughtering and meat-packing, wholesale . . .	11	9,016,672	2,337	27,505,698
Sugar and molasses, refining	7	13,974,045	592	19,626,882
Textiles	512	274,332,129	149,346	214,600,980

The textile industries employed 30 per cent. of the wage-earners engaged in manufactures, and the products were valued at 20·7 per cent. of the total value of the products. Of these industries the most important subdivisions, with the value of their products, are the following: carpets and rugs, $6,966,237; cotton goods, including cotton smallwares, $111,125,175; dyeing and finishing textiles, $8,868,290; hosiery and knitted goods, $6,620,257; silk and silk goods, $5,957,532; woollen goods, $30,888,104; and worsted goods, $40,557,363.

Agriculture, &c.—In 1900 there were 37,715 farms, containing 3,147,064 acres, of which 41·1 per cent. was improved land. The total value of farm property was $182,646,704, and was made up as follows: land, improvements, and buildings, $158,019,290; implements and machinery, $8,828,950; live stock, $15,798,464. During the preceding year the expenditure for labour was $7,487,280; and for fertilizers, $1,320,600. Of the total number of farms 90·4 per cent. were worked by the owners, 8·3 per cent. by cash tenants, and 1·3 per cent. by share tenants. The total value of farm products in 1899 was $42,298,274; the acreages, quantities, and values of the principal crops are shown by the following table:—

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[1] Includes proprietors and firm members, with their salaries.
[2] Decrease.

Products.	Acres.	Quantity.	Value.
Indian corn . .	39,131	1,539,980 bushels	$771,277
Hay and forage .	610,023	856,505 tons	9,056,854
Tobacco . . .	3,827	6,406,570 ℔	956,399
Potatoes . . .	27,521	3,346,590 bushels	1,800,937
Small fruits . .	8,346	...	1,493,714
Orchard fruits .	57,268	3,158,781 bushels	1,170,868
Forest products .	...	...	1,944,714
Flowers and plants	584	...	1,639,760

The most important orchard fruit was apples; in 1900 the number of trees was 1,852,046, which yielded the preceding year 3,023,436 bushels of fruit. The number and value of farm animals in 1900 were as follows:—184,562 dairy cows, $6,546,954; 101,382 other neat cattle, $1,583,963; 75,034 horses, $5,826,457; 33,869 sheep (not including lambs), $142,076; 78,925 swine, $549,617.

The amount of capital invested in the fishing industry in 1895 was $5,338,828, and the value of the products $5,703,143.

Education.—The aggregate sum raised by taxation and expended upon the public schools was, in 1899, $13,624,814, or an average amount for each child in the average membership of the public schools of $34. The ratio of pupils in high schools to the whole number in all the schools is $8\frac{1}{2}$ per cent., and is increasing. The ratio of private school pupils to all the pupils in the state is less than 1 to 7. Fifty cities and towns maintain free evening schools. The proportion of women employed as teachers in the public schools to that of men so employed is about 10 to 1. The average pay of male teachers per month is $136, of female teachers $51. The average number of months (20 school days each) during which the public schools are kept open is $9\frac{8}{10}$. The commonwealth maintains ten normal schools. In 1894 manual training was made a part of the school system of all municipalities having 20,000 inhabitants. By a recent law, cities in which there are in operation 450,000 spindles may maintain textile schools, the commonwealth contributing, up to $25,000, a sum equal to the amount appropriated for the purpose by such city or paid by individuals. Two such schools in Lowell and New Bedford are already in successful operation. The commonwealth maintains on board the U.S.S. *Enterprise* a nautical training-school for instruction in the science and practice of navigation. The regular course is two years, and the average number of pupils is rather over 100. During the Spanish war more than 50 per cent. of the graduates and cadets of this school enlisted in the United States service. Of the 353 cities and towns only five, representing less than one-half of 1 per cent. of the population, are without free library privileges, and in three of these there are association libraries which charge a small fee. The Boston Public Library is the largest free municipal library in the world, and the Harvard University Library is exceeded in the United States only by this and by the Congressional Library at Washington. Of the adult male population of the state in 1900, 6·4 per cent. were illiterate (unable both to read and write). Of the 53,694 persons in this class, 48,615 were foreign-born.

Charitable Institutions.—The Massachusetts reformatory for men at Concord was opened in December 1884; the reformatory prison for women at Sherborn in October 1877. In both the reformation of the inmates is the principal purpose of the discipline and instruction, rather than mere punishment or detention. In 1892 the Massachusetts hospital for dipsomaniacs and inebriates was established, to which justices are authorized to commit patients for a period of two years. The average number of inmates is about 175. In 1898 a separate hospital for epileptics was opened, and in the same year, in the central portion of the state and at an elevation of 1200 feet, the Massachusetts hospital for consumptives and tuberculous patients, the first public hospital for tuberculous patients in the United States. It receives about 200 patients in such stages of the disease as admit of arrest or cure, the chief feature of the treatment, both in summer and winter, being what is known as hyperaëration.

Public Enterprises.—During recent years the commonwealth has undertaken certain noteworthy enterprises, as the agent of the several municipalities in the immediate vicinity of Boston constituting what is known as the Metropolitan District. The greatest single enterprise ever undertaken by the commonwealth is the bringing to this metropolitan district of the water of the Nashua river from Clinton, at a distance of 40 miles from Boston. The original estimate of the cost of this work was $27,000,000. In 1898 the daily average quantity of water consumed by each inhabitant in the district was 103 gallons. The commonwealth joined the city of Boston in the construction of a subway beneath the most congested portion of the city for the passage of electric cars. For the better accommodation of the increasing commerce of the port of Boston, the commonwealth has bought a considerable frontage upon the harbour lines, has begun the construction of a dock capable of receiving the largest vessels, and has supplemented the work of the United States Government in deepening the approaches to the wharves. It has secured as public reservations the summit and sides of Greylock (almost 3500 feet high) in the north-western corner of the state, and of Wachusett (2018 feet) near the centre. Since 1885 a large expenditure has been incurred in the abolition of grade crossings of railways and highways, which the increasing density of the population rendered a grave danger. The usual allotment of the cost of this work is as follows:—65 per cent. is paid by the railway company, 25 per cent. by the commonwealth, and 10 per cent. by the municipality in which the crossing is located. Since 1894, when the work was begun, the commonwealth has spent $3,000,000 in the construction and maintenance of state highways, the cost being apportioned between the commonwealth and the country in the proportion of 3 to 1.

The attempt to exterminate the Gipsy Moth, *Ocneria* (or more properly *Porthetria*) *dispar*, has attracted much attention. This notorious pest was introduced into Massachusetts in 1869 by a French naturalist, who was conducting experiments with various silk-producing insects with a view to the commercial value of the cocoon. Being allowed to escape, the Gipsy Moth multiplied until its increasing depredations were deemed too serious to be dealt with by individuals or even by towns, and in 1890 the commonwealth entered upon the task of extermination. Since then a large force of men has been annually employed in the work, and an aggregate of $1,155,000 expended; but though the area infested has been restricted, extermination has not yet been accomplished.

Legislation.—In 1885, owing to certain local conditions, the legislature placed the administration of the police department of Boston, including the granting of liquor licences, in the hands of a board of three commissioners appointed by the governor; and in 1894 a similar board was created for Fall River. In each case the result has been an improvement in administration; but it is generally conceded that only exceptional conditions can justify this interference on the part of the state with the duty and right of local self-government, and two subsequent measures establishing such boards in other cities were defeated by executive veto. State boards of registration in pharmacy, in dentistry, and in medicine have been established, to determine and certify the qualifications of applicants. Since 1886 a state board of arbitration and conciliation has existed for the peaceful settlement of controversies between employers and employed. An Act was passed in 1895 providing for the imposition of indeterminate sentences on all convicts sentenced to the state prison otherwise than for life or as habitual criminals. Under this Act a maximum and a minimum term are established, and upon the expiration of the latter a revocable permit to be at liberty may be issued. The Habitual Criminals Act provided that a person convicted of a felony, who has previously served two sentences of not less than three years each, shall be deemed a habitual criminal, and shall be punished by imprisonment for twenty-five years. In 1898 electrocution was substituted for hanging in all cases where the death penalty is imposed. For the purpose of preventing the products of prison labour from entering into injurious competition with the products of free labour, legislation of increasing stringency has limited the number of prisoners who may be employed in specific industries. The employment of prisoners is no longer determined by its financial result. Clothing for use in the different institutions of the state is made in the prisons from cloth woven on hand-looms, and other processes are performed without the use of machinery. Authority has been given by the legislature for the purchase of waste land, not exceeding 1000 acres, for the purpose of reclaiming it by the labour of prisoners from the gaols and houses of correction. The so-called Torrens or Australian system for the registration of land titles has been adopted, and a court created for its administration. The hours of labour of women and children in mills and factories have been limited by legislation, and in 1899 eight hours were made to constitute a day's work for all labourers, workmen, and mechanics employed by or on behalf of any city or town adopting the Act at an annual election. Acts have been passed extending the common-law liability of employers, prohibiting the manufacture and sale of clothing made in unhealthy places (known as sweating-shops), and authorizing cities and towns to provide free lectures and to maintain public baths, gymnasia, and playgrounds. The referendum has been sparingly used in matters of local concern. In the case of all quasi-public corporations, rigid laws have been enacted prohibiting the issue of stock or bonds unless the par value is first paid in, prohibiting the declaration of any stock or scrip dividend, and requiring that new stock shall be offered to stockholders at not less than its market value, to be determined by the proper state officials, any shares not so subscribed for to be sold at public auction. These laws are aimed at preventing fictitious capitalization and "stock-watering." What is known as civil service reform legislation was first applied to the public service of Massachusetts in 1884. By subsequent legislation it has been provided that veterans of the War of the Rebellion passing the required examination shall be appointed in preference to a person not a veteran, and that the appointing power may, in its discretion, appoint a veteran without examination.

The Spanish War.—The formal declaration of war with Spain, adopted by Congress 25th April 1898, was made to date from the 21st. On the very day after war was thus formally declared the First Regiment Heavy Artillery, M.V.M., fully armed and equipped, was sent to Fort Warren in Boston harbour, then almost wholly unprotected by national troops, upon which it was thought, for a brief time, that a hostile attack might be made. In response to the calls of the President, Massachusetts contributed to the national service the regiment above named, five infantry regiments, and nearly its entire naval brigade, which saw active service in the blockading squadron and in coast defence duty. The total number furnished by Massachusetts to the national Government was 11,780. The quota assigned in the President's calls was 7388. The several militia regiments entered the U.S. service with such equipment in arms, clothing, tentage, and commissary and surgical supplies as placed them among the most thoroughly-equipped regiments furnished by any state during this brief war. Two of the infantry regiments, the 2nd and 9th, were a part of the force engaged in the reduction of Santiago, and suffered severely through disease and hardship. The 6th regiment took part in the peaceful occupation of Porto Rico. The other two infantry regiments were stationed at camps in the southern states, but the early close of the war prevented their being ordered out of the country. A most important work in furnishing supplies and medical stores to regiments in camp and to soldiers in hospital was performed by the Massachusetts Volunteer Aid Association. This association also equipped a hospital ship—purchased by the commonwealth—with every appliance which could minister to the comfort and recovery of those committed to its care. In addition to the amount allowed by the U.S. Government, the commonwealth provided for the payment of $7 per month to every non-commissioned officer, soldier, or marine entering the service of the United States as a part of the quota of the commonwealth. (R. Wo.)

Massage.—The word *massage* has of late years come into general use to signify the method of treating disease or other physical conditions by manipulating the muscles and joints. According to Littré, the word is derived from the Arabic *mass*, and has the specific meaning of "pressing the muscular parts of the body with the hands, and exercising traction on the joints in order to give suppleness and stimulate vitality." It was probably adopted from the Arabian physicians by the French, who have played a leading part in reviving this method of treatment, which has been practised from time immemorial, and by the most primitive people, but has from time to time fallen into disuse among Western nations. In the *Odyssey* the women are described as rubbing and kneading the heroes on their return from battle. In India, under the name "shampoo" (*tshâmpuá*), the same process has formed part of the native system of medicine from the most remote times; professional massers were employed there by Alexander the Great in 327 B.C. In China the method is also of great antiquity, and practised by a professional class; the Swedish gymnastic system instituted by Ling is derived from the book of Cong-Fou, the bonze of Tao-Sse. Hippocrates describes and enjoins the use of manipulation, especially in cases of stiff joints, and he was followed by other Greek physicians. Oribasius gives an account of the application of friction with the bare hands, which exactly corresponds with the modern practice of massage. It is worthy of note that the treatment, after being held in high esteem by the leading Greek physicians, fell into disrepute with the profession, apparently on account of its association with vicious abuses. The same drawback has made itself felt in the present day, and can only be met by the most scrupulous care in the choice of agents and the manner of their employment. Among the Greeks, Romans, Egyptians, and, later, the Turks, massage came to be part of the ordinary procedure of the bath without any special therapeutic intention, and the usage has survived until to-day; but that mode of application was no doubt a refinement of civilized life. Medical rubbing is older and more elementary than bathing, as we see from its employment by savages. Probably it was evolved independently among different races from the natural instinct—shared by the lower animals—which teaches to rub, press, or lick any part of the body in which uneasiness is felt, and is therefore the oldest of all therapeutic means. Its systematic use among savages, not only for the removal of fatigue, but also for the treatment of disease, is sufficiently attested by Captain Cook's experience with the Pacific islanders. The interesting account of his treatment by the natives of Tahiti, for an attack of sciatica, is worth quoting:—

> The manner in which our commander was freed from a rheumatic complaint, that consisted of a pain extending from the hip to the foot, deserves to be recorded. Otoo's mother, his three sisters, and eight other women went on board for the express purpose of undertaking the cure of his disorder. He accepted of their friendly offer, had a bed spread for them on the cabin floor, and submitted himself to their directions. Being desired to lay himself down amongst them, then, as many of them as could get round him, began to squeeze him with both hands, from head to foot, but more particularly in the part where the pain was lodged, till they made his bones crack, and his flesh became a perfect mummy. After undergoing this discipline about a quarter of an hour, he was glad to be released from the women. The operation, however, gave him immediate relief; so that he was encouraged to submit to another rubbing down before he went to bed; the consequence of which was that he was tolerably easy all the succeeding night. His female physicians repeated their prescription the next morning and again in the evening; after which his pains were entirely removed and the cure was perfected. This operation, which is called *romee*, is universally practised among these islanders, being sometimes performed by the men, but more generally by the women.—*Third Voyage.*

According to Weiss, the therapeutic use of massage was revived in Europe by Fabricius ab Aquapendente, who applied it to stiff joints and similar conditions. Paracelsus, in his *De Medicina Ægyptiorum* (1591), gives a description of methodical massage as practised by the Egyptians quite on modern lines. Thereafter it appears to have been adopted here and there by individual practitioners, and various references are made to it, especially by French writers. The word "massage" occurs in an essay written by Piorry for a large encyclopædia which appeared in 1818, but it was probably used before. The practice was gradually advocated by an increasing number of medical men. In Great Britain it was called "medical rubbing," and at Edinburgh Beveridge had a staff of eight trained male rubbers. A book published by Estradère in 1863 attracted much attention, but the man who contributed most to the modern popularity of massage was Metzger of Amsterdam, who began to use it tentatively in 1853, and then proceeded to study and apply it methodically. He published an essay on the subject in 1868. The modern refinements of the treatment are chiefly due to him. At the same time, its application by Weir Mitchell to hysterical and other nervous conditions, in conjunction with the "rest cure," has done much to make it known.

Massage, as now practised, includes several processes, some of which are passive and others active. The former are carried out by an operator, and consist of rubbing and kneading the skin and deeper tissues with the hands, and exercising the joints by bending the patient's limbs. The active movements consist of a special form of gymnastics, designed to exercise particular muscles or groups of muscles. In what is called "Swedish massage" the operator moves the limbs while the patient resists, thus bringing the opposing muscles into play. Some writers insist on confining the word "massage" to the rubbing processes, and use the general term "manipulation" to cover all the movements mentioned; but this is a verbal subtlety of no importance. It is evident that alike among the Greeks, the Orientals, and savage races, the two processes have always been applied as part of the same treatment, and the definition quoted above from Littré goes to show that the word "massage" is properly applied to both.

Rubbing has been subdivided into several processes, namely, (1) stroking, (2) kneading, (3) rubbing, and (4) tapping, and some practitioners attach great importance to the application of a particular process in a particular way. As a rule, oils and other lubricants are not used. But, however it may be applied, the treatment acts essentially by increasing circulation and improving nutrition. It has been shown by Lauder Brunton that more blood actually flows through the tissues during and after rubbing. The number of red corpuscles, and, to some extent, their hæmoglobin value, are also said to be increased (Mitchell). At the same time the movement of the lymph stream is accelerated. In order to assist the flow of blood and lymph, stroking is applied centripetally, that is to say, upwards along the limbs and the lower part of the body, downwards from the head. The effects of the increased physiological activity set up are numerous. Functional ability is restored to exhausted muscles by the removal of fatigue products and the induction of a fresh blood supply; congestion is relieved; collections of serous fluid are dispersed; secretion and excretion are stimulated; local and general nutrition are improved. These effects indicate the conditions in which massage may be usefully applied. Such are various forms of paralysis and muscular wasting, chronic and subacute affections of the joints, muscular rheumatism, sciatica and other neuralgias, local congestions, sprains, contractions, insomnia and some forms of headache, in which downward stroking from the head relieves cerebral congestion. It has also been used in anæmia, hysteria and "neurasthenia," disorders of the female organs, melancholia and other forms of insanity, morphinism, obesity, constipation, inflammatory and other affections of the eye, including even cataract. General massage is sometimes applied, as a form of passive exercise, to indolent persons whose tissues are overloaded with the products of incomplete metabolism.

As with other methods of treatment, there has been a tendency on the part of some practitioners to exalt it into a cure-all, and of others to ignore it altogether. Of its therapeutic value, when judiciously used, there is no doubt, but it is for the physician or surgeon to say when and how it should be applied. He will be guided by the condition of the patient, and the effect he desires to produce in directing the employment of light and superficial friction, or deep and firm pressure, locally or generally, for a short or a long time, at long or short intervals. Affections to which it is not applicable are fevers, pregnancy, collections of pus, acute inflammation of the joints, inflamed veins, fragile arteries, wounds of the skin, and, generally speaking, those conditions in which it is not desirable to increase the circulation, or in which the patient cannot bear handling. In such conditions it may have a very injurious and even dangerous effect, and therefore should not be used in a haphazard manner without competent advice.

The revival of massage in Europe and America has called into existence a considerable number of professional operators, both male and female, who may be regarded as forming a branch of the nursing profession. Some of these are trained in hospitals or other institutions, some by private practitioners, and some not at all. Similarly, some are attached to organized societies or institutions, while others pursue their calling independently. Without going so far as to make massing a closed profession, it is obviously desirable to have some guarantee of competency. Several things are required for a good operator. One is physical strength. Deep massage is very laborious work, and cannot be carried on for an hour, or even half an hour, without unusual muscular power. Feeble persons cannot practise it effectively at all. The duration of a sitting may vary from five or ten minutes to an hour. For general massage at least half an hour is required. The Tahitian women completed a heroic operation on Captain Cook in a quarter of an hour, but there were twelve of them, and no doubt they took turns. A single masser should have strength enough to do the work without too obvious exhaustion, which gives the patient an unpleasant impression. A second requirement is tactile and muscular sensibility. A person not endowed with a fine sense of touch and resistance is liable to exert too great or too little pressure; the one hurts the patient, the other is ineffective. Then skill and knowledge, which can only be acquired by a course of instruction, are necessary. Finally, some guarantee of cleanliness and character is almost indispensable. Independent massers may possess all these qualifications in a higher degree than those connected with an institution, but they may also be totally devoid of them, whereas connexion with a recognized hospital or society is a guarantee for a certain standard of efficiency. In London there are several such institutions, which train and send out both male and female massers. The fee is 5s. an hour, or from two to four guineas a week. On the Continent, where trained massers are much employed by some practitioners, the fee is considerably lower; in the United States it is higher (see NURSING). For reasons mentioned above, it is most desirable that patients should be attended by operators of their own sex. If this is not insisted upon, a valuable therapeutic means will be in danger of falling into disrepute both with the medical profession and the general public.

Massa Marittima, a town and bishop's see of the province of Grosseto, Tuscany, Italy, 24 miles north-north-west of Grosseto. It has a cathedral, and mines of iron, mercury, lignite, and copper, with foundries, iron-works, and olive-oil mills. At Follonica, on the coast, but in this commune, are the furnaces in which are smelted the iron ore of Elba. There are also mineral springs and jets of boracic acid vapour. Population (1899), 3500.

Massawa. See ERITREA.

Massenet, Émile Frédéric Jules (1842——), one of the most individual of modern French composers, was born at Montaud, 12th May 1842. He studied at the Paris Conservatoire, where he obtained the Grand Prix de Rome in 1863 with the cantata *David Rizzio*. He has composed the following operas: *La Grande Tante*, one act, Opéra Comique, 1867; *Don César de Bazan*, three acts, Opéra Comique, 1872; *Le Roi de Lahore*, five acts, Opéra, 1877; *Hérodiade*, five acts, Brussels, 1881; *Manon*, five acts, Opéra Comique, 1884; *Le Cid*, four acts, Opéra, 1885; *Esclarmonde*, four acts, Opéra Comique, 1889; *Le Mage*, five acts, Opéra, 1891; *Werther*, four acts, Vienna, 1892; *Thaïs*, three acts, Opéra, 1894; *Le Portrait de Manon*, one act, Opéra Comique, 1894; *La Navarraise*, two acts, Covent Garden, 1894; *Sapho*, Opéra Comique, 1897; *Cendrillon*, Opéra Comique, 1900; *Grisélidis*, Opéra Comique, 1901; *Le Jongleur de Notre Dame*, Mentone, 1902. Massenet's other works include *Marie Madeleine*, sacred drama (1873); *Eve*, a mystery (1875); *La Vierge*, sacred legend (1880); six orchestral suites entitled *Scènes Hongroises*, *Scènes Pittoresques*, *Scènes Dramatiques*, *Scènes Napolitaines*, *Scènes de Féerie*, *Scènes Alsaciennes*; music to the tragedy *Les Erynnies*, to *Théodora*, *Le Crocodile*, *L'Hetman*; a requiem, *Narcisse*; an idyll, *Biblis*; a *Scène Antique*; several sets of songs, entitled *Poème d'Avril*, *Poème d'Amour*, *Poème d'Hiver*, *Poème d'Octobre*, *Poème Pastoral*, *Poème du Souvenir*; also a large number of detached songs. The foregoing list will suffice to show that Massenet is one of the most prolific composers of his time. He was professor of composition at the Conservatoire from 1878 to 1896. Among his pupils the following have already distinguished themselves: Hillemacher, Marty, Bruneau, Vidal, Pierné, Leroux, and Charpentier. Massenet undoubtedly possesses a style of his own, one which it is impossible to mistake. He is at his best in music descriptive of the tender passion, and many of the love scenes in his operas are very beautiful. Like all individual composers, he has his mannerisms, and these have not lacked imitators. His ideas with regard to operatic construction do not appear to be absolutely defined. At any rate, he has never given a strict adherence to the forms of either the old-fashioned opera or the modern lyrical drama, usually preferring to compromise between the two. *Manon* is perhaps his most popular opera.

Massey, Gerald (1828——), English poet, was born near Tring, Hertfordshire, on the 29th of May 1828. His parents were in humble circumstances, and Massey was little more than a child when he was set to hard work in a silk factory, which he afterwards deserted for the equally laborious occupation of straw-plaiting. These early years were rendered gloomy by much distress and deprivation, against which the young man strove with increasing spirit and virility, educating himself in his spare time, and gradually cultivating his innate taste for literary work. He was attracted by the movement known as Christian Socialism, into which he threw himself with whole-hearted vigour, and so became associated with Maurice and Kingsley. His first public appearance as a writer was in connexion with a journal called *The Spirit of Freedom*, of which he became editor, and he was only twenty-two when he published his first volume of poems, *Voices of Freedom and Lyrics of Love*. These he followed in rapid succession by *The Ballad of Babe Christabel* (1854), *War Waits* (1855), *Havelock's March* (1860), and *A Tale of Eternity* (1869). Many years afterwards, in 1890, he collected the best of the contents of these volumes, with additions, into a two-volume edition of his poems called *My Lyrical Life*. He also published works dealing with spiritualism, the study of Shakespeare's sonnets, and theological speculation. It is generally understood that he was the original of George Eliot's Felix Holt. Massey's poetry has a certain rough and vigorous element of sincerity and strength which easily accounts for its popularity at the time of its production. He treated the theme of Sir Richard Grenville before Tennyson thought of using it, and handled it with much force and vitality. Indeed, Tennyson's own praise of Massey's work is still its best eulogy, for the Laureate found in him "a poet of fine lyrical impulse, and of a rich half-Oriental imagination." The inspiration of his poetry is essentially British; he was a patriot to the core. Crudities of expression and melody are only to be expected in a talent reared among such unpoetic surroundings; but even where, as Tennyson said, he makes the "good old English tongue crack and sweat," the inequality of tone is really due to a superabundance of force, irresistible and infectious, if not always under control. He has the true lyric ring, the note of natural and spontaneous melody, and his virile and buoyant verse deserves a more emphatic recognition than it would seem to have received at the hands of a younger generation.

Massillon, a city of Stark county, Ohio, U.S.A., situated on the Tuscarawas river, north-east of the centre of the state, at an altitude of 952 feet. It is on the Ohio canal, and on the Cleveland, Lorain and Wheeling, the Pennsylvania, and the Wheeling and Lake Erie railways. It is in a farming, coal, and building-stone region, and has large manufactories, including iron and steel works, agricultural implement works, paper-mills and glass-works. Population (1890), 10,092; (1900), 11,944, of whom 1693 were foreign-born and 83 were negroes.

Masson, David (1822–——), Scottish man of letters, was born at Aberdeen, 2nd December 1822, and educated at Marischal College. Intending to enter the Church, he proceeded to Edinburgh University, where he studied theology under Dr Chalmers, whose friendship he enjoyed until the divine's death in 1847. However, abandoning his project of the ministry, he returned to his native city to undertake the editorship of *The Banner*, a weekly paper devoted to the advocacy of Free Kirk principles. After two years he resigned this post and went back to the capital, bent upon pursuing a purely literary career. There he wrote a great deal for the firm of Messrs W. and R. Chambers, several of the volumes of their well-known "Educational Course" being Masson's work, besides contributing to *Fraser's Magazine*, *Dublin University Magazine* (in which appeared his essays on Chatterton), and other periodicals. In 1847 he came to London, where he found wider scope for his untiring energy and ample knowledge. His sympathy with Liberal principles was manifested by his accepting the secretaryship of the "Friends of Italy," a society which did much to promote Italian liberty, one of its leading members being Mr Stansfeld. In 1852 he was appointed professor of English literature at University College, London, in succession to A. H. Clough, and from 1858 to 1865 he edited *Macmillan's Magazine*. In 1865 he was selected for the chair of English literature at Edinburgh, and this post he retained till 1895. In 1879 he became editor of the Register of the Scottish Privy Council, and in 1893 was appointed Historiographer Royal for Scotland. His *magnum opus* is his *Life of Milton*, in six volumes, the first of which appeared in 1858 and the last in 1880. He also edited De Quincey's *Collected Works;* and among his other publications are *Essays, Biographical and Critical* (1856, reprinted with additions, 1874), *British Novelists and their Styles* (1859), *Drummond of Hawthornden* (1873), and *Edinburgh Sketches* (1892).

Masulipatam, or BANDAR, a seaport town of British India, administrative headquarters of the Kistna district of Madras, on one of the mouths of the river Kistna, 215 miles north of Madras city. Population (1881), 35,056; (1891), 38,809; municipal income (1897–98), Rs.65,710. It is a centre of the weaving industry, and was formerly famous for printed chintzes and coloured kerchiefs. It is a station of the Church Missionary Society. The port is only a roadstead, where vessels anchor 5 miles out. In 1897–98 the total seaborne trade of the district was valued at Rs.27,51,324. It is proposed to construct a branch line from Bezwara on the Southern Mahratta Railway. Noble College had 74 students in 1896–97, and there are two high schools, with 533 pupils. There are a club and two literary associations, and four printing-presses, issuing a district gazette and three vernacular periodicals. Memories of Mrs Draper, Sterne's "Eliza," are still cherished.

Matabeleland. See RHODESIA (SOUTH).

Matanzas, an important commercial city of Cuba and capital of Matanzas province, situated on the north coast, about 60 miles east of Havana. There are many large warehouses, rum distilleries, sugar-mills, and railway machine-shops. It is the chief outlet for an extensive sugar region to the south, the normal exports of sugar amounting to nearly $15,000,000 per annum. It is considered the healthiest city in the island. The streets are well laid out and paved; there are several handsome ornamental plazas, and the better houses are large, commodious two-storey buildings. There are several club-houses, churches, and a large theatre. Near it are two of the most noted natural resorts of Cuba, the valley of the Yumuri, about two miles west, and the caves of Bellamar, a few miles east of the city. Railways run from Matanzas south, east, and west, making it the centre of communication. The population in 1899 was 36,374. In the Spanish-American war of 1898 Matanzas was bombarded by the United States warships, and much amusement was created in Europe by the telegraphic announcement that one mule had been injured. The Matanzas mule has become proverbial.

Mataro, a town of Spain, in the province of Barcelona, on the Mediterranean coast, and on the railway running from Barcelona to France. Its population was 19,918 in 1897. The local industries consist of manufactures of linen and cotton goods, soap, paper, cremor, chemicals, starch, glass, leather, chocolate, liqueurs and alcohols, and flour- and saw-milling. Like most of the more progressive Catalan towns, Mataro has good modern public buildings and schools.

MATHEMATICAL INSTRUMENTS.

Calculating machines.

CALCULATING MACHINES, designed for the mechanical performance of numerical calculations, have in modern times come into ever-increasing use. They may be classified as follows:—(i.) Addition machines; the first invented by Pascal (1642). (ii.) Addition machines modified to facilitate multiplication; the first by Leibnitz (1671). (iii.) True multiplication machines; Léon Bollés (1888), Steiger (1894). (iv.) Difference machines; Müller (1786), Babbage (1822). (v.) Analytical machines; Babbage (1834). The number of distinct machines of the first three kinds is remarkable and is being constantly added to, old machines being improved and new ones invented; Professor R. Mehmke has counted over eighty distinct machines of this type. The fullest published account of the subject is given by Mehmke in the *Encyclopædie der Mathematischen Wissenschaften*, article "Numerisches Rechnen," vol. i., heft 6 (1901). It contains historical notes and full references. Dyck's *Catalogue* also contains descriptions of various machines. We will confine ourselves to explaining the principles of some leading types, without giving an exact description of any particular one.

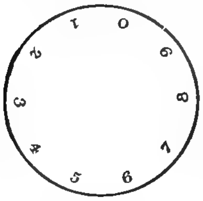

Fig. 1.

Practically all calculating machines contain a "counting work," a series of "figure discs" consisting in the original form of horizontal circular discs (Fig. 1), on which the figures 0, 1, 2 to 9 are marked. Each disc can turn about its vertical axis, and is covered by a fixed plate with a hole or "window" in it through which one figure can be seen. On turning the disc through one-tenth of a revolution this figure will be changed into the next higher or lower. Such turning is called a "step," and this step is *positive* if the next higher and *negative* if the next lower figure appears. Each positive step therefore adds one unit to the figure under the window, while two steps add two, and so on. If a series, say six, of such figure discs be placed side by side, their windows lying in a row, then any number of six places can be made to appear, for instance 000373. In order to add 6425 to this number, the discs, counting from right to left, have to be turned 5, 2, 4, and 6 steps respectively. If this is done the sum 006798 will appear. In case the sum of the two figures at any disc is greater than 9, if for instance the last figure to be added is 8 instead of 5, the sum for this disc is 11 and the 1 only will appear. Hence an arrangement for "carrying" has to be introduced. This may be done as follows. The axis of a figure disc contains a wheel with ten teeth. Each figure disc has, besides one long tooth which when its 0 passes the window turns the next wheel to the left, one tooth forward, and hence the figure disc one step. The actual mechanism is not quite so simple, because the long teeth as described would gear also into the wheel to the right, and besides would interfere with each other. They must therefore be replaced by a somewhat more complicated arrangement, which has been done in various ways not necessary to describe more fully. On the way in which this is done, however, depends to a great extent the durability and trustworthiness of any arithmometer; in fact, it is often its weakest point. If to the series of figure discs described arrangements are added for turning each disc through a required number of steps, we have an addition machine, essentially of Pascal's type, in which each disc had to be turned by hand. Keyboards have been introduced by Stettner (1882), Max Mayer (1887), and in the comptometer by Dorr Z. Felt of Chicago.[1] In the comptograph also by Felt and in "Bourrough's Registering Accountant" the result is printed. These machines require that for each figure of the number to be added a key be pressed down; and multiplication, as repeated addition, becomes somewhat laborious, depending for rapid execution essentially on the skill of the operator. The figure discs described may, of course, be replaced by cylindrical discs thick enough to receive the figures on the rim, and may then be mounted on one common axis, greatly to the advantage of compactness.

To adapt an addition machine, as described, to rapid multiplication the turnings of the separate figure discs are replaced by one motion, commonly the turning of a handle. As, however, the different discs have to be turned through different steps, a contrivance has to be inserted which can be "set" in such a way that each disc is moved by one turn of the handle through a number of steps equal to the number of units which is to be added on that disc; and this may be done by making each of the figure discs receive on its axis a ten-toothed wheel, called hereafter the A-wheel, which is acted on either directly or indirectly by another wheel (called the B-wheel) in which the number of teeth can be varied from 0 to 9. This variation of the teeth has been effected in different ways. Theoretically the simplest seems to be to have on the B-wheel nine teeth which can be drawn back into the body of the wheel, so that at will any number from 0 to 9 can be made to project. This idea, previously mentioned by Leibnitz, has been reinvented by Bohdner in the "Brunsviga." Another way, also due to Leibnitz, consists in inserting between the axis of the handle bar and the A-wheel a "stepped" cylinder. This may be considered as being made up of ten wheels large enough to contain about twenty teeth each; but most of these teeth are cut away so that these wheels retain in succession 9, 8, . . . 1, 0 teeth. If these are made as one piece they form a cylinder with teeth of lengths from 9, 8 . . . times the length of a tooth on a single wheel.

In the diagrammatic vertical section of such a machine (Fig. 2) FF is a figure disc with a conical wheel A on its axis. In the covering plate HK is the window W. A stepped cylinder is shown at B. The axis Z, which runs along the whole machine, is turned by a handle, and itself turns the cylinder B by aid of conical wheels. Above this cylinder lies an axis EE with square section along which a wheel D can be moved. The same axis carries at E′

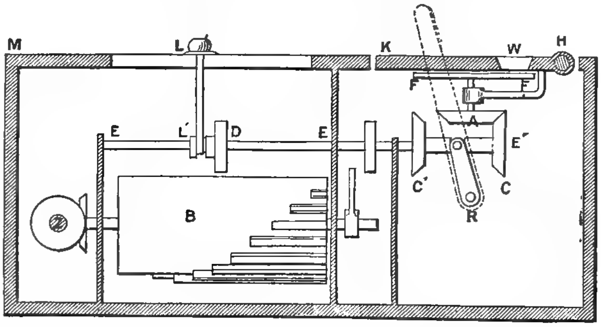

Fig. 2.

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[1] For a fuller description of the manner in which a mere addition machine can be used for multiplication and division, and even for the extraction of square roots, see an article by C. V. Boys in *Nature*, 11th July 1901.

a pair of conical wheels C and C′, which can also slide on the axis so that either can be made to drive the A-wheel. The covering plate MK has a slot above the axis EE allowing a rod LL′ to be moved by aid of a button L, thus carrying the wheel D with it. Along the slot is a scale of numbers 0 1 2 . . . 9 corresponding with the number of teeth on the cylinder B, with which the wheel D will gear in any given position. A series of such slots is shown in the top middle part of Steiger's machine (Fig. 3). Let now the handle driving the axis Z be turned once round, the button being set to 4. Then four teeth of the B-wheel will turn D and with it the A-wheel, and consequently the figure disc will be moved four steps. These steps will be positive or forward if the wheel C gears in A, and consequently four will be added to the figure showing at the window W. But if the wheels CC′ are moved to the right, C′ will gear with A moving backwards, with the result that four is subtracted at the window. This motion of all the wheels C is done simultaneously by the push of a lever which appears at the top plate of the machine, its two positions being marked "addition" and "subtraction." The B-wheels are in fixed positions below the plate MK. Level with this, but separate, is the plate KH with the window. On it the figure discs are mounted. This plate is hinged at the back at H and can be lifted up, thereby throwing the A-wheels out of gear. When thus raised the figure discs can be set to any figures; at the same time it can slide to and fro so that an A-wheel can be put in gear with any C-wheel forming with it one "element." The number of these varies with the size of the machine. Suppose there are six B-wheels and twelve figure discs. Let these be all set to zero with the exception of the last four to the right, these showing 1 4 3 2, and let these be placed opposite the last B-wheels to the right. If now the buttons belonging to the latter be set to 3 2 5 6, then on turning the B-wheels all once round the latter figures will be added to the former, thus showing 4 6 8 8 at the windows. By the aid of wheels not shown in the diagram, this turning of the B-wheels is performed simultaneously by the movement of one handle. We have thus an addition machine. If it be required to multiply a number, say 725, by any number up to six figures, say 357, the buttons are set to the figures 725, the windows all showing zero. The handle is then turned, 725 appears at the windows, and successive turns add this number to the first. Hence seven turns show the product seven times 725. Now the plate with the A-wheels is lifted and moved one step to the right and the handle is turned twice, thus adding twenty times 725 to the product obtained. Finally, by moving the plate again, and turning the handle three times, the required product is obtained. To this another product may be added. If the machine has six B-wheels and twelve discs the product of two six-figure numbers can be obtained. Division is performed by repeated subtraction. The lever regulating the C-wheel is set to subtraction, producing negative steps at the discs. The dividend is set up at the windows and the divisor at the buttons. Each turn of the handle subtracts the divisor once. To count the number of turns of the handle a second set of windows is arranged between and in front of the first, with number discs below. These have no carrying arrangement, but the one which happens to be near the handle is turned one step for each turn of the handle.

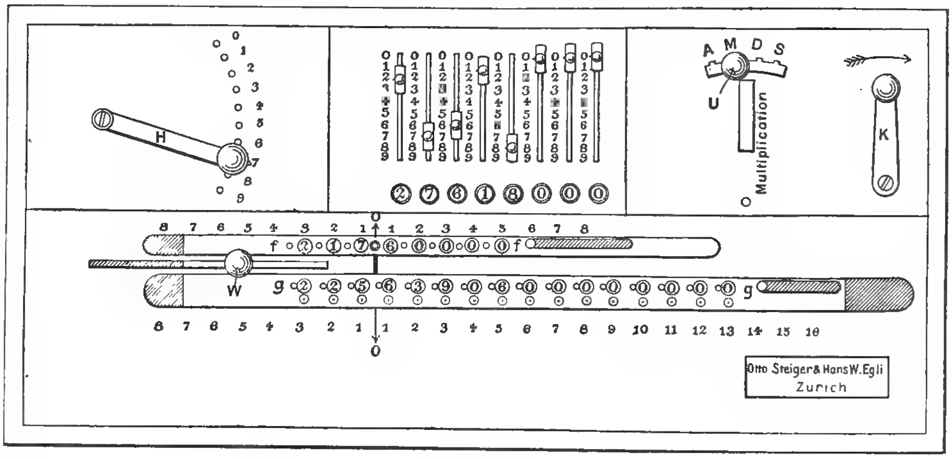

Fig. 3.

It will be seen that this arrangement is really an addition machine. The machine described is essentially that of M. Thomas of Colmar, which was the first that came into practical use. Of earlier machines those of Leibnitz, Müller (1782), and Hahn (1809) deserve to be mentioned (see Dyck, *Catalogue*). Thomas's machine has had many imitations, both in England and on the Continent, with more or less important alterations. Mr Joseph Edmondson of Halifax has given it a circular form, which has many advantages. The accuracy and durability of the machine depend to a great extent on the manner in which the carrying machine is constructed. No wheel must be capable of moving in any other way than that required; hence every part must be locked and be released only when required to move. Further, any disc must carry to the next only after the carrying to itself has been completed. If all were to carry at the same time a considerable force would be required to turn the handle, and serious strains would be introduced. It is for this reason that the B-wheels or cylinders have the greater part of the circumference free from teeth. Again, the carrying acts generally as in the machine described, in one sense only, and this involves that the handle be turned always in the same direction. Subtraction therefore cannot be done by turning it in the opposite way, hence the two wheels C and C′ are introduced. These are moved all at once by one lever acting on a bar shown at R in section (Fig. 2).

In the Brunsviga, the figure disc is replaced by a cylinder with the figures at the rim; the wheel mounted beside it is acted on directly by the B-wheel. By an ingenious contrivance the teeth are made to appear from out of the rim to any desired number. The carrying mechanism, too, is different, and so arranged that the handle can be turned either way, no special setting being required for subtraction or division. It is extremely handy, taking up much less room than the others. Professor Selling of Würzburg has invented an altogether different machine, which has been made by Max Ott, of Munich. The B-wheels are replaced by lazy-tongs. To the joints of these the ends of racks are pinned; and as they are stretched out the racks are moved forward 0 to 9 steps, according to the joints they are pinned to. The racks gear directly in the A-wheels, and the figures are placed on cylinders as in the Brunsviga. The carrying is done continuously by a train of epicycloidal wheels. The working is thus rendered very smooth, without the jerks which the ordinary carrying tooth produces; but the arrangement has the disadvantage that the resulting figures do not appear in a straight line, a figure followed by a 5, for instance, being already carried half a step forward. This is not a serious matter in the hands of a mathematician or an operator using the machine constantly, but it is serious for casual work. Anyhow, it has prevented the machine from being a commercial success, and it is not any longer made. For ease and rapidity of working it surpasses all others. Since the lazy-tongs allow of an extension equivalent to five turnings of the handle, if the multiplier is 5 or under, one push forward will do the same as five (or less) turns of the handle, and more than two pushes are never required.

The *Steiger-Egli* machine is a multiplication machine, of which Fig. 3 gives a picture as it appears to the manipulator. The lower part of the figure contains, under the covering plate, a carriage W with two rows of windows for the figures marked *ff* and *gg*. On pressing down the button W the carriage can be moved to right or left. Under each window is a figure-disc, as in the Thomas machine. The upper part has three sections. The one to the right contains the handle K for working the machine, and a button U for setting the machine for addition, multiplication, division, or subtraction. In the middle section a number of parallel slots are seen, with indices which can each be set to one of the numbers 0 to 9. Below each slot, and parallel to it, lies a shaft of square section on which a toothed wheel slides to and fro with the index in the slot. Below these wheels again lie 9 toothed racks. By setting the index in any slot the wheel below it comes into gear with one of these racks. On moving the rack, the wheels turn their shafts and, as in the Thomas machine, the figure-discs *gg* opposite to them. The dimensions are such that a motion of a rack through 1 cm. turns the figure-disc through one "step" or adds 1 to the figure under the window. The racks are moved by an arrangement contained in the section to the left of the slots. There is a vertical plate called the multiplication table block, or more shortly, the *block*. From it project rows of horizontal rods of lengths varying from 0 to 9 centimetres. If one of these rows is brought opposite the row of racks and then pushed forward to the right through 9 cm., each rack will move and add to its figure-disc a number of units equal to the number of centimetres of the rod which operates on it. The block has a square face divided into a hundred squares. Looking at its face from the right—*i.e.*, from the side where the racks lie—suppose the horizontal rows of these squares numbered from 0 to 9, beginning at the top, and the columns numbered similarly, the 0 being to the right; then the multiplication table for numbers 0 to 9 can be placed on these squares. The row 7 will therefore contain the numbers 63, 56, . . . 7, 0. Instead of these numbers, each square receives two "rods" perpendicular to the plate, which may be called the units-rod and the tens-rod. Instead of the number 63 we have thus a tens-rod 6 cm. and a units-rod 3 cm. long. By aid of a lever H the block can be raised or lowered so that any row of the block comes to the level of the racks, the units-rods being opposite the ends of the racks.

The action of the machine will be understood by considering an example. Let it be required to form the product 7 times 385. The indices of three consecutive slots are set to the numbers 3, 8, 5 respectively. Let the windows *gg* opposite these slots be called *a*, *b*, *c*. Then to the figures shown at these windows we have to add 21, 56, 35 respectively. This is the same thing as adding first the number 165, formed by the units of each place, and next 2530 corresponding to the tens; or again, as adding first 165, and then moving the carriage one step to the right, and adding 253. The first is done by moving the block with the units-rods opposite the racks forward. The racks are then put out of gear, and together with the block brought back to their normal position; the block is moved sideways to bring the tens-rods opposite the racks, and again moved forward, adding the tens, the carriage having also been moved forward as required. This complicated movement, together with the necessary carrying, is actually performed by one turn of the handle. During the first quarter-turn the block moves forward, the units-rods coming into operation. During the second quarter-turn the carriage is put out of gear, and moved one step to the right while the necessary carrying is performed; at the same time the block and the racks are moved back, and the block is shifted so as to bring the tens-rods opposite the racks. During the next two quarter-turns the process is repeated, the block ultimately returning to its original position. Multiplication by a number with more places is performed as in the Thomas. The advantage of this machine over the Thomas in saving time is obvious. Multiplying by 817 requires in the Thomas 16 turns of the handle, but in the Steiger-Egli only 3 turns, with 3 settings of the lever H. If the lever H is set to 1 we have a simple addition machine like the Thomas or the Brunsviga. The inventors state that the product of two 8-figure numbers can be got in 6–7 seconds, the quotient of a **6**-figure number by one of 3 figures in the same time, while the square root to 5 places of a 9-figure number requires 18 seconds.

Machines of far greater powers than the arithmometers mentioned have been invented by Babbage and by Scheutz. An account of these is given in the article CALCULATING MACHINES (*Ency. Brit.* vol. iv.), but without any description of the mechanism; in fact, such description is impossible without elaborate drawings. Of Babbage's *Difference Machine*, however, the following account will afford some idea of its working. Imagine a number of striking clocks placed in a row, each with only an hour hand, and with only the striking apparatus retained. As the hand comes opposite a number on the dial of the first clock, it strikes that number of times. Let this clock be connected with the second in such a manner that by each stroke of the first the hand of the second is moved from one number to the next, but can only strike when the first comes to rest. If the second hand stands at 5 and the first strikes 3, then when this is done the second will strike 8; the second will act similarly on the third, and so on. Let there be four such clocks with hands set to the numbers 6, 6, 1, 0, respectively. Now set the third clock striking 1, this sets the hand of the fourth clock to 1; strike the second (6), this puts the third to 7 and the fourth to 8. Next strike the first (6); this moves the other hands to 12, 19, 27, respectively, and now repeat the striking of the first. The hand of the fourth clock will then give in succession the numbers 1, 8, 27, 64, &c., being the cubes of the natural numbers. The numbers thus obtained on the last dial will have the differences given by those shown in succession on the dial before it, their differences by the next, and so on till we come to the constant difference on the first dial. A function

$$y=a+bx+cx^2+dx^3+ex^4$$

gives, on increasing x always by unity, a set of values for which the fourth difference is constant. We can, by an arrangement like the above, with five clocks calculate y for $x=1, 2, 3, \ldots$ to any extent. This is the principle of Babbage's difference machine. The clock dials have to be replaced by a series of dials as in the arithmometers described, and an arrangement has to be made to drive the whole by turning one handle by hand or some other power. Imagine further that with the last clock is connected a kind of typewriter which prints the number, or, better, impresses the number in a soft substance from which a stereotype casting can be taken, and we have a machine which, when once set for a given formula like the above, will automatically print, or prepare stereotype plates for the printing of, tables of the function without any copying or typesetting, thus excluding all possibility of errors.

With regard to Babbage's *Analytical Machine*, the statement in the article referred to, that Babbage left complete plans, is incorrect. The committee of the British Association appointed to consider the possibility of having it made came to the conclusion (*Brit. Assoc. Report*, 1878, pp. 92–102) that no detailed working drawings existed at all, but that the drawings were only diagrammatic and not nearly sufficient to put into the hands of a draughtsman for making working plans; and "that in the present state of the design it is not more than a theoretical possibility." A full account of all the work done by Babbage in connexion with calculating machines, and much else published by others in connexion therewith, is contained in a work published by his son, General Babbage.

Slide rules.

Slide rules are instruments for performing logarithmic calculations mechanically, and are extensively used, especially where only rough approximations are required. They are almost as old as logarithms themselves. Edmund Gunter, the colleague of Briggs at Gresham College, drew a "logarithmic line" on his "Scales" as follows (Fig. 4):—On a line AB lengths are set off to scale to represent the common logarithms of the numbers 1 2 3 . . . 10, and the points thus obtained are marked with these numbers. As lg 1 = 0, the beginning A has the number 1 and B the number 10, hence the unit of length is AB as lg 10 = 1. The same division is repeated from B to C. The distance 1,2 thus represents lg 2, 1,3 gives lg 3, the distance between 4 and 5 gives $\lg 5 - \lg 4 = \lg.\ \frac{5}{4}$, and so for others. In order to multiply two numbers, say 2 and 3, we have $\lg 2 \times 3 = \lg 2 + \lg 3$. Hence, setting off the distance 1,2 from 3 forward by the aid of a pair of compasses will give the distance lg 2 + lg 3, and will bring us to 6 as the required product. Again, if it is required to find $\frac{4}{5}$ of 7, set off the distance between 4 and 5 from 7 backwards, and the required number will be obtained. In the actual scales the spaces between the numbers are subdivided into 10 or even more parts, so that from two to three figures may be read. The numbers 2, 3 . . . in the interval BC give the logarithms of 10 times the same numbers in the interval AB; hence, if the 2 in the latter means 2 or ·2, then the 2 in the former means 20 or 2.

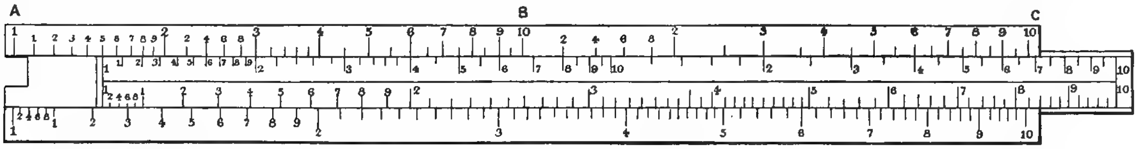

Fig. 4.

Soon after Gunter's publication (1620) of these "logarithmic lines," Wingate (1872) constructed the slide rule by repeating the logarithmic scale on a tongue or "slide," which could be moved along the first scale, thus avoiding the use of a pair of compasses. A clear idea of this device can be formed if the scale in Fig. 4 be copied on the edge of a strip of paper placed against the line A C. If this is now moved to the right till its 1 comes opposite the 2 on the first scale, then the 3 of the second will be opposite 6 on the top scale, this being the product of 2 and 3; and in this position every number on the top scale will be twice that on the lower. For every position of the lower scale the ratio of the numbers on the two scales which coincide will be the same. Therefore multiplications, divisions, and simple proportions can be solved at once.

Many different forms of slide rules are now on the market. The handiest for general use is the Gravet rule made by Tavernier-Gravet in Paris, according to instructions of the mathematician M. Mannheim of the École Polytechnique in Paris. It contains at the back of the slide scales for the logarithms of sines and tangents so arranged that they can be worked with the scale on the front. An improved form is now made by Davis and Son of Derby, who engrave the scales on white celluloid instead of on box-wood, thus greatly facilitating the readings. These scales have the distance from one to ten about twice that in Fig. 4. Tavernier-Gravet makes them of that size and longer, even ½ metre long. But they then become somewhat unwieldy, though they allow of reading to more figures. To get a handy long scale Professor G. Fuller has constructed a spiral slide rule drawn on a cylinder, which admits of reading to three and four figures. The handiest of all is perhaps the "Calculating Circle" by Boucher, made in form of a watch. For various purposes special adaptations of the slide rules are met with—for instance, in various exposure meters for photographic purposes. General Strachey has introduced slide rules into the Meteorological Office for performing special calculations. At some blast furnaces a slide rule is used for determining the amount of coke and flux required for any weight of ore. Near the balance a large logarithmic scale is fixed with a slide which has three indices only. A load of ore is put on the scales, and the first index of the slide is put to the number giving the weight, when the second and third point to the weights of coke and flux required.

Curvometers.

In order to measure the length of a curve, such as the road on a map, a wheel is rolled along it. For one revolution of the wheel the path described by its point of contact is equal to the circumference of the wheel. Thus, if a cyclist counts the number of revolutions of his front wheel he can calculate the distance ridden by multiplying that number by the circumference of the wheel. An ordinary cyclometer is nothing but an arrangement for counting these revolutions, but it is graduated in such a manner that it gives at once the distance in miles. On the same principle depend a number of instruments which, under various fancy names, serve to measure the length of any curve; they are in the shape of a small meter chiefly for the use of cyclists. They all have a small wheel which is rolled along the curve to be measured, and this sets a hand in motion which gives the reading on a dial. Their accuracy is not very great, because it is difficult to place the wheel so on the paper that the point of contact lies exactly over a given point; the beginning and end of the readings are therefore badly defined. Besides, it is not easy to guide the wheel along the curve to which it should always lie tangentially. To obviate this defect more complicated curvometers or kartometers have been devised. The handiest seems to be that of Coradi. He uses two wheels; the tracing-point, halfway between them, is guided along the curve, the line joining the wheels being kept normal to the curve. This is pretty easily done by eye; a constant deviation of 8° from this direction produces an error of only 1 per cent. The sum of the two readings gives the length. E. Fleischhauer uses three, five, or more wheels arranged symmetrically round a tracer whose point is guided along the curve; the planes of the wheels all pass through the tracer, and the wheels can only turn in one direction. The sum of the readings of all the wheels gives approximately the length of the curve, the approximation increasing with the number of the wheels used. It is stated that with three wheels practically useful results can be obtained, although in this case the error, if the instrument is consistently handled so as always to produce the greatest inaccuracy, may be as much as 5 per cent.

Planimeters.

Planimeters are instruments for the determination by mechanical means of the area of any figure. A pointer, generally called the "tracer," is guided round the boundary of the figure, and then the area is read off on the recording apparatus of the instrument. The simplest and most useful is Amsler's (Fig. 5). It consists of two bars of metal OQ and QT, which are hinged together at Q. At O is a needle-point which is driven in the drawing board, and at T is the tracer. As this is guided round the boundary of the figure a wheel W mounted on QT rolls on the paper, and the turning of this wheel measures, to some known scale, the area. We shall give the theory of this instrument fully in an elementary manner by aid of geometry. The theory of other planimeters can then be easily understood.

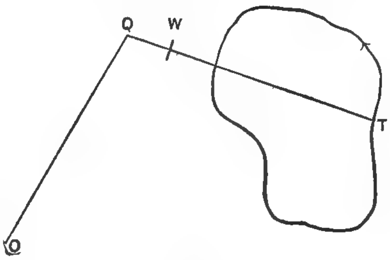

Fig. 5.

Consider the rod QT with the wheel W, without the arm OQ. Let it be placed with the wheel on the paper, and now moved perpendicular to itself from AC to BD (Fig. 6). The rod sweeps over, or generates, the area of the rectangle ACDB$=lp$ where l denotes the length of the rod and p the distance AB though which it has been moved. This distance, as measured by the rolling of the wheel, which acts as a curvometer, will be called the "roll" of the wheel and be denoted w. In this case $p=w$, and the area P is given by $P=wl$. Let the circumference of the wheel be divided into say a hundred equal parts u; then w registers the number of u's rolled over, and w therefore gives the number of areas lu contained in the rectangle. By suitably selecting the radius of the wheel and the length l, this area lu may be any convenient unit, say a square inch or square centimetre. By changing l this unit will be changed.

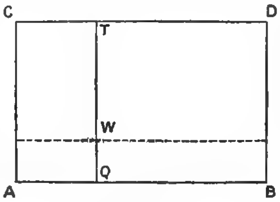

Fig. 6.

Again, suppose the rod to turn (Fig. 7) about the end Q, then T will describe an arc of a circle, and the rod will generate an area $\frac{1}{2}l^2\theta$, where θ is the angle AQB through which the rod has turned. The wheel will roll over an arc $c\theta$, where c is the distance of the wheel from Q. The "roll" is now $w=c\theta$; hence the area generated is

$$P=\frac{1}{2}\frac{l^2}{c}w,$$

and is again determined by w.

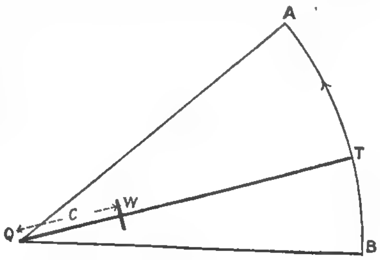

Fig. 7.

Next let the rod be moved parallel to itself, but in a direction not perpendicular to itself (Fig. 8). The wheel will now not simply roll. Consider a *small* motion of the rod from QT to Q′T′. This may be resolved into the motion to RR′ perpendicular to the rod, whereby the rectangle QTR′R is generated, and the sliding of the rod along itself from RR′ to Q′T′. During this second step no area will be generated. During the first step the roll of the wheel will give QR, whilst during the second step there will be no roll at all. The roll of the wheel will therefore measure the area of the rectangle which equals the parallelogram QTT′Q′. If the whole motion of the rod be considered as made up of a very great number of small steps, each resolved as stated, it will be seen that the roll again measured the area generated as in the first case. But it has to be noticed that now the wheel does not only roll, but also slips, over the paper. This, as will be pointed out later, may introduce an error in the reading.

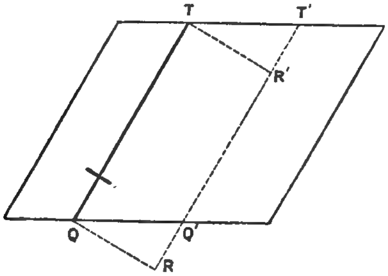

Fig. 8.

We can now investigate the most general motion of the rod. We again resolve the motion into a number of small steps. Let AB be one position, CD the next after a step so small that the arcs AC or BD over which the ends have passed may be considered as straight lines. The area generated is ACDB. This motion we resolve into a step from AB to CB′, parallel to AB and a turning about C from CB′ to CD, steps such as have been investigated. During the first, the "roll" will be over p the altitude of the parallelogram; during the second it will be $c\theta$. Therefore

$$w=p+c\theta.$$

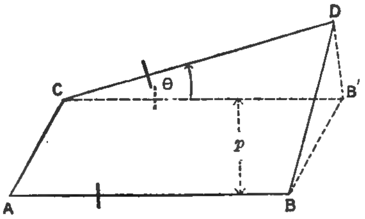

Fig. 9.

The area generated is $lp+\frac{1}{2}l^2\theta$, or, expressing p in terms of w, $lw+(\frac{1}{2}l^2-lc)\theta$. For a finite motion we get the area equal to the sum of the areas generated during the different steps. But the wheel will continue rolling, and give the whole roll as the sum of the rolls for the successive steps. Let then w denote the whole roll (in Fig 10), and let a denote the sum of all the small turnings θ; then the area is

$$P=lw+(\tfrac{1}{2}l^2-lc)a.$$

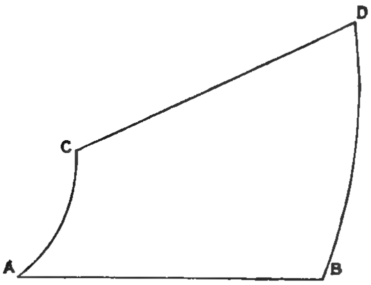

Fig. 10.

Here a is the angle which the last position of the rod makes with the first. In all applications of the planimeter the rod is brought back to its original position. Then the angle a is either zero, or it is 2π if the rod has been once turned quite round.

Hence in the first case we have

$$P=lw \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and w gives the area as in case of a rectangle.

In the other case

$$P=lw+lC \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where $C=(\frac{1}{2}l-c)2\pi$, if the rod has once turned round. The number C will be seen to be always the same, as it depends only on the dimensions of the instrument. Hence now again the area is determined by w if C is known.

Thus it is seen that the area generated by the motion of the rod can be measured by the roll of the wheel; it remains to show how any given area can be generated by the rod. Let the rod move in any manner but return to its original position. Q and T then describe closed curves. Such motion may be called cyclical. Here the theorem holds:—*If a rod QT performs a cyclical motion, then the area generated equals the difference of the areas enclosed by the paths of T and Q respectively.* The truth of this proposition will be seen from a figure. In Fig. 11 the different positions of the moving rod QT have been marked, and its motion can be easily followed. It will be seen that every part of the area TT′ BB′ will be passed over once and always by a *forward motion* of the rod, whereby the wheel will *increase* its roll. The area AA′QQ′ will also be swept over once, but with a *backward* roll; it must therefore be counted as negative. The area between the curves is passed over twice, once with a forward and once with a backward roll; it therefore counts once positive and once negative; hence not at all. In more complicated figures it may happen that the area within one of the curves, say TT′BB′, is passed over several times, but then it will be passed over once more in the forward direction than in the backward one, and thus the theorem will still hold.

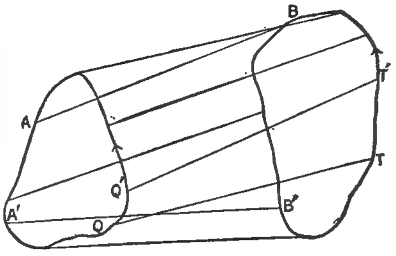

Fig. 11.

To use the planimeter, place the pole O on the paper *outside* the figure to be measured. Then the area generated by QT is that of the figure, because the point Q moves on an arc of a circle to and fro enclosing no area. At the same time the rod comes back without making a complete rotation. We have therefore in formula (1), $a=o$, and hence

$$P=lw,$$

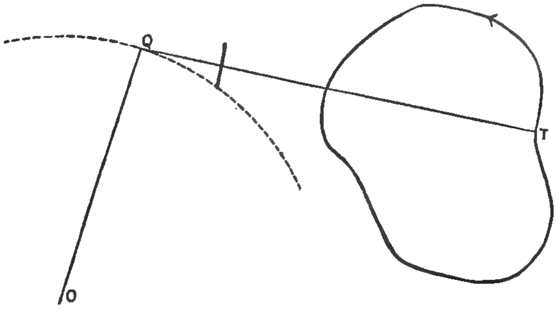

Fig. 12.

which is read off. But if the area is too large the pole O may be placed within the area. The rod describes the area between the boundary of the figure and the circle with radius $r=OQ$, whilst the rod turns once completely round, making $a=2\pi$. The area measured by the wheel is by formula (2), $lw+(\frac{1}{2}l^2-lc)2\pi$. To this the area of the circle πr^2 must be added, so that now

$$P=lw+(\tfrac{1}{2}l^2-lc)2\pi+\pi r^2,$$

or

$$P=lw+C,$$

where $C=(\frac{1}{2}l^2-lc)2\pi+\pi r^2$ is a constant, as it depends on the dimensions of the instrument alone. This constant is given with each instrument.

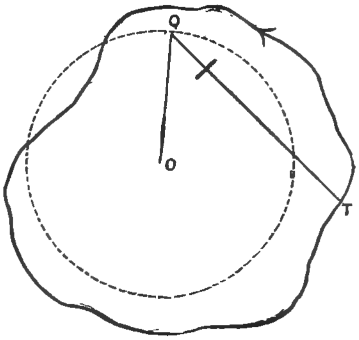

Fig. 13.

Amsler's planimeters are made either with a rod QT of fixed length, which gives the area therefore in terms of a fixed unit, say in square inches, or else the rod can be moved in a sleeve to which the arm OQ is hinged (Fig. 13). This makes it possible to change the unit lu, which is proportional to l.

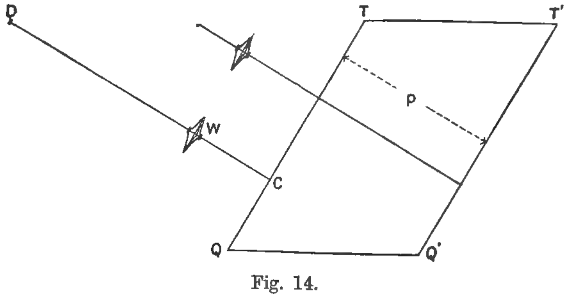

Fig. 14.

In the planimeters described the recording or integrating apparatus is a smooth wheel rolling on the paper or on some other surface. Amsler has described another recorder, viz., a wheel with a sharp edge. This will roll on the paper but not slip. Let the rod QT carry with it an arm CD perpendicular to it. Let there be mounted on it a wheel W, which can slip along and turn about it. If now QT is moved parallel to itself to Q′T′, then W will roll without slipping parallel to QT, and slip along CD. This amount of slipping will equal the perpendicular distance between QT and

Q'T', and therefore serve to measure the area swept over like the wheel in the machine already described. The turning of the rod will also produce slipping of the wheel, but it will be seen without difficulty that this will cancel during a cyclical motion of the rod, provided the rod does not perform a whole rotation. Messrs Hine and Robertson, New York, have constructed a planimeter on this principle, which, however, is only a slight modification of one described by Amsler in 1856. The end Q of the rod ends in a button which slides along a V-groove.

The first planimeter was made on the following principles:—A frame FF (Fig. 15) can move in the direction OX. It carries a rod T'T movable in its own length, hence the tracer T can be guided along any curve ATB. When the rod has been pushed back to Q'Q, the tracer moves along the axis OX. As the frame is moved a cone VCC' mounted on it turns about its axis. The latter is slanting so that its top edge is horizontal and parallel to the rod; its vertex is opposite to Q'. A wheel W is mounted on the rod at T', or on an axis parallel to and rigidly connected with it. This wheel rests on the top edge of the cone. If now the tracer T, when pulled out through a distance y above Q, be moved parallel to OX through a distance dx, the frame moves through an equal distance, and the cone turns through an angle $d\theta$ proportional to dx. The wheel W rolls on the cone to an amount again proportional to dx, and also proportional to y, its distance from V. Hence the roll of the wheel is proportional to the area ydx described by the rod QT. As T is moved from A to B along the curve the roll of the wheel will therefore be proportional to the area AA'BB'. If the curve is closed, and the tracer moved round it, the roll will measure the area independent of the position of the axis OX, as will be seen by drawing a figure. The cone may with advantage be replaced by a horizontal disc, with its centre at V; this allows of y being negative. It may be noticed at once that the roll of the wheel gives at every moment the area A'ATQ. It will therefore allow of registering a set of values of $\int_a ydx$ for any values of x, and thus of tabulating the values of any indefinite integral. In this it differs from Amsler's planimeter. Planimeters of this type were first invented in 1814 by the Bavarian engineer Hermann, who, however, published nothing. They were re-invented by Prof. Tito Gonnella of Florence in 1824, and by the Swiss engineer Oppikofer, and improved by Ernst in Paris, the astronomer Hansen in Gotha, and others (see Henrici, *British Association Report*, 1894). But all were driven out of the field by Amsler's simpler planimeter.

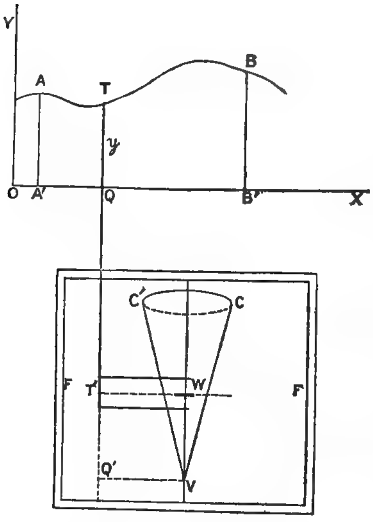

Fig. 15.

Altogether different from the planimeters described is the hatchet planimeter, invented by Captain Prytz, a Dane, and made by Herr Cornelius Knudson in Copenhagen. It consists of a single rigid piece like Fig. 16. The one end T is the tracer, the other Q has a sharp hatchet-like edge. If this is placed with QT on the paper and T is moved along any curve, Q will follow, describing a "curve of pursuit." In consequence of the sharp edge, Q can only move in the direction of T, but the whole can turn about Q. Any small step forward can therefore be considered as made up of a motion along QT, together with a turning about Q. The latter motion alone generates an area. If therefore a line OA = QT is turning about O, always keeping parallel to QT, it will sweep over an area equal to that generated by the more general motion of QT. Let now (Fig. 17) QT be placed on OA, and T be guided round the closed curve in the sense of the arrow. Q will describe a curve OSB. It may be made visible by putting a piece of "copying paper" under the hatchet. When T has returned to A the hatchet has the position BA. The line turning from OA about O kept parallel to QT will describe the circular sector OAC, which is equal in magnitude and sense to AOB. This therefore measures the area generated by the motion of QT. To make this motion cyclical, suppose the hatchet turned about A till Q comes from B to O. Hereby the sector AOB is again described, and again in the positive sense, if it is remembered that it turns about T. The whole area now generated is therefore twice the area of this sector, or equal to OA.OB, where OB is measured along the arc. According to the theorem given p. 579, this area also equals the area of the given curve less the area OSBO. To make this area disappear, a slight modification of the motion of QT is required. Let the tracer T be moved, both from the first position OA and the last BA of the rod, along some straight line AX. Q describes curves OF and BH respectively. Now begin the motion with T at some point R on AX, and move it along this line to A, round the curve and back to R. Q will describe the curve DOSBED, if the motion is again made cyclical by turning QT with T fixed at A. If R is properly selected, the path of Q will cut itself, and parts of the area will be positive, parts negative, as marked in the figure, and may therefore be made to vanish. When this is done the area of the curve will equal twice the area of the sector RDE. It is therefore equal to the arc DE multiplied by the length QT; if the latter equals 10 inches, then 10 times the number of inches contained in the arc DE gives the number of square inches contained within the given figure. If the area is not too large, the arc DE may be replaced by the straight line DE.

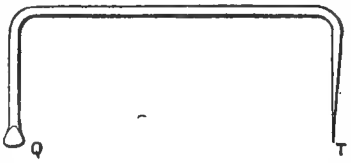

Fig. 16.

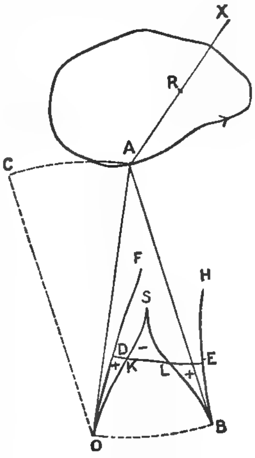

Fig. 17.

To use this simple instrument as a planimeter requires the possibility of selecting the point R. The geometrical theory here given has so far failed to give any rule. In fact, every line through any point in the curve contains such a point. The analytical theory of the inventor, which is very similar to that given by Mr F. W. Hill (*Phil. Mag.* 1894), is too complicated to repeat here. The integrals expressing the area generated by QT have to be expanded in a series. By retaining only the most important terms a result is obtained which comes to this, that if the mass-centre be taken as R, then A may be any point on the curve. This is only approximate. Capt. Prytz gives the following instructions:—Take a point R as near as you can guess to the mass-centre, put the tracer T on it, the knife-edge Q outside; make a mark on the paper by pressing the knife-edge into it, guide the tracer from R along a straight line to a point A on the boundary, round the boundary, and back from A to R; lastly, make again a mark with the knife-edge, and measure the distance c between the marks, then the area is nearly cl where l = QT. A nearer approximation is obtained by repeating the operation after turning QT through 180° from the original position, and using the mean of the two values of c thus obtained. The greatest dimension of the area should not exceed $\frac{1}{2}\,l$, otherwise the area must be divided into parts which are determined separately. This condition being fulfilled, the instrument gives very satisfactory results, especially if the figures to be measured, as in the case of indicator diagrams, are much of the same shape, for in this case the operator soon learns where to put the point R.

Integrators.

Integrators serve to evaluate an integral, and especially a definite integral $\int_a^b f(x)dx$, where $f(x)$ is given graphically, or, if given by a formula, is first represented graphically. If we plot out the curve whose equation is $y=f(x)$, the integral $\int ydx$ between the proper limits represents the area of a figure bounded by the curve, the axis of x, and the ordinates at $x=a$, $\chi=b$. Hence if the curve is drawn, any planimeter may be used for finding the value of the integral. In this sense planimeters are integrators. In fact, a planimeter may often be used with advantage to solve problems more complicated than the determination of a mere area, by converting the one problem graphically into the other. We give an example:—

Let the problem be to determine for the figure ABG (Fig. 18), not only the area, but also the first and second moment with regard to the axis XX. At a distance a draw a line, C′D′, parallel to XX. In the figure draw a number of lines parallel to AB. Let CD be one of them. Draw C and D vertically upwards to C′D′, join these points to some selected point O in XX, and mark the points C_1D_1 where OC′ and OD′ cut CD. Do this for a sufficient number of lines, and join the points C_1D_1 thus obtained. This gives a new curve, which may be called the first derived curve. By the same process get a new curve from this, the second derived curve. By aid of a planimeter determine the areas P, P_1, P_2, of these three curves. Then, if $\bar{x}$ is the distance of the mass-centre of the given area from XX; $\bar{x}'$ the same quantity for the first derived figure, and $I = Ak^2$ the moment of inertia of the first figure, k its radius of gyration, with regard to XX as axis, the following relations are easily proved:—

$$P\bar{x} = aP_1\,;\ P_1\bar{x}_1 = aP_2\,;\ I = aP_1\bar{x}_1 = a^2P_1P_2\,;\ k^2 = \bar{x}\bar{x}_1,$$

which determine P, $\bar{x}$ and I or k. Amsler has constructed an integrator which serves to determine these quantities by guiding a tracer once round the boundary of the given figure (see below). Again, it may be required to find the value of an integral $\int y\phi(x)dx$ between given limits where $\phi(x)$ is a simple function like $\sin nx$, and where y is given as the ordinate of a curve. The harmonic analysers described below are examples of instruments for evaluating such integrals.

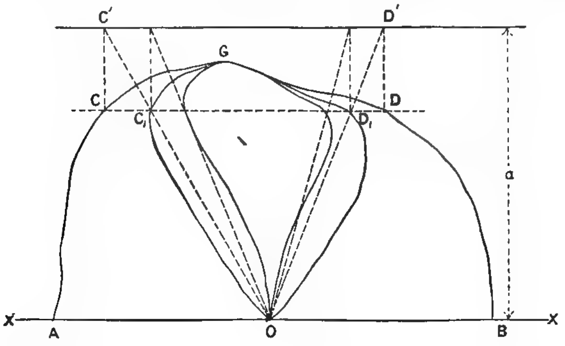

Fig. 18.

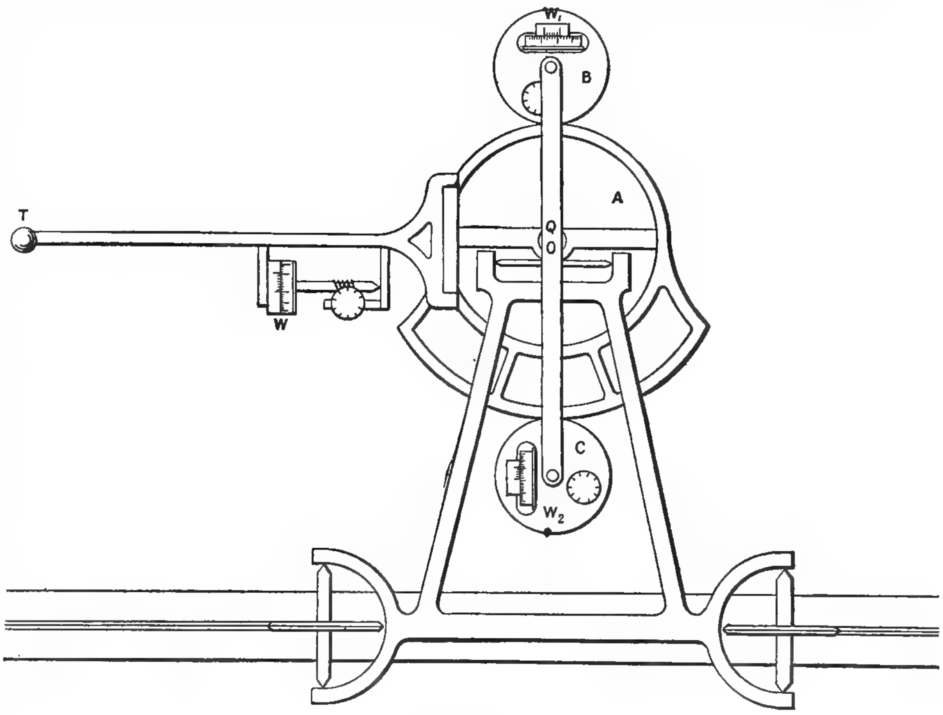

Fig. 19.

Amsler has modified his planimeter in such a manner that instead of the area it gives the first or second moment of a figure about an axis in its plane. This instrument, known as the Amsler's integrator or moment-planimeter, has one tracer but three recording wheels. It is mounted on a carriage which runs on a straight rail (Fig. 19). This carries a horizontal disc A, movable about a vertical axis Q. Slightly more than half the circumference is circular with radius $2a$, the other part with radius $3a$. Against these gear two discs, B and C, with radii a; their axes are fixed in the carriage. The first part extends to the left to a rod OT of length l, on which a recording wheel W is mounted. The discs B and C have also recording wheels, W_1 and W_2. The centres of the three discs are in a line perpendicular to the rail. If now T is guided round a figure F, O will move to and fro in a straight line. This part is therefore a simple planimeter, in which the one end of the arm moves in a straight line instead of in a circular arc. Consequently, the "roll" of W will record the area of the figure. Imagine now that the discs B and C also receive arms of length l from the centres of the discs to points T_1 and T_2, and in the directions of the axes of the wheels. Then these arms with their wheels will again be planimeters. As T is guided round the given figure F, these points T_1 and T_2 will describe closed curves, F_1 and F_2, and the "rolls" of W_1 and W_2 will give their areas A_1 and A_2. Let XX (Fig. 20) denote the line, parallel to the rail, on which O moves; then when T lies on this line, the arm BT_1 is perpendicular to XX, and CT_2 parallel to it. If OT is turned through an angle θ, clockwise, BT_1 will turn counter-clockwise through an angle 2θ, and CT_2 through an angle 3θ, also counter-clockwise. If in this position T is moved through a distance x parallel to the axis XX, the points T_1 and T_2 will move parallel to it through an equal distance. If now the first arm is turned through a small angle $d\theta$, moved back through a distance x, and lastly turned back through the angle $d\theta$, the tracer T will have described the boundary of a small strip of area. We divide the given figure into such strips. Then to every such strip will correspond a strip of equal length x of the figures described by T_1 and T_2. The distances of the points, T, T_1, T_2, from the axis XX may be called y, y_1, y_2.

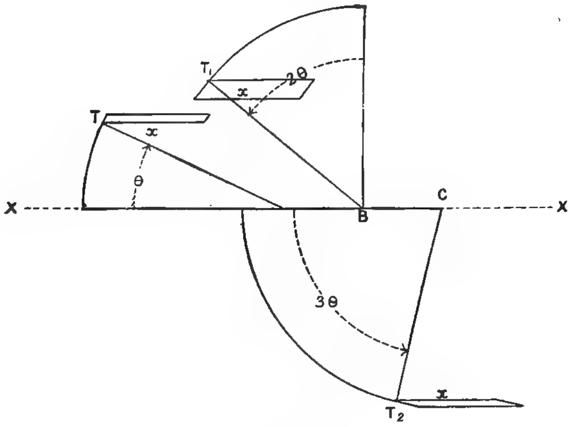

Fig. 20.

These have the values

$$y = l\sin\theta,\ y_1 = l\cos 2\theta,\ y_2 = -l\sin 3\theta,$$

from which

$$dy = l\cos\theta.d\theta,\quad dy_1 = -2l\sin 2\theta.d\theta,\quad dy_2 = -3l\cos 3\theta.d\theta.$$

The areas of the three strips are respectively

$$dA = xdy,\quad dA_1 = xdy_1,\quad dA_2 = xdy_2.$$

Now dy_1 can be written $dy_1 = -4l\sin\theta\cos\theta d\theta = -4\sin\theta dy$;

therefore

$$dA_1 = -4 \sin \theta . dA = -\frac{4}{l} y dA;$$

whence

$$A_1 = -\frac{4}{l}\int y dA = -\frac{4}{l}A\bar{y},$$

where A is the area of the given figure, and $\bar{y}$ the distance of its mass-centre from the axis XX. But A_1 is the area of the second figure F_1, which is proportional to the reading of W_1. Hence we may say

$$A\bar{y} = C_1 w_1,$$

where C_1 is a constant depending on the dimensions of the instrument. The negative sign in the expression for A_1 is got rid of by numbering the wheel W_1 the other way round.

Again

$$dy_2 = -3l \cos \theta \{4 \cos^2 \theta - 3\} d\theta = -3\{4 \cos^2 \theta - 3\} dy$$
$$= -3\left\{\frac{4}{l^2}y^2 - 3\right\} dy,$$

which gives

$$dA_2 = -\frac{12}{l^2} y^2 dA + 9dA,$$

and

$$A_2 = -\frac{12}{l^2}\int y^2 dA + 9A.$$

But the integral gives the moment of inertia I of the area A about the axis XX. As A_2 is proportional to the roll of w_2, A to that of W, we can write

$$I = Cw - C_2 w_2,$$
$$A\bar{y} = C_1 w_1,$$
$$A = C_0 w.$$

If a line be drawn parallel to the axis XX at the distance $\bar{y}$, it will pass through the mass-centre of the given figure. If this represents the section of a beam subject to bending, this line gives for a proper choice of XX the neutral fibre. The moment of inertia for it will be $I + A\bar{y}^2$. Thus the instrument gives at once all those quantities which are required for calculating the strength of the beam under bending. One chief use of this integrator is for the calculation of the displacement and stability of a ship from the drawings of a number of sections. It will be noticed that the length of the figure in the direction of XX is only limited by the length of the rail.

This integrator is also made in a simplified form without the wheel W_2. It then gives the area and first moment of any figure.

Integraphs. While an integrator determines the value of a definite integral, hence a mere constant, an integraph gives the value of an indefinite integral, which is a function of x. Analytically if y is a given function $f(x)$ of x and

$$Y = \int_c^x y dx \text{ or } Y = \int y dx + \text{const.}$$

the function Y has to be determined from the condition

$$\frac{dY}{dx} = y.$$

Graphically $y = f(x)$ is either given by a curve, or the graph of the equation is drawn: y, therefore, and similarly Y, is a length. But $\frac{dY}{dx}$ is in this case a mere number, and cannot equal a length y. Hence we introduce an arbitrary constant length a, the unit to which the integraph draws the curve, and write

$$\frac{dY}{dx} = \frac{y}{a} \text{ and } aY = \int y dx.$$

Now for the Y-curve $\frac{dY}{dx} = \tan \phi$, where ϕ is the angle between the tangent to the curve, and the axis of x. Our condition therefore becomes

$$\tan \phi = \frac{y}{a}$$

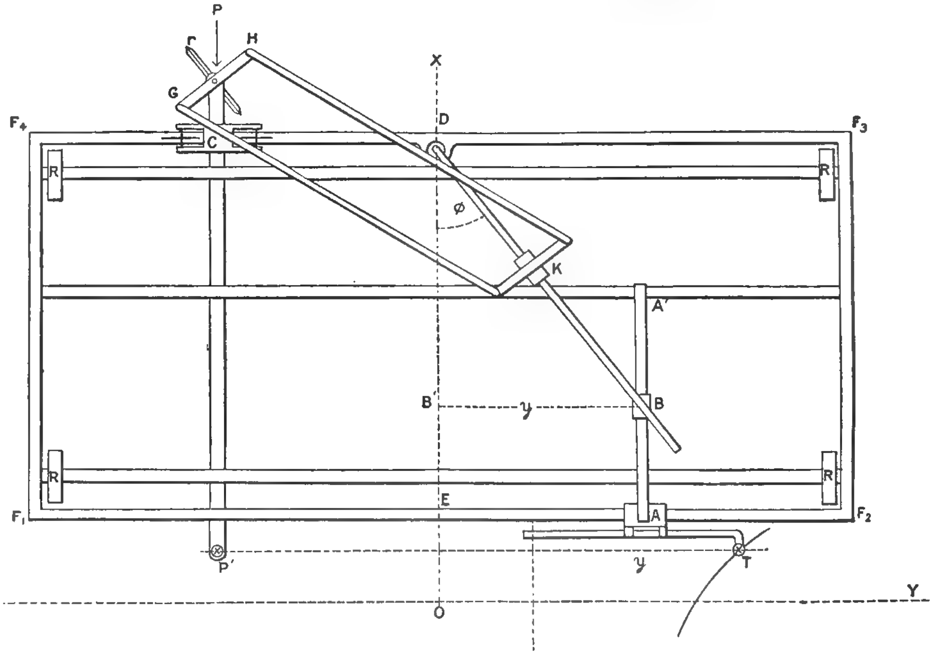

Fig. 22.

This ϕ is easily constructed for any given point on the y-curve:—From the foot B′ (Fig. 21) of the ordinate $y = B'B$ set off, as in the figure, $B'D = a$, then angle $BDB' = \phi$. Let now DB′ with a perpendicular B′B move along the axis of x, whilst B follows the y-curve, then a pen P on B′B will describe the Y-curve provided it moves at every moment in a direction parallel to BD. The object of the integraph is to draw this new curve when the tracer of the instrument is guided along the y-curve.

The first to describe such instruments was Abdank-Abakanowicz, who in 1889 published a book in which a variety of mechanisms to obtain the object in question are described. Some years later Coradi, in Zürich, carried out his ideas. Before this was done, Mr C. V. Boys, without knowing of Abdank-Abakanowicz's work, actually made an integraph which was exhibited at the Physical Society in 1881. Both make use of a sharp edge wheel. Such a wheel will not slip sideways; it will roll forwards along the line in which its plane intersects the plane of the paper, and while rolling will be able to turn gradually about its point of contact. If then the angle between its direction of rolling and the x-axis be always equal to ϕ, the wheel will roll along the Y-curve required. The axis of x is fixed only in direction; shifting it parallel to itself adds a constant to Y, and this gives the arbitrary constant of integration.

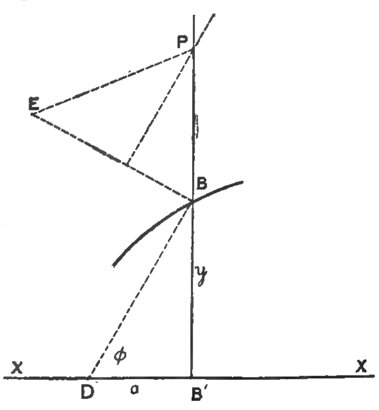

Fig. 21.

In fact, if Y shall vanish for $x = c$, or if

$$Y = \int_c^x y dx,$$

then the axis of x has to be drawn through that point on the y-curve which corresponds to $x = c$.

In Coradi's integraph a rectangular frame $F_1F_2F_3F_4$ (Fig. 22) rests with four rollers R on the drawing board, and can roll freely in the direction OX, which will be called the axis of the instrument. On the front edge F_1F_2 travels a carriage AA′ supported at A′ on another rail. A bar DB can turn about D, fixed to the frame in its axis, and slide through a point B fixed in the carriage AA′. Along it a block K can slide. On the back edge F_3F_4 of the frame another carriage C travels. It holds a vertical spindle with the knife-edge wheel at the bottom. At right angles to the plane of the wheel, the spindle has an arm GH, which is kept parallel to a similar arm attached to K perpendicular to DB. The plane of the knife-edge wheel r is therefore always parallel to DB. If now the point B is made to follow a curve whose y is measured from OX, we have in the triangle BDB′, with the angle ϕ at D,

$$\tan \phi = y/a,$$

where $a = \mathrm{DB}'$ is the constant base to which the instrument works. The point of contact of the wheel r or any point of the carriage C will therefore always move in a direction making an angle ϕ with the axis of x, whilst it moves in the x-direction through the same distance as the point B on the y-curve—that is to say, it will trace out the integral curve required, and so will any point rigidly connected with the carriage C. A pen P attached to this carriage will therefore draw the integral curve. Instead of moving B along the y-curve, a tracer T fixed to the carriage A is guided along it. For using the instrument the carriage is placed on the drawing-board with the front edge parallel to the axis of y, the carriage A being clamped in the central position with B on the axis AE. The tracer is then placed on the x-axis of the y-curve and clamped to the carriage, and the instrument is ready for use. As it is convenient to have the integral curve placed directly opposite to the y-curve so that corresponding values of y or Y are drawn on the same line, a pen P′ is fixed to C in a line with the tracer.

Boys' integraph was invented during a sleepless night, and during the following days carried out as a working model, which gives highly satisfactory results. It is ingenious in its simplicity, and a direct realization as a mechanism of the principles explained in connexion with Fig. 21. The line B′B is represented by the edge of an ordinary T-square sliding against the edge of a drawing-board. The points B and P are connected by two rods BE and EP, jointed at E. At B, E, and P are small pulleys of equal diameters. Over these an endless string runs, ensuring that the pulleys at B and P always turn through equal angles. The pulley at B is fixed to a rod which passes through the point D, which itself is fixed in the T-square. The pulley at P carries the knife-edge wheel. If then B and P are kept on the edge of the T-square, and B is guided along the curve, the wheel at P will roll along the Y-curve, it having been originally set parallel to BD. To give the wheel at P sufficient grip on the paper, a small loaded three-wheeled carriage, the knife-edge wheel P being one of its wheels, is added. If a piece of copying paper is inserted between the wheel P and the drawing paper the Y-curve is drawn very sharply.

Integraphs have also been constructed, by aid of which ordinary differential equations, especially linear ones, can be solved, the solution being given as a curve. The first suggestion in this direction was made by Lord Kelvin. So far no really useful instrument has been made, although the ideas seem sufficiently developed to enable a skilful instrument-maker to produce one should there be sufficient demand for it. Sometimes a combination of graphical work with an integraph will serve the purpose. This is the case if the variables are separated, hence if the equation

$$\mathrm{X}dx + \mathrm{Y}dy = o$$

has to be integrated where $\mathrm{X} = p(x)$, $\mathrm{Y} = \phi(y)$ are given as curves. If we write

$$au = \int \mathrm{X}dx, \qquad av = \int \mathrm{Y}dy$$

then u as a function of x, and v as a function of y can be graphically found by the integraph. The general solution is then

$$u + v = c$$

with the condition, for the determination for c, that $y = y_0$, for $x = x_0$. This determines $c = u_0 + v_0$, where u_0 and v_0 are known from the graphs of u and v. From this the solution as a curve giving y a function of x can be drawn:—For any x take u from its graph, and find the y for which $v = c - u$, plotting these y against their x gives the curve required.

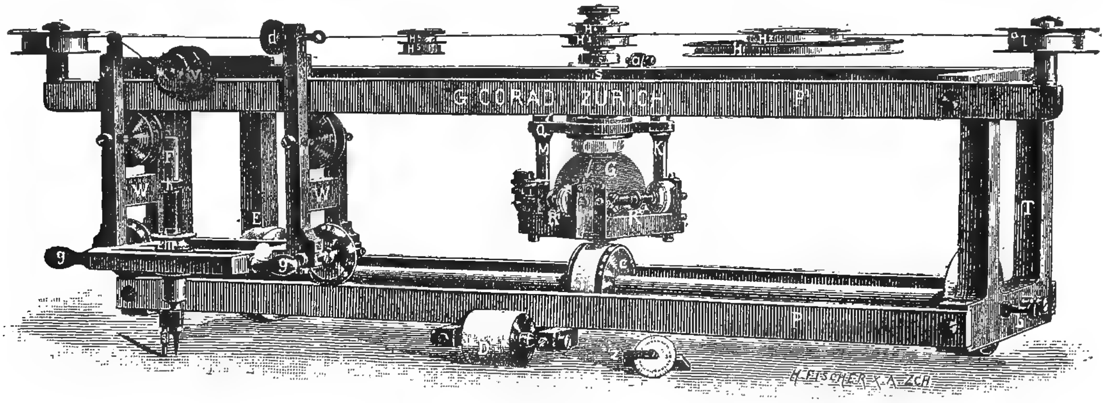

Fig. 23.

Harmonic analysers. If a periodic function y of x is given by its graph for one period c, it can, according to the theory of Fourier's Series, be expanded in a series.

$$\begin{aligned} y = \mathrm{A}_0 + \mathrm{A}_1 \cos\theta + \mathrm{A}_2 \cos 2\theta + \ . \ . \ . \ + \mathrm{A}_n \cos n\theta + \ . \ . \ . \\ + \mathrm{B}_1 \sin\theta + \mathrm{B}_2 \sin 2\theta + \ . \ . \ . \ + \mathrm{B}_n \sin n\theta + \ . \ . \ . \end{aligned}$$

where $\theta = \dfrac{2\pi x}{c}$

The absolute term A_0 equals the mean ordinate of the curve, and can therefore be determined by any planimeter. The other coefficients are

$$\mathrm{A}_n = \frac{1}{\pi}\int_0^{2\pi} y \cos n\theta . d\theta \ ; \ \mathrm{B}_n = \frac{1}{\pi}\int_0^{2\pi} y \sin n\theta . d\theta .$$

A harmonic analyser is an instrument which determines these integrals, and is therefore an integrator. The first instrument of this kind is due to Lord Kelvin (*Proc. Roy. Soc.* vol. xxiv., 1876). Since then several others have been invented (see Dyck's *Catalogue*; Henrici, *Phil. Mag.*, July 1894; *Phys. Soc.*, 9th March; Sharp, *Phil. Mag.*, July 1894; *Phys. Soc.*, 13th April). In Lord Kelvin's instrument the curve to be analysed is drawn on a cylinder whose circumference equals the period c, and the sine and cosine terms of the integral are introduced by aid of simple harmonic motion. Sommerfeld and Wiechert, of Königsberg, avoid this motion by turning the cylinder about an axis perpendicular to that of the cylinder. Both these machines are large, and practically fixtures in the room where they are used. The first has done good work in the Meteorological Office in London in the analysis of meteorological curves. Quite different and simpler constructions can be used, if the integrals determining A_n and B_n be integrated by parts. This gives

$$n\mathrm{A}_n = -\frac{1}{\pi}\int_o^{2\pi} \sin n\theta . dy \ ; n\mathrm{B}_n = \frac{1}{\pi}\int_o^{2\pi} \cos n\theta . dy .$$

An analyser presently to be described, based on these forms, has been constructed by Coradi in Zürich (1894). Lastly a most powerful analyser has been invented by Michelson and Stratton (U.S.A.) (*Phil. Mag.*, 1898), which will also be described.

The *Henrici-Coradi* analyser has to add up the values of $dy . \sin n\theta$ and $dy . \cos n\theta$. But these are the components of dy in two directions perpendicular to each other, of which one makes an angle $n\theta$ with the axis of x or of θ. This decomposition can be performed by Amsler's registering wheels. Let two of these be mounted, perpendicular to each other, in one horizontal frame which can be turned about a vertical axis, the wheels resting on the paper on which the curve is drawn. When the tracer is placed on the curve at the point $\theta = o$ the one axis is parallel to the axis of θ. As the tracer follows the curve the frame is made to turn through an angle $n\theta$. At the same time the frame moves with the tracer in the direction of y. For a small motion the two wheels will then register just the components required, and during the continued motion of the tracer along the curve the wheels will add these components, and thus give the values of $n\mathrm{A}_n$ and $n\mathrm{B}_n$. The factors $1/\pi$ and $-1/\pi$ are taken account of in the graduation of the wheels. The readings have then to be divided by n to give the coefficients required. Coradi's realization of this idea will be understood from Fig. 23. The frame PP′ of the instrument rests on three rollers E, E′, and D. The first two drive an axis with a disc C on it. It is placed parallel to the axis of x of the curve. The tracer is attached to a carriage WW which runs on the rail P. As it follows the curve this carriage moves through a distance x whilst the whole instrument runs forward through a distance y. The wheel C turns through an angle proportional, during each small motion, to dy. On it rests a glass sphere, which will therefore also turn about its horizontal axis proportionally to dy. The registering frame is suspended by aid of a spindle S, having a disc H. It is turned by aid of a wire connected with the carriage WW, and turns n times round as the tracer describes the whole length of the curve. The registering wheels R, R′ rest against the glass sphere and give the values nA_n and nB_n. The value of n can be altered by changing the disc H into one of different diameter. It is also possible to mount on the same frame a number of spindles with registering wheels and glass spheres, each of the latter resting on a separate disc C. As many as five have been introduced. One guiding of the tracer over the curve gives then at once the ten coefficients A_n and B_n for $n=1$ to 5.

Michelson and Stratton Analyser.—All the calculating machines and integrators considered so far have been kinematic. We have now to describe a most remarkable instrument based on the equilibrium of a rigid body under the action of springs. The body itself for rigidity's sake is made a hollow cylinder H, shown in Fig. 24 in end view. It can turn about its axis, being supported on knife-edges O. To it springs are attached at the prolongation of a horizontal diameter; to the left a series of n small springs s, all alike, side by side at equal intervals at a distance a from the axis of the knife-edges; to the right a single spring S at distance b. These springs are supposed to follow Hooke's law. If the elongation beyond the natural length of a spring is λ, the force asserted by it is $p=k\lambda$. Let for the position of equilibrium l, L be respectively the elongation of a small and the large spring k, K their constants, then is

$$nkla=\mathrm{K}\mathrm{L}b.$$

The position now obtained will be called the *normal* one. Now let the top ends C of the small springs be movable, and let any one of them be raised through a distance y. This will turn the body H, B will move down through a distance z and A up through a distance $\frac{a}{b}z$. The new forces thus introduced will be in equilibrium if

$$ak\left(\Sigma y-n\frac{a}{b}z\right)=b\mathrm{K}z.$$

Or

$$z=\frac{\Sigma y}{n\frac{a}{b}+\frac{b}{a}\frac{\mathrm{K}}{k}}=\frac{\Sigma y}{n\left(\frac{a}{b}+\frac{l}{\mathrm{L}}\right)}.$$

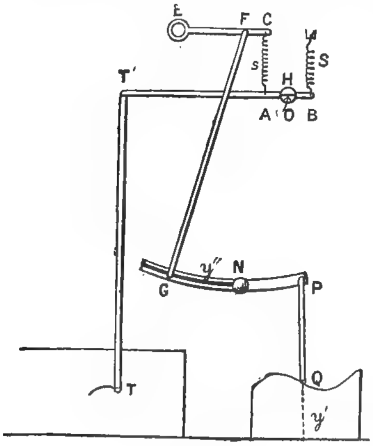

Fig. 24.

This shows that the displacement z of B is proportional to the sum of the displacements y of the tops of the small springs. The arrangement can therefore be used for the addition of a number of displacements. The instrument made has eighty small springs, and the authors state that from the experience gained there is no impossibility of increasing their number even to a thousand. The displacement z, which necessarily must be small, can be enlarged by aid of a lever OT. To regulate the displacements y of the points C (Fig. 24) each spring is attached to a lever EC, fulcrum E. To this again a long rod FG is fixed by aid of a joint at F. The lower end of this rod rests on another lever GP, fulcrum N, at a changeable distance $y''=\mathrm{NG}$ from N. The elongation y of any spring s can thus be produced by a motion of P. If P be raised through a distance y', then the displacement y of C will be proportional to $y'y''$; it is, say, equal to $\mu y'y''$ where μ is the same for all springs. Now let the points C, and with it the springs s, the levers, &c., be numbered $C_0\,C_1\,C_2\ldots$ There will be a zero-position for the points P all in a straight horizontal line. When in this position the points C will also be in a line, and this we take as axis of x. On it the points $C_0\,C_1\,C_2\ldots$ follow at equal distances, say each equal to h. The point C_k lies at the distance kh which gives the x of this point. Suppose now that the rods FG are all set at unit distance NG from N, and that the points P be raised so as to form points in a continuous curve $y'=\phi(x)$, then the points C will lie in a curve $y=\mu\phi(x)$. The area of this curve is

$$\mu\int_0^c\phi(x)dx.$$

Approximately this equals $\Sigma hy=h\Sigma y$. Hence we have

$$\int_0^c\phi(x)dx=\frac{h}{\mu}\Sigma y=\frac{\lambda h}{\mu}z,$$

where z is the displacement of the point B which can be measured. The curve $y'=\phi(x)$ may be supposed cut out as a templet. By putting this under the points P the area of the curve is thus determined—the instrument is a simple integrator.

The integral can be made more general by varying the distances $\mathrm{NG}=y''$. These can be set to form another curve $y''=f(x)$. We have now $y=\mu y'y''=\mu f(x)\phi(x)$, and get as before

$$\int_0^c f(x)\phi(x)dx=\frac{\lambda h}{\mu}z.$$

These integrals are obtained by the addition of ordinates, and therefore by an approximate method. But the ordinates are numerous, there being 79 of them, and the results are in consequence very accurate. The displacement z of B is small, but it can be magnified by taking the reading of a point T′ on the lever AB. The actual reading is done at point T connected with T′ by a long vertical rod. At T either a scale can be placed or a drawing-board, on which a pen at T marks the displacement.

If the points G are set so that the distances NG on the different levers are proportional to the terms of a numerical series

$$u_0+u_1+u_2+\ \ldots$$

and if all P be moved through the same distance, then z will be proportional to the sum of this series up to 80 terms. We get an *Addition Machine.*

The use of the machine can, however, be still further extended. Let a templet with a curve $y'=\phi(\xi)$ be set under each point P at right angles to the axis of x hence parallel to the plane of the figure. Let these templets form sections of a continuous surface, then each section parallel to the axis of x will form a curve like the old $y'=\phi(x)$, but with a variable parameter ξ or $y'=\phi(\xi,x)$. For each value of ξ the displacement of T will give the integral

$$\mathrm{Y}=\int_0^c f(x)\phi(\xi x)dx=\mathrm{F}(\xi),\quad .\quad .\quad .\ (1)$$

where Y equals the displacement of T to some scale dependent on the constants of the instrument.

If the whole block of templets be now pushed under the points P and if the drawing-board be moved at the same rate, then the pen T will draw the curve $\mathrm{Y}=\mathrm{F}(\xi)$. The instrument now is an *integraph* giving the value of a definite integral as function of a *variable parameter.*

Having thus shown how the lever with its springs can be made to serve a variety of purposes, we return to the description of the actual instrument constructed. The machine serves first of all to sum up a series of harmonic motions or to draw the curve

$$\mathrm{Y}=a_1\cos x+a_2\cos 2x+a_1\cos 3x+\ .\ .\ .\quad .\quad .\ (2)$$

The motion of the points $P_1\,P_2\ldots$ is here made harmonic by aid of a series of excentric discs arranged so that for one revolution of the first the other discs complete 2, 3, . . . revolutions. They are all driven by one handle. These discs take the place of the templets described before. The distances NG are made equal to the amplitudes a_1, u_2, a_3, . . . The drawing-board, moved forward by the turning of the handle, now receives a curve of which (2) is the equation. If all excentrics are turned through a right angle a sine-series can be added up.

It is a remarkable fact that the same machine can be used as a harmonic analyser of a given curve.

Let the curve to be analysed be set off along the levers NG so that in the old notation it is

$$y''=f(x)\ ;$$

whilst the curves $y'=\phi(x\xi)$ are replaced by the excentrics, hence ξ by the angle θ through which the first excentric is turned, so that $y'_k=\cos k\theta$.

But $kh=x$ and $nh=\pi$, n being the number of springs s, and π taking the place of c. This makes

$$k\theta=\frac{n}{\pi}\theta.x.$$

Hence our instrument draws a curve which gives the integral (1) in the form

$$y=\frac{2}{\pi}\int_0^\pi f\,(x)\cos\left(\frac{n}{\pi}\theta x\right)dx$$

as a function of θ.

But this integral becomes the coefficient a_m in the cosine expansion if we make

$$\frac{n}{\pi}\theta=m \text{ or } \theta=m\frac{\pi}{n}.$$

The ordinates of the curve at the values $\theta=\frac{\pi}{n}, 2\frac{\pi}{n} \ldots$ give therefore all coefficients up to $m=80$.

The curve shows at a glance which and how many of the coefficients are of importance.

The instrument is described in *Phil. Mag.* vol. xlv., 1898. A number of curves drawn by it are given, and also examples of the analysis of curves for which the coefficients a_m are known. These indicate that a remarkable accuracy is obtained. (O. H.)

Matlock, a town in the western parliamentary division of Derbyshire, England, 17 miles north by west of Derby, on the river Derwent and the Midland Railway (Matlock Bridge station). The newer portion, Matlock Bank, famous for its hydropathics, has been connected with the older by a tramway worked by a single cable, with a gradient said to be the steepest in the world. Population of urban district (1891), 5285; (1901), 5980; of the separate urban district of Matlock Bath (1901), 1816.

Matsugata, Count (1835-——), Japanese statesman, was born at Kagoshima in 1835, being a son of a *samurai* of the Satsuma clan. On the completion of the feudal revolution of 1868 he was appointed governor of the province of Tosa, and having served six years in this office, was transferred to Tôkyô as assistant minister of finance. As representative of Japan at the Paris Exhibition of 1878, he took the opportunity afforded by his mission to study the financial systems of the great European Powers. On his return home, he held for a short time in 1880 the portfolio of home affairs, and was in 1881 appointed minister of finance. The condition of the currency of Japan was at that time deplorable, and national bankruptcy threatened. The coinage had not only been seriously debased during the closing years of the Tokugawa *régime*, but large quantities of paper currency had been issued and circulated, both by many of the feudal lords and by the central government itself, as a temporary expedient for filling an impoverished exchequer. In 1878 depreciation had set in, and the inconvertible paper had by the close of 1881 grown to such an extent that it was then at a discount of 80 per cent. as compared with silver. Count Matsugata showed the Government the danger of the situation, and urged that the issue of further paper currency should be stopped at once, the expenses of administration curtailed, and the resulting surplus of revenue used in the redemption of the paper currency and in the creation of a specie reserve. These proposals were acted upon: the Bank of Japan was established, and the right of issuing convertible notes given to it; and within three years of the initiation of these financial reforms, the paper currency, largely reduced in quantity, was restored to its full par value with silver, and the currency as a whole placed on a solvent basis. From this time forward Japan's commercial and military advancement continued to make uninterrupted progress. But *pari passu* with the extraordinary impetus given to its trade by the successful conclusion of the war with China, the national expenditure enormously increased, rising within a few years from 80 to 250 million yen. The task of providing for this expenditure fell entirely on Count Matsugata, who had to face strong opposition on the part of the Diet. But he distributed the increased taxation so equally, and chose its subjects so wisely, that the ordinary administrative expenditure and the interest on the national debt were fully provided for, while the extraordinary expenditure for military purposes was met from the Chinese indemnity. As far back as 1878 Count Matsugata perceived the advantages of a gold standard, but it was not until 1897 that his scheme could be realized. In this year the Bill authorizing it was under his auspices submitted to the Diet and passed; and with this financial achievement Count Matsugata saw the fulfilment of his ideas of financial reform, which were conceived during his first visit to Europe. Count Matsugata twice held the office of prime minister (1891–92, 1896–97), and during both his administrations he combined the portfolio of finance with the premiership; in 1899 and 1900 he was minister of finance only. His name in Japanese history is indissolubly connected with the financial progress of his country at the end of the 19th century.

Matteawan, a village of Dutchess county, New York, U.S.A., near the eastern bank of the Hudson river, opposite Newburg, in the south-eastern part of the state, on the New York, New Haven, and Hartford (New England), and the Newburg, Dutchess, and Connecticut Railways. Population (1890), 4278; (1900), 5807, of whom 1044 were foreign-born.

Matto Grosso, a state of Brazil, extending between 7° 30′ and 24° 10′ S. and 50° 35′ and 65° 10′ W., having on the N. the states of Amazonas and Pará, on the W. Bolivia, on the S. Paraguay, and on the E. Goyaz, Minas Geraes, Sao Paulo, and Paraná. Its area covers 532,708 square miles. It is drained in the north by the Tocantins-Araguaya, and in the south by the Paraná-Parahyba. Its mineral wealth is considerable, though many of the mines are of little importance. Gold, iron, diamonds, and rock-salt are amongst the minerals that occur in greater or smaller quantities. The rearing of cattle is the chief agricultural pursuit. Population (1870), 60,417; (1890), 92,827. The capital, Cuyabá (8000), is in telegraphic connexion with Rio de Janeiro.

Mattoon, a city of Coles county, Illinois, U.S.A., south-east of the centre of the state, at the intersection of the Cleveland, Cincinnati, Chicago and St Louis, the Illinois Central, and the Peoria, Decatur and Evansville Railways, at an altitude of 726 feet. It is in a rich farming country, for which it serves as a collecting and distributing point. Population (1890), 6833; (1900), 9622, of whom 430 were foreign-born and 227 were negroes.

Maubeuge, a town in the arrondissement of Avesnes, department of Nord, France, 48 miles south-east of Lille, on the railway from Paris. Large glass-works are now important industrial features. The town forms the nucleus of an entrenched camp, of which the perimeter is about 18 miles. Population (1891), 11,953; (1901), 20,826.

Maupassant, Henri René Albert Guy de (1850–1893), French novelist and poet, was born at the Château of Miromesnil in the department of Seine-Inférieure on 5th August 1850. His grandfather, a landed proprietor of a good Lorraine family, owned an estate at Neuville-Champ-d'Oisel near Rouen, and bequeathed a moderate fortune to his son, a Paris stockbroker, who married Mademoiselle Laure Lepoitevin. Maupassant was educated at Yvetot and at the Rouen lycée. A copy of verses entitled *Le Dieu Créateur*, written during his year of philosophy, has been preserved and printed. He entered the ministry of marine, and was promoted by M. Bardoux to the Cabinet de l'Instruction Publique. A pleasant legend says that, in a report by his official chief, Maupassant is mentioned as not reaching the standard of the department in the matter of style. He may very well have been an unsatisfactory clerk, as he divided his time between rowing expeditions and attending the literary gatherings at the house of Gustave Flaubert, who was not, as he is often alleged to be, connected with Maupassant by any blood tie. Flaubert was not his uncle, nor his cousin, nor even his godfather, but merely an old friend of Madame de Maupassant, whom he had known from childhood. At the literary meetings Maupassant seldom shared in the conversation. Upon those who met him—Tourgenieff, Alphonse Daudet, M. Catulle Mendès, M. José-Maria de Heredia, and M. Zola—he left the impression of a simple young athlete. Even Flaubert, to whom Maupassant submitted some sketches, was not greatly struck by their talent, though he encouraged the youth to persevere. Maupassant's first essay was a dramatic piece twice given at Étretat in 1873 before an audience which included Tourgenieff, Flaubert, and Meilhac. In this indecorous performance, of which nothing more is heard, Maupassant played the part of a woman. During the next seven years he served a severe apprenticeship to Flaubert, who by this time realized his pupil's exceptional gifts. In 1880 Maupassant published a volume of poems, *Des Vers*, against which the public prosecutor of Étampes took proceedings that were finally withdrawn through the influence of the senator Cordier. From Flaubert, who had himself been prosecuted for his first book, *Madame Bovary*, there came a letter congratulating the poet on the similarity between their first literary experiences. *Des Vers* is an extremely interesting experiment, which shows Maupassant to us still hesitating in his choice of a medium; but he recognized that it was not wholly satisfactory, and that its chief deficiency—the absence of verbal melody—was fatal. Later in the same year he contributed to the *Soirées de Médan*, a collection of short stories by MM. Zola, J.-K. Huysmans, Henry Céard, Léon Hennique, and Paul Alexis; and in *Boule de Suif* the young unknown author revealed himself to his amazed collaborators and to the public as an admirable writer of prose and a consummate master of the *conte*. There is perhaps no other instance in modern literary history of a writer beginning, as a fully-equipped artist, with a genuine masterpiece. This early success was quickly followed by another. The volume entitled *La Maison Tellier* (1881) confirmed the first impression, and vanquished even those who were repelled by the author's choice of subjects. In *Mademoiselle Fifi* (1883) he repeated his previous triumphs as a *conteur*, and in this same year he, for the first time, attempted to write on a larger scale. Choosing to portray the life of a blameless girl, unfortunate in her marriage, unfortunate in her son, consistently unfortunate in every circumstance of existence, he leaves her, ruined and prematurely old, clinging to the tragic hope, which time, as one feels, will belie, that she may find happiness in her grandson. This picture of an average woman undergoing the constant agony of disillusion Maupassant calls *Une Vie* (1883), and as in modern literature there is no finer example of cruel observation, so there is no sadder book than this, while the effect of extreme truthfulness which it conveys justifies its sub-title—*l'humble vérité*. Certain passages of *Une Vie* are of such a character that the sale of the volume at railway bookstalls was forbidden throughout France. The matter was brought before the Chamber of Deputies, with the result of drawing still more attention to the book, and of advertising the *Contes de la Bécasse* (1883), a collection of stories as improper as they are clever. *Au Soleil* (1884), a book of travels which has the eminent qualities of lucid observation and exact description, was less read than *Clair de Lune*, *Miss Harriet*, *Les Sœurs Rondoli*, and *Yvette*, all published in 1884, when Maupassant's powers were at their highest level. Three further collections of short tales, entitled *Contes et Nouvelles*, *Monsieur Parent*, and *Contes du Jour et de la Nuit*, issued in 1885, proved that while the author's vision was as incomparable as ever, his fecundity had not improved his impeccable form. To 1885 also belongs an elaborate novel, *Bel-Ami*, the cynical history of a particularly detestable, brutal scoundrel who makes his way in the world by means of his handsome face. Maupassant is here no less vivid in realizing his literary men, financiers, and frivolous women than in dealing with his favourite peasants, boors, and servants, to whom he returned in *Toine* (1886) and in *La Petite Roque* (1886). About this time appeared the first symptoms of the malady which destroyed him; he wrote less, and though the novel *Mont-Oriol* (1887) shows him apparently in undiminished possession of his faculty, *Le Horla* (1887) suggests that he was already subject to alarming hallucinations. Restored to some extent by a sea-voyage, recorded in *Sur l'Eau* (1888), he went back to short stories in *Le Rosier de Madame Husson* (1888), a burst of Rabelaisian humour equal to anything he had ever written. His novels *Pierre et Jean* (1888), *Fort comme la Mort* (1889), and *Notre Cœur* (1890) are penetrating studies touched with a profounder sympathy than had hitherto distinguished him; and this softening into pity for the tragedy of life is deepened in some of the tales included in *Inutile Beauté* (1890). One of these, *Le Champ d'Oliviers*, is an unsurpassable example of poignant, emotional narrative. With *La Vie errante* (1890), a volume of travels, Maupassant's career practically closed. *Musotte*, a theatrical piece written in collaboration with M. Jacques Normand, was published in 1891. By this time inherited nervous maladies, aggravated by excessive physical exercises and by the imprudent use of drugs, had undermined his constitution. He began to take an interest in religious problems, and for a while made the *Imitation* his handbook; but his misanthropy deepened, and he suffered from curious delusions as to his wealth and rank. A victim of *la folie des grandeurs*, he drank the waters at Aix-les-Bains during the summer of 1891, and retired to Cannes, where he purposed passing the winter. The singularities of conduct which had been observed at Aix-les-Bains grew more and more marked. Maupassant's reason slowly gave way. On 6th January 1892 he attempted suicide, and was removed to Paris, where he died in the most painful circumstances on 6th July 1893. He is buried in the cemetery of Montparnasse. The opening chapters of two projected novels, *L'Angélus* and *L'Âme Étrangère*, were found among his papers; these, with *La Paix du Ménage*, a comedy in two acts, and two collections of tales, *Le Père Milon* (1898) and *Le Colporteur* (1899), have been published posthumously. A correspondence, called *Amitié amoureuse* (1897), and dedicated to his mother, is probably unauthentic. Among the prefaces which he wrote for the works of others, only one—an introduction to a French prose version of Mr Swinburne's *Poems and Ballads*—is likely to interest English readers.

Maupassant began as a follower of Flaubert and of M. Zola, but, whatever the masters may have called themselves, they both remained essentially *romantiques*. The pupil is the last of the "naturalists": he even destroyed naturalism, since he did all that can be done in that direction. He had no psychology, no theories of art, no moral or strong social prejudices, no disturbing imagination, no wealth of perplexing ideas. It is no paradox to say that his marked limitations made him the incomparable artist that he was. Undisturbed by any external influence, his marvellous vision enabled him to become a supreme observer, and, given his literary sense, the rest was simple. He prided himself in having no invention; he described nothing that he had not seen. The peasants whom he had known as a boy figure in a score of tales; what he saw in Government offices is set down in *L'Héritage;* from Algiers he gathers the material for *Maroca;* he drinks the waters and builds up *Mont-Oriol;* he enters journalism, constructs *Bel-Ami,* and, for the sake of precision, makes his brother, Hervé de Maupassant, sit for the infamous hero's portrait; he sees fashionable society, and, though it wearied him intensely, he transcribes its life in *Fort comme la Mort* and *Notre Cœur.* Fundamentally he finds all men alike. In every grade he finds the same ferocious, cunning, animal instincts at work: it is not a gay world, but he knows no other; he is possessed by the dread of growing old, of ceasing to enjoy; the horror of death haunts him like a spectre. It is an extremely simple outlook. Maupassant does not prefer good to bad, one man to another; he never pauses to argue about the meaning of life, a senseless thing which has the one advantage of yielding materials for art; his one aim is to discover the hidden aspect of visible things, to relate what he has observed, to give an objective rendering of it, and he has seen so intensely and so serenely that he is the most exact transcriber in literature. And as the substance is, so is the form: his style is exceedingly simple and exceedingly strong; he uses no rare or superfluous word, and is content to use the humblest word if only it conveys the exact picture of the thing seen. In ten years he produced some thirty volumes. With the exception of *Pierre et Jean,* his novels, excellent as they are, scarcely represent him at his best, and of over two hundred *contes,* a proportion must be rejected. But enough will remain to vindicate his claim to a permanent place in literature as an unmatched observer and the most perfect master of the short story. (J. F.-K.)

Mauritius, known also as Isle of France, an island in the south-western portion of the Indian Ocean, 600 miles east of Madagascar, 1500 miles east of the coast of Africa, 20° 10′ S. and 57° 35′ E. Its mineral productions are few and unimportant. The climate of the island cannot be considered very healthy, and there were several very fatal epidemics during the latter half of the 19th century. In common with Réunion, it is exposed to severe and destructive cyclones, but the soil is of considerable fertility, and the greater portion of the level plains is now a vast sugar plantation. Port Louis, the capital, had in 1891 a population of about 70,000, but in 1897 this had diminished to 55,000, a large number of its former inhabitants now living at villages on the railway lines stretching to the north and south of the island. These lines had in 1896 a total length of 105 miles. In recent years extensive explorations have been made in the beds of some of the ancient lakes, and considerable quantities of the bones of the extinct dodo, solitaire, and other short-winged birds, which were almost or quite incapable of flight, have been discovered. Some changes have taken place since 1882 in the governmental arrangements of the island. The Legislative Council now consists of 27 members, 10 being elected, 8 *ex officio,* and 9 nominated by the governor. In 1884–85 a constitutional change was made by the introduction of an elective element into the legislature. Under a moderate franchise ten members are now elected, one for each of the eight divisions of the island, and two for Port Louis.

The following statistics show the revenue and expenditure of the colony:—

	1888.	1898.	1900.
	Rs.	Rs.	Rs.
Revenue .	8,574,058	7,620,320	9,179,975
Expenditure .	7,771,579	8,131,470	8,568,943

At the beginning of 1901 the public debt stood at £1,189,284.

General Trade.

	1888.	1898.	1900.
	Rs.	Rs.	Rs.
Exports . .	32,291,978	27,537,930	30,982,673
Imports . .	15,341,202	24,006,970	22,810,778

British Trade.

	1888.	1898.	1900.
Exports . .	£275,546	£100,863	£232,566
Imports . .	253,928	239,242	377,174

Of the above general trade, the following were the principal items of export:—

	1888.	1898.	1900.
	Rs.	Rs.	Rs.
Sugar value .	28,754,798	24,727,690	28,836,355
Rum ,, .	297,882	85,800	224,086
Cocoa-nut oil ,, .	107,275	59,180	46,479
Vanilla ,, .	311,639	140,100	169,821
Aloe-fibre ,, .	690,858	427,130	940,432

A great change is taking place in the population. Most of Port Louis has passed from Europeans to Hindus or Chinese, and the sugar estates of the island are being similarly transferred. During the 5 years 1896–1900 land to the value of 9,084,490 rupees was purchased by Hindus from Mauritian planters, and since 1864 real property to the value of 24,159,945 rupees. The following are statistics of the population, including all nationalities:—

	1881.	1891.	1901.
Males . .	209,560	207,103	380,040
Females . .	151,287	164,552	
Total . .	360,847	371,655	

Of the above, the Hindu coolie proportion was:—

	1881.	1891.	1901.
	249,064	255,500	261,136

By the census of 1891 the general population, as respects religion, was divided as follows: Hindus (pagan), 209,079; Roman Catholics, 115,438; Mahommedans, 34,763; Protestants, 7307.

Primary education is provided in 75 Government and 98 denominational and aided schools, the number of pupils on the roll in 1900 being 19,481, with an average attendance of 12,235. Secondary education is provided in the Royal College at Curepipe (temporarily), with 169 pupils; the royal college school, at the same place, with 116 pupils; and the royal college school at Port Louis, with 54 pupils. (J. St*.)

Mawkmai (called by the Burmese *Maukmè*), one of the largest states in the eastern division of the southern Shan States of Burma. It lies approximately between 19° 30′ and 20° 30′ N. and 97° 30′ and 98° 15′ E., and has an area of 2787 square miles. The central portion of the state consists of a wide plain well watered and under rice cultivation. The rest is chiefly hills, in ranges running north and south. There is a good deal of teak in the state, but it has been ruinously worked. The Sawbwa now works as contractor for Government, which takes one-third of the net profits. Rice is the chief crop, but much tobacco of good quality is grown in the Langkö district on the Têng river. There is also a great deal of cattle-breeding. The population was estimated in 1892 at 18,693, over two-thirds of whom were Shans and the remainder Taungthu (4502), Burmese (552), Yangsek (445), and Red Karens (312). The Sawbwa pays a tribute of Rs.13,000 for the period 1898–1902. The capital, Mawkmai, stands in a fine paddy plain in 20° 9′ N. and 97° 25′ E. It had about 150 houses when it first submitted in 1887, but was burnt out by the Red Karens in the following year. It has since recovered. There are very fine orange groves a few miles south of the town at Kantu-awn.

Max Müller, Friedrich (1823–1900), Orientalist and comparative philologist, was born at Dessau, 6th December 1823, being the son of Wilhelm Müller, celebrated for his phil-Hellenic lyrics. He lost his father before he had attained his fourth year, but received a very careful education. The elder Müller had endeared himself to the most intellectual circles in Germany by his amiable character and his genuine poetic gift, and it was his son's good fortune to meet in his youth with a succession of eminent friends, who, already interested in him for his father's sake, and charmed by the qualities which they discovered in the young man himself, powerfully aided him by advice and patronage. Mendelssohn dissuaded him from indulging his natural bent to the study of music; Professor Brockhaus of the University of Leipzig, where Max Müller matriculated in 1841, induced him to take up Sanskrit; Bopp, at the University of Berlin (1844), made the Sanskrit student a scientific comparative philologist; Schelling, at the same university, inspired him with a love for metaphysical speculation, though failing to attract him to his own philosophy; Burnouf, at Paris in the following year, by teaching him Zend, started him on the track of inquiry into the science of comparative religion, and impelled him to edit the *Rig Veda;* and when, in 1846, Max Müller came to England upon this errand, Bunsen, in conjunction with Professor H. H. Wilson, prevailed upon the East India Company to undertake the expense of publication. Up to this time Max Müller had lived the life of a poor student, supporting himself partly by copying manuscripts, but Bunsen's introductions to Queen Victoria and the Prince Consort, and to Oxford University, laid the foundation for him of fame and fortune. In 1848 the printing of his *Rig Veda* at the University Press obliged him to settle in Oxford, a step which decided his future career. He arrived at a favourable conjuncture; the Tractarian strife, which had so long thrust learning into the background, was just over, and Oxford was becoming accessible to modern ideas. The young German excited curiosity and interest, and it was soon discovered that, although a genuine scholar, he was no mere bookworm. Part of his social success was due to his readiness to exert his musical talents at private parties. Max Müller was speedily subjugated by the *genius loci.* He was appointed deputy Taylorian professor of modern languages in 1850, and the German Government failed to tempt him back to Strasburg. In the following year he was made M.A. and honorary fellow of Christ Church, and in 1858 he was elected a fellow of All Souls. In 1854 the Crimean war gave him the opportunity of utilizing his Oriental learning in vocabularies and schemes of transliteration. In 1857 he successfully essayed another kind of literature in his beautiful story *Deutsche Liebe*, written both in German and English. He had by this time become an extensive contributor to English periodical literature, and had written several of the essays subsequently collected as *Chips from a German Workshop.* The most important of them was the fascinating essay on "Comparative Mythology" in the *Oxford Essays* for 1856. His valuable *History of Ancient Sanskrit Literature,* so far as it illustrates the primitive religion of the Brahmans (and hence the Vedic period only), was published in 1859.

Professor Max Müller.

(From a photograph by Elliott and Fry, London.)

Though Max Müller's reputation was that of a comparative philologist and Orientalist, his professorial duties at Oxford were long confined to lecturing on modern languages, or at least their mediæval forms. In 1860 the death of Horace Hayman Wilson, professor of Sanskrit, seemed to open a more congenial sphere to him. His claims to the succession seemed incontestable, for his opponent, Monier Williams, though well qualified as a Sanskritist, lacked Max Müller's brilliant versatility, and although educated at Oxford, had held no University office. But Max Müller was a Liberal, and the friend of Liberals in University matters, in politics, and in theology, and this consideration united with his foreign birth to bring the country clergy in such hosts to the poll that the voice of resident Oxford was overborne, and Monier Williams was elected by a large majority. It was the one great disappointment of Max Müller's life, and he never quite recovered from it. It was, nevertheless, serviceable to his influence and reputation by permitting him to enter upon a wider field of subjects than would have been possible otherwise. Directly, Sanskrit philology received little more from him, except in connexion with his later undertaking of *The Sacred Books of the East*, but indirectly he exalted it more than any predecessor by proclaiming its commanding position in the history of the human intellect by his *Science of Language,* two courses of lectures delivered at the Royal Institution in 1861 and 1863. Max Müller ought not to be described as "the introducer of comparative philology into England." Prichard had proved the Aryan affinities of the Celtic languages by the methods of comparative philology so long before as 1831; Winning's *Manual of Comparative Philology* had been published in 1838; the discoveries of Bopp and Pott and Pictet had been recognized in brilliant articles in the *Quarterly Review*, and had guided the researches of Rawlinson. But Max Müller undoubtedly did far more to popularize the subject than had been done, or could have been done, by any predecessor. He was on less sure ground in another department of the study of language—the problem of its origin. His speculations on this subject brought him into collision with the Darwinians, though they were perhaps no more capable than himself of seeing more than one side of the question. He wrote upon it as a disciple of Kant, whose *Critique of Pure Reason* he translated. His essays on mythology are among the most delightful of his writings, but their value is somewhat impaired by a too uncompromising adherence to the seductive generalization of the solar myth.

Max Müller's studies in mythology led him to another field of activity in which his influence was more durable and extensive, that of the comparative science of religions.

Here, so far as Great Britain is concerned, he does deserve the fame of an originator, and his *Introduction to the Science of Religion* (1873—the same year in which he lectured on the subject, at Dean Stanley's invitation, in Westminster Abbey, this being the only occasion on which a layman had given an address there) marks an epoch. It was followed by other works of importance, especially the four volumes of Gifford lectures, delivered between 1888 and 1892; but the most tangible result of the impulse he had given was the publication under his editorship, from 1875 onwards, of *The Sacred Books of the East*, in fifty-one volumes, including indexes, all but three of which appeared under his superintendence during his lifetime. These comprise translations by the most competent scholars of all the really important non-Christian scriptures of Oriental nations, which can now for the first time be appreciated without a knowledge of the original languages. The advantage to the comparative study of religions is unspeakable; considering, indeed, how few are able to read more than one or two Oriental languages, it may be said to have rendered such a comparison for the first time possible. If the positive value of the books thus interpreted proves less than was anticipated, this fact, too, has its useful side. *Omne ignotum* can no longer be taken *pro magnifico*. Max Müller also wrote on Indian philosophy in his latter years, and his exertions to stimulate search for Oriental manuscripts and inscriptions were rewarded with important discoveries of early Buddhist scriptures, in their Indian form, made in Japan. He was on particularly friendly terms with native Japanese scholars, and after his death his library was purchased by the University of Tôkyô.

In 1868 Max Müller had been indemnified for his disappointment over the Sanskrit professorship by the establishment of a chair of comparative philology, to be filled by him. He retired, however, from the actual duties of the post in 1875, when entering upon the editorship of *The Sacred Books of the East*. The most remarkable external events of his latter years were his delivery of lectures at the restored University of Strasburg in 1872, when he devoted his honorarium to the endowment of a Sanskrit lectureship, and his presidency over the International Congress of Orientalists in 1892. But his days, if uneventful, were busy. He participated in every movement at Oxford of which he could approve, and was intimate with nearly all its men of light and leading; he was a curator of the Bodleian Library, and a delegate of the University Press. He was acquainted with most of the crowned heads of Europe, and was an especial favourite with the English royal family. His hospitality was ample, especially to visitors from India, where he was far better known than any other European Orientalist. His distinctions, conferred by foreign governments and learned societies, were innumerable, and, having been naturalized shortly after his arrival in England, he received the high honour of being made a privy councillor. In 1898 and 1899 he published autobiographical reminiscences under the title of *Auld Lang Syne*. He was writing a more detailed autobiography when overtaken by death on 28th October 1900, shortly after he had written, in the *Nineteenth Century*, on the religions of China, and vindicated the British cause in South Africa against Professor Mommsen. Max Müller married in 1859 Georgiana Adelaide Grenfell, sister of the wives of Charles Kingsley and J. A. Froude. One of his daughters, Mrs Conybeare, distinguished herself by a translation of Scherer's *History of German Literature*, but died shortly afterwards.

Though undoubtedly a great scholar, Max Müller did not so much represent scholarship pure and simple as her hybrid types—the scholar-author and the scholar-courtier. In the former capacity, though manifesting little of the originality of genius, he rendered vast service by popularizing high truths among high minds. In his public and social character he represented Oriental studies with a brilliancy, and conferred upon them a distinction, which they had not previously enjoyed in Great Britain. There were drawbacks in both respects: the author was too prone to build upon insecure foundations, and the man of the world incurred censure for failings which may perhaps be best indicated by the remark that he seemed too much of a diplomatist. Vanity and kindred faults may easily be detected in his writings, but the sum of foibles seems insignificant in comparison with the life of intense labour dedicated to the service of culture and humanity. (R. G.)

Maxwelltown. See DUMFRIES.

Mayaguez, a city situated at the west end of Porto Rico, 72 miles west-south-west of San Juan. It was founded in 1752, is the third in population and the most pleasant and most beautiful city of the island. Its streets are wide, shaded, and lined with handsome residences and shops. The public buildings are numerous and commodious, including a cathedral, theatre, the court-house (Ayuntamiento), hospital, barracks, and custom-house. The city has a public library and excellent water works. It is lighted by electricity, and until recently possessed the only tramway on the island. Mayaguez Playa, where the shipping is carried on, as at Ponce, is about three miles from the main city. Much coffee is exported. Population (1899), about 15,187.

Mayavaram, a town of British India, in the Tanjore district of Madras, on the Cauvery river; junction on the South Indian railway, 174 miles south of Madras. Population (1891), 23,765; municipal income (1897–98), Rs.35,830. It makes a speciality of the fine cotton cloth known as Kornad from the suburb in which the weavers live. The municipal high school had 417 pupils in 1897–98.

Maybole, a burgh of barony and police burgh of Ayrshire, Scotland, 9 miles south by west of Ayr by rail. The four principal boot factories employ 1700 hands, and the trade of 1899 made a record. The manufacture of agricultural implements is also a staple industry. The municipal buildings are modern. One of the public schools has a secondary department. Population (1881), 4474; (1901), 5892.

Mayen, a town of Prussia, in the Rhine province, on the east side of the Eifel, 16 miles west of Coblenz. It has lava and slate quarries, various textile industries, tanneries, oil and flour mills, and tobacco factories. It has fragments of its mediæval walls, and a mediæval keep (restored in 1893–94). Population (1885), 8440; (1900), 11,961.

Mayence. See MAINZ.

Mayenne, a department of the north-west of France, watered by the Mayenne.

Area, 1987 square miles. The population, 340,063 in 1886, numbered 311,207 in 1901. Births in 1899, 7003, of which 290 were illegitimate; deaths, 6851; marriages, 2362. There were in 1896, 626 primary schools, with 45,000 pupils, 5 per cent. of the population being illiterate. The land under cultivation amounted in 1896 to 1,183,677 acres, 889,611 acres being plough-land and almost all the rest grass land. The wheat crop of 1899 was valued at £1,200,000; meslin, £156,000; barley, £472,000; oats, £320,000; buckwheat, £120,000; potatoes, £148,000; mangold-wurzel, £232,000. Natural pastures yielded £532,000; hemp, £11,000; flax, £6400; apples, £168,000. The live stock included 78,550 horses, 292,080 cattle, 72,660 sheep, and 76,360 pigs. Mining in 1898 produced only 35,000 metric tons of coal. Spinning at Laval and at Château-Gontier is the only industry of a department which is almost exclusively agricultural. Laval, the capital, had in 1901 30,356 inhabitants.

Mayenne, chief town of arrondissement and railway station, department of Mayenne, France, 18 miles north by east of Laval. A statue of Joan of Arc was erected in 1896. The "cloth" manufacture consists of tickings, linens, handkerchiefs, and calicoes. There is a departmental asylum, and a practical school of agriculture about three miles from the town. Population (1891), 7386; (1901), 10,125.

Mayhew, Henry (1812–1887), English author, son of a London solicitor, was born in 1812. He began to study law under his father, but soon gave it up for writing. With Gilbert à Beckett, in 1831, he started the first of several ephemeral papers, which introduced him to journalism; and he had a fairly successful opening with one or two farces. His brothers HORACE (1816–1872), and AUGUSTUS SEPTIMUS (1826–1875), also took to authorship, and with them Henry occasionally collaborated, notably with the younger in stories like *The Greatest Plague of Life* (1847), and in *Acting Charades* (1850). In 1841 Henry Mayhew was one of the leading spirits in the foundation of *Punch*, of which he was for the first two years joint-editor with Mark Lemon. He afterwards figured as a writer on all kinds of subjects, and published a number of volumes of no permanent reputation—humorous stories, travel, practical handbooks, and journalism of various sorts. He is credited with being the first to "write up" the poverty side of London life from a philanthropic point of view; with the collaboration of other writers he published *London Labour and London Poor* (1851; completed 1864) and other works on the subject, which had considerable influence at the time. He died in London, 25th July 1887. HORACE MAYHEW also contributed to *Punch* up to 1852, and was the author of several humorous publications and plays. Both his and his brother Augustus's volumes were enriched by Cruikshank's illustrations, and their survival is mainly due to that.

Mayo, a maritime county of Ireland, province of Connaught.

Population.—The area of the administrative county in 1900 was 1,327,777 acres, of which 157,279 were tillage, 534,764 pasture, 429 fallow, 8870 plantation, 278,151 turf bog, 44,517 marsh, 232,644 barren mountain, and 71,123 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, includes two electoral divisions formerly situated in Galway, and three electoral divisions formerly situated in Sligo, but is diminished by two electoral divisions now added to other counties. The population in 1881 was 245,212, in 1891, 219,034, and in 1901, 202,627, of whom 99,058 were males and 103,569 females, divided as follows among the different religions:—Roman Catholics, 198,014; Protestant Episcopalians, 3757; Presbyterians, 562; Methodists, 166; and other denominations, 128. The decrease of population between 1881 and 1891 was 10·68 per cent., and between 1891 and 1901, 7·3 per cent. The average number of persons to an acre was ·16 in 1891 and ·15 in 1901. Of the total population in 1891, 207,754 persons inhabited the rural districts, being an average of 191 persons to each square mile under crops and pasture. The following table gives the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R.C.	Pr.Ep.	Presb.	Meth.
Read and write	57,401	53,673	111,074	56·1	88·8	93·4	94·5
Read only .	10,118	11,349	21,467	11·2	5·8	3·3	3·5
Illiterate .	27,848	34,661	62,509	32·7	5·4	3·3	2·0

The percentage of illiterates among Roman Catholics in 1881 was 45·9. In 1891 there were three superior schools with 251 pupils (Roman Catholics 233, and Protestants 18), and 410 primary schools with 30,840 pupils (Roman Catholics 30,008, and Protestants 832). The number of pupils on the rolls of the National schools on 31st December 1900 was 37,402, of whom 36,707 were Roman Catholics and 695 Protestants.

The following table gives the number of births, deaths, and marriages in various years:—

Year.	Births.	Deaths.	Marriages.
1881	6013	3277	844
1891	5058	3339	703
1900	4491	2817	808

In 1900 the birth-rate per thousand was 22·2, and the death-rate 13·9; the rate of illegitimacy was ·3 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 164,291, of whom 74,924 were males and 89,367 females. The chief towns in the county are Ballina, Westport, and Castlebar.

Administration.—The county is divided into four parliamentary divisions—North, South, East, and West, the number of registered electors in 1901 being respectively 7655, 8412, 8204, and 8412. The rateable value in 1900 was £318,829. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises three urban and eight rural sanitary districts.

Agriculture.—The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900. The figures for 1900 are for the new administrative county:—

Year.	Wheat.	Oats.	Barley, Flax, Beans, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	1046	62,830	3717	56,728	8427	3856	42.739	179,343
1891	1700	45,326	3582	43,473	7695	3881	48,020	153,677
1895	1112	44,234	3021	42,144	7904	4547	59,310	162,272
1900	1211	40,341	3339	39,104	6825	5480	61,079	157,379

In 1900 the total value of the cereal and other crops was estimated at £1,091,683. The number of acres under pasture in 1881 was 545,040, in 1891, 547,279, and in 1900, 534,764.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	21,293	20,424	166,527	251,108	48,216	6122	677,610
1891	18,718	23,866	174,983	351,343	53,316	8979	751,992
1895	21,190	23,623	180,830	308,148	67,854	7855	775,800
1900	19,479	24,418	191,497	361,978	74,746	8486	917,657

The number of milch cows in 1891 was 52,710, and in 1900, 57,432. Mayo supports more sheep than any other county in Ireland except Galway. It is estimated that the total value of cattle, sheep, and pigs for 1900 was £3,343,604. In 1900 the number of holdings not exceeding 1 acre was 2104; between 1 and 5, 3490; between 5 and 15, 15,180; between 15 and 30, 9544; between 30 and 50, 2905; between 50 and 100, 1690; between 100 and 200, 751; between 200 and 500, 459; and above 500, 198—total, 36,341. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901 was 759, amounting to £193,273. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1901, was 986, and the amount issued was £63,649. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £232,761.

Fisheries.—The number of boats registered in 1900 in the deep-sea and coast fishing districts of Keel, Belmullet, and Ballycastle was 485, employing 2449 hands. The number of persons employed in the same year in the salmon-fishing district of Ballina was 450. (W. H. PO.)

Mayotte. See COMORO ISLANDS.

Maysville, a city of Kentucky, U.S.A., capital of Mason county, on the Ohio river, in the north-eastern part of the state, at an altitude of 511 feet. It is on the Chesapeake and Ohio and the Louisville and Nashville railways, in a farming region, and has varied manufactures. Population (1890), 5358; (1900), 6423, of whom 237 were foreign-born and 1155 were negroes.

Mazagan (*El Jadîda*), the port for Marrákesh (from which it is 110 miles nearly due north), Morocco. It does a considerable grain and wool trade. It was built by the Portuguese in 1509, and abandoned by them in 1769, the inhabitants settling at New Mazagan, in Brazil. There are European merchants, vice-consuls, and missionaries. The exports increased from £125,416 in 1896 to £360,577 in 1900, and the imports from £156,866 in 1896 to £281,690 in 1900. The port was cleared in the same two years by totals of 130,883 and 189,013 tons respectively. Population, about 10,000.

Mazamet, a town in the arrondissement of Castres, department of Tarn, France, 33 miles in direct line south-south-east of Albi, on the railway from Castres to St Pons. Manufacturing activity has greatly increased, and now includes important tanneries and leather-dressing works. About 10 establishments are employed in wool-spinning, and 22 in the manufacture of "swanskins" and flannels. The total annual value of manufactured products is about £800,000. Extensive commerce is carried on in wool and raw hides from Argentina, Australia, and Cape Colony. There is a large model dairy. Population, about 10,000.

Mazarron, a town of Spain, in the province of Murcia, to the east of Cartagena, four miles from the coast. Its population was in 1887, 16,454, and in 1897, 17,047. There are soap and flour mills and metallurgic factories. The mountains near contain rich beds of iron and lead ores, in working which one company employs 1200 workmen. A railway five miles long unites Mazarron to the port, where there is a suburb with 2500 inhabitants (mostly engaged in fisheries and coasting trade). There are barracks, a custom-house, and important lead works. Outside of the suburb there are salt-pans, most of the proceeds of which are exported to Galicia. The total output of the Mazarron lead mines in 1898 was nearly 87,000 tons. About 450 vessels visit the port annually, importing chiefly coal, machinery, timber, salt fish, and flour, and exporting iron ore, copper, and argentiferous lead. The total imports in 1898 amounted to 40,968 tons, and the total exports to 50,120 tons. The trade is largely with Great Britain.

Mazatlan, a town and port of Mexico, in the state of Sinaloa, on the Pacific. It is the leading commercial and industrial Mexican town on the Pacific, and is a port of call of several steamship lines. It has a weather bureau, a fine custom-house and other public buildings, also tramways and a chamber of commerce. The depth of water on the bar varies from 12 to 15 feet. Population (1895), 15,852.

Meade, George Gordon (1815–1872), American soldier, was born in Cadiz, Spain, 31st December 1815. Graduating at the United States Military Academy in 1835, he served in Florida in the 3rd United States Artillery against the Seminoles. Resigning from the army in 1836, he became a civil engineer and constructor of railways, and was soon engaged under the War Department in the survey of the Delta of the Mississippi. In 1842 he was appointed a lieutenant in the corps of the topographical engineers. In the war with Mexico he was successively on the staff of General Zachary Taylor, General William J. Worth, and General Robert Patterson, and was brevetted for gallant conduct. Until the Civil War he was engaged mainly on the lighthouse board and in the survey of the North-Western Lakes, of which he had charge, having reached the rank of captain of topographical engineers. He was considered a conservative, scientific, and highly intellectual engineer, and had proved himself a model officer in the field and under fire. In 1861 he was appointed a brigadier-general in the United States Volunteers, and had command of the 2nd Brigade of the Pennsylvania Reserves in the army of the Potomac under General M'Call. He was in the battles of Mechanicsville and Gaines's Mills, and being severely wounded at the advance at New Market Cross-Roads on the day before the battle of Malvern Hill, he was absent from his command until the second battle of Bull Run, after which he obtained the command of the Reserve Division. At the battle of South Mountain he distinguished himself by his skill and intrepidity, and when General Joseph Hooker was wounded he succeeded to the command of the 1st corps of the army on the field of battle. He was especially mentioned for the services of his command at the battle of Fredericksburg, and was promoted to the rank of major-general.

In December he was placed in permanent command of the fifth army corps. At the battle of Chancellorsville he displayed great intrepidity and energy, and a thorough comprehension of the situation, and was appointed to the command of the army of the Potomac in June 1863, on the eve of the Gettysburg campaign. The details of the problem he was now called upon to solve could not have been known to him in his previous subordinate position, but he justified the confidence which the better class of officers had always reposed in him. Upon ascertaining the position of the enemy he at once made dispositions to concentrate upon Gettysburg. In the famous three days' battle that followed, General Meade's plan proved to be the best possible in the circumstances, forcing the Confederates to attack the well-chosen Union position. In the result Meade with 84,000 men defeated the army of General Lee, numbering very nearly the same as the active portion of his own army, one of his corps not being engaged. Lee retreating to the Potomac, Meade followed by a longer route and proposed to attack on the morning of 14th July, but the enemy crossed the river during the night. Meade was the first Union commander to defeat Lee in the open field, and his victory was the turning-point of the war. He was rewarded with the commission of brigadier-general in the regular army. Until Lee's surrender at Appomattox Court House, Meade commanded the army of the Potomac. His manœuvres, when Lee attempted to pass to his right and obtain the position between him and Washington, were masterful; and the actions of Bristoe Station, Kelley's Ford, and Rappahannock Station, and the operations at Mile Run increased the confidence with which his army regarded him. Grant, commanding all the armies of the United States, joined the army of the Potomac in the spring of 1864, and remained with it until the end of the war; but he continued Meade in his command, and successfully urged his appointment as major-general in the regular army (18th August 1864), eulogizing him as the commander who had successfully met and defeated the best general and the strongest army on the Confederate side. After the war Meade commanded the military division of the Atlantic and the Department of the East until August 1868. He then took command of the military districts embracing Georgia and Alabama, and then of the Department of the South, comprising the same states together with South Carolina and Florida. At the time of his death he was in command of the military division of the Atlantic. He died at Philadelphia, 6th November 1872, of pneumonia, which was aggravated by complications resulting from the wound he received at New Market Cross-Roads in 1862. The degree of LL.D. was conferred upon him by Harvard University, and his scientific attainments were recognized by the American Philosophical Society and the Pennsylvania Academy of Natural Sciences.

(A. S. W*.)

Meadville, a city of Pennsylvania, U.S.A., capital of Crawford county, on French Creek, in the north-western part of the state, at an altitude of 1078 feet. It is on the Erie, and the Pittsburg, Bessemer and Lake Erie railways, and its manufactures are varied. It is the seat of Allegheny College, a Methodist Episcopal institution, which in 1899 had 16 instructors and was attended by 299 students, including 111 women. Population (1890), 9520; (1900), 10,291, of whom 912 were foreign-born and 173 were negroes.

Measuring Instruments, Electric.—In all departments of electrical engineering, and in the applications of electrical science in the arts and industries, it is necessary to be able to make exact measurements of the electric quantities with which we are concerned. These are stated in certain units (see Electricity, IV.), and are practically ascertained by appliances called electric measuring instruments, which may be divided into various species and types, according to the nature of the measurement to be made and the scientific fact or principle on which they depend. They may be classified thus:—

(*a*) *Electric current* measuring instruments, or Amperemeters.
(*b*) *Electric potential* „ or Voltmeters.
(*c*) *Electric power* „ or Wattmeters.
(*d*) *Electric resistance* „ or Ohmmeters.
(*e*) *Electric energy* „ or Ergmeters.
(*f*) *Electric quantity* „ or Coulombmeters.

The last two classes include the chief types of electric house-meters. In addition, there are forms of instrument especially employed in connexion with alternating-current measurements, such as those for determining the *wave form* of periodic currents (see Electricity, III., and Electricity Supply, II.), and those for determining the *frequency* and *power-factor* of alternating or periodic currents. We may then furthermore divide all the above instruments into various types, depending on their principles of construction, namely, (i.) *Electrodynamic*, (ii.) *Electromagnetic*, (iii.) *Electrothermal*, (iv.) *Electrostatic*, (v.) *Electrochemical*.

Amperemeters.

Instruments of each species can be made in some or all of the five types. Thus, for instance, current-measuring instruments may be electrodynamic, electromagnetic, or electrothermal, but not entirely electrostatic; whilst potential-measuring instruments may be of all the above types. Current-measuring instruments may be additionally divided into (1) *galvanometers* and (2) *amperemeters* or *ammeters*. Galvanometers are instruments that simply indicate the value of an electric current in some arbitrary units, whereas amperemeters or ammeters indicate its value directly in practical units or amperes. Under the head of electrodynamic current-measuring instruments are included such instruments as Siemens's electrodynamometer, Lord Kelvin's ampere-balances, and various other forms of Weber's electrodynamometer; under electromagnetic current-measuring instruments, those of Weston, Evershed, Nalder, Dobrovolsky, and others; and under electrothermal current-measuring instruments those of Hartmann and Braun, Holden and Cardew. An important class of current-measuring instruments may be called *potentiometer ammeters*. In these instruments the current to be measured is passed through a strip of metal of low resistance, and the fall in potential down this resistance is measured by a suitable voltmeter or potential-measuring instrument. The value of the current is deduced from the numerical quotient of the fall in potential by the resistance.

In the Siemens dynamometer (Fig. 1) there are two coils of wire, one fixed (F) and the other (D) suspended by a bundle of silk fibres; the suspended coil embraces the fixed coil, and has its axis at right angles to it. The movable coil is attached to a fixed torsion head through a steel spiral spring (S), and carries an index-needle (I). The torsion head is provided with a circular scale of degrees. The terminals of the movable coil dip into fixed mercury cups (M M), by means of which one and the same current can be sent through the fixed and movable coils, or, for some uses of the instrument, different currents may be sent through the two coils. In any case the mechanical forces brought into play depend upon the product or mean product of the values of the currents in the two coils. If, for instance, the same current is passed through the coils in series, the movable coil tends to twist round so that its axis comes more into line with that of the fixed coil, which can be brought back to its original position by applying to the torsion head (T) a twist, and thereby twisting the top end of the spiral spring. The angle through which T must be twisted to do this is proportional to the torque or couple thereby applied to the movable coil, and this couple is proportional to the square of the strength of the current flowing through the coils. Hence the square root of the twist given to the torsion head, multiplied by a constant, will be numerically equal to the value of the current in amperes. Since the direction of the force is not altered by reversing the direction of the current, the instrument is suitable for measuring alternating currents, provided that the time of free vibration of the movable coil is large compared with the periodic time of the current. Under these last conditions, however, when the same current traverses both coils, the instrument measures the square root of the mean of the equidistant values of the current during the cycle, or, as it is generally called, *the root-mean-square* (*R.M.S.*) *value* of the current. If two currents differing in phase but identical in frequency are passed through the two circuits, then the torque is proportional to the mean value of the product of the instantaneous values of the currents.[1]

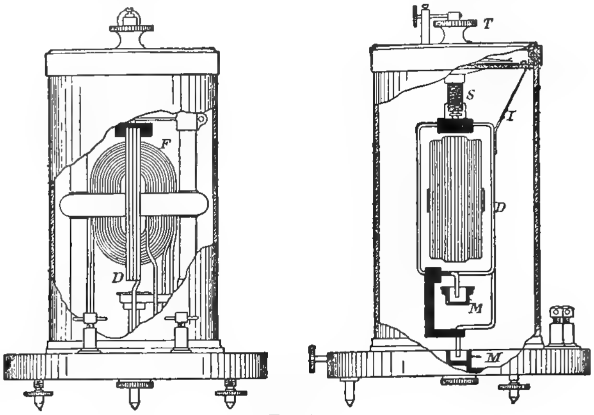

Fig. 1.

The details of Lord Kelvin's ampere-balances are described under Electricity, III., and it may therefore here simply be mentioned that these instruments are practically electrodynamometers, in which a movable coil is displaced relatively to a fixed coil when the same current passes through them both, and the coils are brought back to their original position by the application of a torque or couple due to the position of a weight sliding along a scale attached to the movable coils.

One of the most convenient of the electromagnetic current-measuring instruments is the ammeter devised by Weston. In this there is a fixed permanent magnet prepared of a special steel, and so treated as to possess a very constant interpolar field. Between the poles of this magnet is placed a small circular coil fixed to an axis which is carried in jewelled bearings like those of a watch. The current is passed into and out of this coil by small and very flexible wires. The coil is constrained to take up a definite position by means of a fine spiral steel spring, and it carries an index-needle moving over a scale of degrees. The normal position of the coil is with its plane parallel to the direction of the magnetic field, but when a current passes through the coil it is deflected against the controlling couple due to the spring, and takes up a definite position in accordance with the value of the current. The scale of the instrument is graduated to show the value of this current directly in amperes or milliamperes. One advantage of these Weston movable coil instruments is that the scale divisions for equal increments of current are very nearly equal, and, moreover, there is no dead or non-divided part of the scale. They are exceedingly useful for the measurement of continuous currents varying from a centiampere up to one or two deciamperes, and for the measurement of larger currents a resistance is included which shunts part of the current so that only a definitely-selected portion of it goes through the movable coil. They have, however, the disadvantage that they can only be used for continuous and unidirectional currents, and not for alternating currents.

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[1] There are many electric measurements which can be effected by employing the two circuits, fixed and movable, of the electrodynamometer separately, and passing through them two alternating currents differing it may be in phase. For details of such measurements and use of the instrument the reader is referred to a treatise on *Alternating Currents of Electricity*, by T. H. Blakesley, 2nd ed., chap. xi., London, 1899; also to a valuable paper by Prof. H. A. Rowland in the *American Journal of Science*, December, 1897, or *Electrician*, vol. xl. p. 251.

The construction of a number of instruments used for the commercial measurement of electric currents depends upon the fact that a small mass of iron placed in a non-uniform magnetic field tends to move from places of weak to places of strong field. If a circular coil of insulated wire is placed with its plane vertical and axis horizontal, and if a small mass of iron is suspended from a pivoted arm so as to occupy a position somewhere near the centre of the coil, then when the coil is traversed by a current the iron will move from the position near the centre of the coil, where the field is weak, to a position near the inner surface of the coil, where the field is stronger. This motion can be resisted by the weight of the iron, and its movement indicated by the needle attached to the axis of rotation. In this manner an instrument can be constructed in which there is a definite position for the needle corresponding to every stated value of the current through the coil. Another method is to place a cylindrical coil or helix of wire in a vertical position, and so arrange a small piece of soft iron, balanced upon a pivoted arm, that it is situated near the mouth of the coil when no current is passing, but is drawn more or less into the coil when the current is started. Of such form are the amperemeters devised by von Dobrovolsky and others. A movable iron mass may be arranged to be drawn in between two fixed pieces of iron placed in the field of a fixed coil, as in the case of the instruments of Evershed.

Another large class of ammeters depend for their action upon the heating effect of the current. If a fine wire or number of fine wires joined in parallel are traversed by a current, they become heated. If they are contained in an enclosure which is kept at a constant temperature, the temperature of the wires will rise until the rate at which they lose energy by radiation is equal to the rate at which energy is dissipated in them by the current. The temperature will then remain constant, and can be measured by the linear elongation of the wire or wires if one end is fixed and the other end arranged to move an indicating device. Alternatively, both ends of the wire may be fixed, and the extent to which it sags on expansion may be measured by some suitable indicating gear, as in the instruments of Hartmann and Braun.

By far the most satisfactory method of measuring continuous currents is that involving the use of a *potentiometer* and a low resistance. An essential requisite in every electric laboratory is a set of strips of metal composed of some alloy not altering its resistance greatly with temperature (see ELECTRICITY, I.). These strips are cut and formed so as to have a resistance between two particular terminals, called *potential terminals*, of a known low value, such, for instance, as one-tenth, one-hundredth, or one-thousandth of an ohm. These are technically termed low-resistance strips. By means of the potentiometer and a Clark cell the difference of potential between the potential terminals of such a strip may be measured when a continuous current is flowing through it. The value of the current in amperes is then given by the quotient of this difference of potential in volts divided by the resistance of the strip in ohms. For measuring very large currents these resistance strips may consist of tubes of manganin cooled by water flowing through them. In this manner a very high current density can be employed. The advantage of using resistance strips for the measurement of continuous currents is that the voltmeter or potentiometer part of the instrument need not be in close proximity to the resistance strip. Thus the whole current passing out of a continuous-current generating station can be passed through a strip of platinoid of appropriate size and known resistance, and the current value determined by measuring with a suitable voltmeter the fall of pressure down the strip, the voltmeter being placed a mile away if necessary.

A good amperemeter should, in the first place, if possible, be suitable for use both with continuous currents and alternating currents. In the next place, its indications should be the same for the same true current value whether it has been just previously employed for measuring another larger current or not. In the third place, the scale divisions should, if possible, be equal, so that increments of currents correspond to equal scale movements of the indicating needle; and fourthly, the correctness of its indications should not be affected by any heating effect of the current in the coils, or by the presence of external magnetic field. These requirements are seldom, if ever, complied with in the same instrument. In all *gravity* instruments, in which the controlling force is a couple due to a weight, a correction is necessary for the latitude of the place at which the apparatus is used. The value of the acceleration of gravity is about one-half per cent. greater at the poles of the earth than at the equator, the value of g in centimetres per second squared being 978·1 at the latter and 983·1 at the former. Hence a gravity instrument standardized and made correct for use in London would show an error of about one-quarter per cent. if used at the equator or North Pole. Again, in all instruments which depend upon the employment of soft iron moving in a magnetic field there is generally a *hysteresis* error, which will exhibit itself if two readings are taken with the same small current, but a reading with a very large current interpolated. A hysteresis error is indicated if the scale readings of the instrument are not the same when a series of currents in ascending magnitudes are passed through the instrument, and then the same currents in descending magnitudes, the reason being that the small mass of iron becomes magnetized and does not immediately demagnetize itself. Again, ammeters having a fixed permanent field magnet are affected by the action of stray magnetic fields; and this is also the case with dynamometer instruments like that of Siemens, which are liable to give inaccurate measurements of continuous currents owing to the influence of the horizontal magnetic field of the earth. A Siemens dynamometer, therefore, when being used with a continuous current should always be placed with the axis of the movable coil in the direction of the magnetic meridian, since the passage of a current through the movable coil does not then tend to disturb its position, apart from the effect produced by the field of the fixed coil.

Voltmeters.

Many of the above types of instruments can be employed as *Voltmeters* or *Potential Measuring Instruments* if they are wound with a wire of high resistance. To measure the difference of potential between two places we may measure the current which flows through a circuit of high resistance connecting these places, but it is an essential condition that the potential difference shall not be sensibly disturbed by such shunted current. Hence a voltmeter depending upon the flow of an electric current through the instrument, whether it be of the electrodynamic, electromagnetic, or electrothermal type, must be constructed with coils of wire having a resistance of several hundred, or preferably several thousand, ohms. Well-known types of voltmeters, corresponding to the Weston, Nalder, Dobrovolsky, and Evershed ammeters, are in use. It is preferable, however, when possible, to employ an electrostatic voltmeter. If two metal surfaces are kept at different potentials, there is a stress or mechanical force between them, drawing them together, which is proportional, other things being equal, to the square of the difference of potential. Hence the force required to maintain the plates in their original position is a measure of their difference of potential. Taking advantage of this principle, many well-known inventors have devised ingenious forms of *electrostatic voltmeters*. One of the best known of these is Lord Kelvin's multicellular voltmeter.

In this instrument (Fig. 2) there are two sets of fixed metal plates (F), connected together and having a quadrantal shape, that is, approximately the shape of a quarter of a circular disc. In the centre between them is suspended a "needle" (V), which consists of a light aluminium axis, to which are affixed a number of paddle-shaped aluminium blades. This needle is suspended by a fine platinum silver wire (W), and its normal position is such that the aluminium paddle blades are just outside the quadrantal-shaped plates. If the needle is connected to one terminal of a circuit, and the fixed plates or cells to the other member of the circuit, and a difference of potential is created between them, then the movable needle is drawn in so that the aluminium blades are more included in the fixed plates. This movement is resisted by the torsional rigidity of the suspending wire, and hence a fixed indicating needle attached to the movable system can be made to indicate directly on a scale the difference of potential between the terminals of the instrument in volts. Instruments of this kind have been constructed not only by Lord Kelvin, but also by Professor Ayrton and others, for measuring voltages from 10,000 volts down to one volt. They have the advantage of taking up no power, whereas an electromagnetic voltmeter, or one of any type depending on the flow of an electric current through it, if maintained permanently in connexion with a circuit, involves considerable expenditure of power. Take, for instance, an electrothermal voltmeter, such as the Cardew voltmeter, in which potential difference is measured by observing the elongation produced by the passage of current in a wire connected to the two points between which exists the difference of potential to be measured. Suppose that the wire has a resistance of 300 ohms, and is connected to two places differing in potential by 100 volts, the instrument then passes a current of one-third of an ampere, and takes up 33 watts in power. Since there are 8760 hours in a year, this instrument, if connected continuously to the circuit, would take up energy equal to 263,000 watt-hours, or 263 Board of Trade units per annum. If the production value of this energy is 1d. per unit, the working expenses of such a voltmeter are more than £1 per annum, and their capitalized value is about £10. Hence the advantage of an electrostatic instrument which takes up no power. Moreover, since the electrostatic instruments depend essentially upon the square of the difference of potential, their indications are irrespective of the sign of the difference of potential, and they can therefore be used for alternating as well as continuous currents.

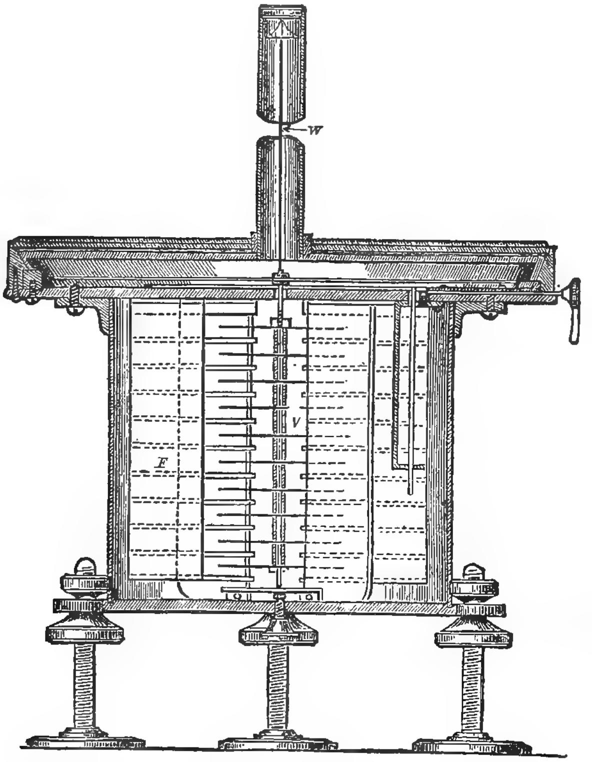

Fig. 2.

Potentiometers.—For the exact measurement of difference of potential when continuous, no instrument is more convenient than the *potentiometer*. The places whose difference of potential is to be measured must be connected by a long fine-wire circuit of high resistance, preferably of platinoid, and wound non-inductively. This must be divided into sections, the ratio of the resistance of which is accurately known. In its commercial form the instrument consists of a series of resistance coils (*r*), generally joined in series with a uniform wire (*ab*) stretched over a scale (Fig. 3). The terminals of this resistance are connected to one or two secondary cells (B), an additional variable resistance (R) being interposed in the circuit. The current through this resistance is then adjusted so that the fall in potential down the wire has a known value, equal say to one-thousandth of a volt per centimetre of the uniform scale wire. This is achieved in the following manner :—A high-resistance galvanometer (G), which may preferably be of the movable coil type, has placed in series with it a Clark standard cell (C), and the two are connected as a shunt on the potentiometer circuit. Over the slide wire a contact-maker is arranged so that contact may be made at any point on the scale. Let this be placed first at *x* so that the scale reading corresponds with the value of the electromotive force of the Clark cell at the temperature at which the experiment is made. Thus the resistance wire of the potentiometer, *e.g.*, in Crompton's form, may consist of 14 coils of wire and of a slide wire equal in resistance to one of them, the scale under the wire being divided into a thousand parts. Taking the electromotive force of a Clark cell at 15° C. as equal to 1·4340 volts, the contact-maker on the slide wire is set to make contact at the 340th division on the wire, and the other terminal of the galvanometer circuit is connected to the end of the potentiometer wire. If then the current through the potentiometer wire is adjusted until the galvanometer shows no current, the fall in potential down the slide wire will be one-ten-thousandth of a volt for each scale division. We may then measure any other potential difference by substituting for the Clark cell a known fraction of the fall in potential down the high-resistance wire above mentioned, which is connected in between the two points the difference of potential of which is required. For example, if it is desired to measure a difference of potential of the order of 100 volts, a high resistance consisting of a wire of 100,000 ohms may be connected between the two terminals. This wire should be divided into two sections, resistances of which are in the ratio of 9 to 1, 99 to 1, or 999 to 1. From the ends of one of the smaller sections two wires are brought to the potentiometer, and connected in place of the Clark cell. By moving the contact-maker along the slide wire until the galvanometer shows no current, we can read off directly on the potentiometer scale the value of a known fractional part of the difference of potential which is to be measured, namely, one-tenth, one-hundredth, or one-thousandth, according to the fraction of the divided resistance employed. The potentiometer and the divided resistance constitute a sort of electrical scale-yard, by means of which any electromotive force or difference of potential can be compared with the electromotive force of a standard cell. Very convenient practical forms of potentiometer have been devised by Crompton, Nalder, Elliott Brothers, and Fleming.

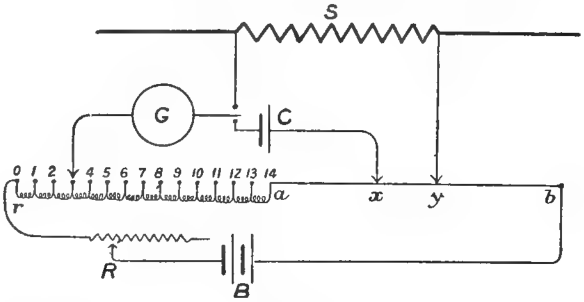

Fig. 3.

Standard Cells.—In addition to the Clark standard cell above mentioned, the elements of which are mercury and zinc separated by a paste of mercurous sulphate mixed with a saturated solution of zinc sulphate, other voltaic standards of electromotive force are in use, such as the Weston cadmium cell, the Helmholtz calomel cell, and the standard Daniell cell. The Clark cell is made in two forms, the Board of Trade or tubular form, and the H form of cell devised by Lord Rayleigh. The German experts seem to favour the latter form ; the specification issued by the Physikalisch-Technische Reichsanstalt of Berlin may be found in the *Electrician*, vol. xxxi. pp. 265–266. The electromotive force of the cell diminishes with rise of temperature, the Board of Trade value being 1·434 volts at 15° C.[1] and 1·434 $(1 - 0{\cdot}00077\,(t - 15))$ volts at t° C. A more exact expression is obtained if instead of 0·00077 the quantity $0{\cdot}00078 + 0{\cdot}000017\,(t - 15)$ is used. In the Weston standard cell cadmium and cadmium sulphate are substituted for zinc and zinc sulphate ; it has the advantage of a much smaller coefficient of temperature variation than the Clark cell. It is most conveniently made up in a glass vessel of H form, pure mercury and cadmium amalgam being the two elements (Fig. 4), and when made as directed below it has at t° C. an electromotive force E_t volts, such that

$$E_t = 1{\cdot}019\ [3{\cdot}8 \times 10^{-5}\,(t - 20) - 0{\cdot}065 \times 10^{-5}\,(t - 20)^2].$$

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[1] According to K. Kahle and W. Wien, the electromotive force of the H form of Clark cell is 1·4322 volts at 15° C.

After the platinum wires have been sealed through the glass, a little aqua regia is placed in the cell legs until bubbles of gas arise from the platinum, when it is thrown out and replaced by a solution of mercurous nitrate. Then by the use of another piece of platinum as anode, mercury is electrolytically deposited upon the platinum, which may also be amalgamated by making it white hot in a Bunsen flame and plunging it in mercury. To prepare the cadmium amalgam, one part of pure cadmium is dissolved in six parts of pure mercury, and the product while warm and fluid is placed in one limb of the cell and warmed, to ensure perfect contact with the platinum wire. The cadmium sulphate solution is prepared by digesting a saturated solution of cadmium sulphate with cadmium hydroxide to remove free acid, care being taken not to raise the temperature above 70° C., and then by digesting it still further with mercurous sulphate until no more precipitation occurs. The cadmium sulphate solution must be saturated and have free crystals of the salt in it. The mercurous sulphate must be free from acid, and made neutral by triturating with finely-divided mercury. In making the paste, so much cadmium sulphate must be added that a saturated solution of that salt is formed and is present in the cell. The cell has the electromotive force above stated if the amalgam of cadmium has from 6 to 13 parts of mercury to 1 of cadmium. The German investigators seem to have a great preference for the H form of cell, but it is clear that a narrow tubular cell of the British Board of Trade form not only comes more quickly to the temperature of the water bath in which it is placed, but is more certain to be wholly at one temperature.

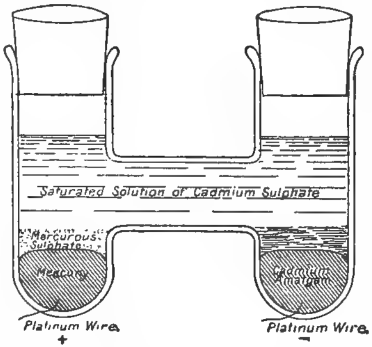

Fig. 4.

In cases when great accuracy is not required, a Daniell cell can be used as a standard of electromotive force. The form designed by J. A. Fleming (*Phil. Mag.* vol. xx. p. 126) consists of a **U** tube, one leg of which contains a rod of pure amalgamated zinc, and the other a rod of freshly-electrotyped copper. The legs are filled with solutions of zinc sulphate and copper sulphate, the zinc rod being in the zinc sulphate and the copper rod in the copper sulphate. When so made, the cell has an electromotive force of 1·072 volts and no sensible temperature variation. The solutions are made by dissolving the purest recrystallized sulphate of copper and sulphate of zinc in distilled water. For the zinc solution, take 55·5 parts by weight of crystals of zinc sulphate ($ZnSO_47OH_2$) and dissolve in 44·5 parts by weight of distilled water; the resulting solution should have a specific gravity of 1·200 at about 20° C. For the sulphate of copper solution, take 16·5 parts by weight of pure crystals of copper sulphate ($CuSO_45OH_2$) and dissolve in 83·5 parts by weight of water; the resulting solution should have a specific gravity of 1·100 at 20° C. The solutions should be adjusted exactly to these densities and kept in stock bottles, from which the reservoirs of the cell should be filled up as required.

Watt-meters.

Instruments for the measurement of electric power are called *wattmeters.* The electric power taken up in a circuit traversed by a continuous current is measured in watts by the product of the current flowing through the circuit in amperes, and the difference of potential between the extremities of the circuit measured in volts. If the current is alternating, and the circuit is truly non-inductive or approximately inductionless, the mean value of the power taken up in the circuit is obtained by multiplying together the root-mean-square value of the current and the root-mean-square value of the potential difference. If, however, the circuit is inductive, as in an electromagnet or a transformer, then the mean power taken up in it is not given simply by the product of the above-mentioned root-mean-square values, but by this product multiplied by a fraction called the *power-factor.* If we are dealing with simple periodic or alternating currents, the variations in instantaneous value follow a simple sine law, and the power-factor becomes the cosine of the angle of lag or phase-difference angle between the current and the electromotive force (see ELECTRICITY, III.). An instrument for the measurement of electric power can be constructed on the same plan as a Siemens dynamometer or a Kelvin ampere-balance, with this difference, that in a wattmeter the two circuits, fixed and movable, have separate terminals. One of these circuits, generally the fixed one, is traversed by the current passing through the power-absorbing circuit, and the movable coil is constructed of a fine high-resistance wire, the terminals of which are connected across the ends of the power-absorbing circuit. In these circumstances the fixed coil is traversed by a current which is the current through the power-absorbing circuit, and the movable coil is traversed by a current which is proportional to the potential difference of the ends of the power-absorbing circuit. If the circuit is inductive and the currents periodic, these two currents differ in phase. In any case, the mechanical couple that must be applied to the movable coil to bring it back to a fixed position with respect to the fixed coil is proportional to the mean value of the product of the instantaneous values of the currents at equidistant intervals of time during the period. But this last mean product is a measure of the mean power; hence the mechanical couple, and therefore the twist of the torsion head, required to restore the movable coil to its original position becomes a measure of the mean power taken up in the circuit tested.

If at any instant the current through the fixed coil is i, and the current through the movable coil is i_1, then the torque to be applied to the movable coil to keep it in its zero position is proportional to the product ii_1. Hence the mean value of the torque is proportional to the value of ii_1 during the phase, or is equal to $\frac{1}{\mathrm{T}}\int_o^t ii_1 dt$ where T is the periodic time. If, therefore, the twist of the upper end of the spiral spring is θ, and D is a constant called the dynamometer constant, $\mathrm{D}\theta = \frac{1}{\mathrm{T}}\int_o^t ii_1 dt.$

If r is the resistance of the movable coil circuit, and e the potential difference of its ends, then $r\mathrm{D}\theta = \frac{1}{\mathrm{T}}\int_o^t iedt.$ The integral on the right-hand side is the expression for the mean power P given to the circuit. Hence

$$r\mathrm{D}\theta = \mathrm{P}.$$

It has been shown that a power-measuring instrument, or wattmeter constructed in this manner, is available for the measurement not only of continuous but of alternating current-power. In measuring the power taken up in inductive circuits supplied at very high electric pressure, in which the difference of potential between the extremities of the circuit is, say, 2000 volts or upwards, an additional device is necessary in order to reduce the current passing through the movable coil to a convenient value. Either a sufficiently large non-inductive resistance may be put in series with the movable coil, or a closed iron circuit *step-down transformer* may be employed. The property of such a transformer is that a periodic electromotive force applied to its primary terminals produces a periodic electromotive force in the secondary circuit, which follows the same law of variation, but is reduced in absolute value by any required amount. Hence in employing a dynamometer wattmeter to measure power taken up in an alternating current circuit when the electromotive force is high, it is usual to join across the terminals of the circuit the step-down transformer, which reduces the voltage to any required amount, and to connect the movable coil of the wattmeter in series with the secondary circuit of this transformer if necessary through a resistance which preferably takes the form of one or more incandescent lamps.

The function of another important class of electric meters is to measure either the electric energy supplied to a circuit, or the electric quantity. If the pressure and current are uniform and unvarying, the electric energy is simply measured by the product of the electric power and

Energy meters.

time, and the electric quantity is measured by the product of the electric current and the time. If the current is variable, the electric energy and the electric quantity are measured by the time-integrals of the power and the current respectively. Instruments which automatically measure these time-integrals are called *energy meters* and *quantity meters*, and of this kind are all those appliances which are also called electric *house-meters*, since they are used for measuring the supply of electric energy or electric quantity from public electric supply stations to customers connected therewith.

One simple form of energy meter is that of Mengarini, an instrument of the wattmeter type. It has a fixed coil traversed by the current passing into the energy-absorbing circuit or house, and a movable coil suspended by a bifilar arrangement with its axis at right angles to the fixed coil. The movable coil carries an index-pen moving over a revolving drum covered with paper, which is driven uniformly by clockwork. If it is connected to the terminals of the power-absorbing circuit, and the fixed coil traversed by the current, then it is deflected through an angle which is nearly proportional to the mean power being given to the circuit; the pen, therefore, will trace a line upon the drum, and when the paper is removed and laid out flat, the area of the curve included between the base line and the two vertical ordinates is proportional to the time-integral of the power supplied to the circuit. The instrument can therefore be easily calibrated so that the measurement of this area gives the power supplied to the circuit in any time in joules or Board of Trade units.[1] Another self-integrating wattmeter of this kind is that due to Elihu Thomson. It consists of a small electric motor, the armature and the field of which contain no iron. The former is a simple drum-wound armature, wound with fine wire and connected through a resistance with the terminals of the power-absorbing circuit; the field magnet consists of two coils of thick wire in series with the power-absorbing circuit. The armature shaft carries a copper disc which revolves between the poles of fixed permanent magnets, and is geared with a counting mechanism which records the number of its revolutions. When the instrument is connected up to the circuits, the mechanical driving power on the motor is proportional to the mean electric power taken up in the circuit measured, while the eddy currents set up in the copper disc exercise a retarding effect proportional to its speed. Hence the speed of the motor, if left to itself, is constant when the currents passing through it are unvarying, and varies as the mean power being taken up in the circuit to which it is connected. Accordingly, the number of revolutions in a given time are a measure of the total electric energy imparted to the circuit in that time. A similar motor-meter has been devised by Evershed. Another much-used form of energy meter or watt-hour meter is that of Aron. In this instrument there is a fixed coil, through which passes the whole current entering the power-absorbing circuit or house. Suspended over this is a movable coil which forms the bob of a clock pendulum, and this is wound with fine wire which is a shunt across the terminals of the power-absorbing circuit. The pendulum regulates a clock, which drives, through a differential gearing, a recording hand registering on a dial or dials the difference in the rate of this and another comparison clock with an ordinary pendulum and clock mechanism. The rate at which a pendulum vibrates being determined by its length and by the force acting on the bob, the rate of the first pendulum is controlled partly by gravity and partly by the force created by the attraction due to the currents in the fixed and movable coils. But this second quantity is proportional to the product of the values of the two currents in the two coils, that is, to the power passing through the instrument; hence the rate at which the clock movement governed by this pendulum gains or loses on the comparison clock is a measure of the power passing through the meter, and the total gain or loss of one clock over the other in any time is a measure of the total energy in watt-hours or Board of Trade units imparted to the circuit in that time.

Quantity meters.

Quantity meters are meters which measure the time-integral of a current in either ampere-hours or coulombs. The simplest type depends upon electrolysis; Bastian's electrolytic meter is an example. In this instrument the current to be integrated passes through a dilute solution of sulphuric acid contained in a glass tube, the current entering and leaving by platinum electrodes. Since every ampere-hour which passes through the instrument liberates from the electrolyte 0·29829 of a gramme of oxygen and 0·03738 of a gramme of hydrogen gas, and therefore diminishes the bulk of the electrolyte by a fixed amount, the total amount of electrolyte destroyed in any given time can be estimated by the fall in level of the liquid as seen in a gauge-glass. The electrolyte is prevented from evaporating by a little paraffin oil placed upon it, and the tube can be calibrated to show at once in Board of Trade units the amount of electric energy which has passed through the instrument, on the assumption that the potential difference between the two sides of the circuit is constant. The meter of course really records the total electric quantity which has passed through it, but on the supposition that that quantity is supplied at a constant voltage, the instrument may be used as an energy meter.

One of the earliest forms of electric house meters devised by Edison was based on the electrolytic principle. In the Edison meter a fraction of the current to be measured is passed through a zinc voltameter, consisting of two zinc plates in a solution of zinc sulphate, which is shunted by a German silver wire across the mains leading into the house. The passage of this fraction of current through the sulphate of zinc removes the zinc from one plate and puts it on the other, and from the measured gain in weight of the one plate or loss in weight of the other, the total electric quantity or time-integral of the current can be estimated. To keep the shunt ratio of the meter constant, Edison employed a copper coil, called a compensating coil, in series with the zinc voltameter, so adjusted that rise or fall in temperature altered its resistance as much in one direction as it altered that of the solution in the other. Another meter of the same kind now in use is the Long-Schattner prepayment meter. In this a certain fraction of the current supplied to any house or circuit is caused to pass through a solution of cupric sulphate contained in a copper box, in which hangs a copper plate suspended from a balanced arm, and as it passes, it removes copper from the suspended plate and deposits it upon the inner surface of the copper box. In this way the weight of the suspended plate is gradually diminished until, when a certain definite weight has been lost, the balance is destroyed and the arm flies up, breaking the main circuit by means of a mercury switch. When this has happened, the main circuit can be closed again by depositing in a slot of the meter a coin of a certain weight and value, say one shilling. The current then passes again, and again reduces the weight of the suspended plate, so that when an amount has been removed equal to the weight of the shilling, the balanced arm flies up and once more opens the main circuit. The whole apparatus is contained in a locked-up box, provided only with a slot and carrying tube for conveying a suitable coin into a bucket hung on the balanced arm. The meter can be so adjusted that the weight of the coin deposited provides the user of the meter with electric energy equal to the value of the coin. Thus the deposit of one shilling in the meter can be made to cause the circuit to remain closed until the customer has had say two Board of Trade units of electric energy; when that amount has been delivered, the supply is automatically cut off. The necessary calculations for designing the meter can be made from a knowledge of the electrochemical equivalent of copper, one ampere-hour of electric quantity passed through a solution of sulphate of copper removing from the anode 1·17700 grammes of copper.

Other quantity meters in use are those of Ferranti, Chamberlain and Hookham, Johnson and Phillips, and Schallenberger. The Ferranti continuous-current ampere-hour meter consists of an electromagnet, with its core formed of mild steel, having a certain retentivity for magnetism; this is worked at such a low flux density that its magnetization is always nearly proportional to the strength of the magnetizing current. In this core there is a disc-shaped cavity, which is lined with an insulating material and filled with mercury. The main current flows through the electromagnet coils, and, entering the mercury at the periphery of the disc-shaped cavity, flows inwards radially in all directions to the centre of the mercury, whence it goes to the other terminal of the meter. Under these conditions the mass of mercury is set in rotation, but its motion is retarded by radial grooves formed in the sides of the chamber. The mechanical force driving it is proportional to the square of the strength of the current, and the force retarding it is proportional to the square of the speed; hence it follows that the number of rotations in any given time is proportional to the total quantity of electricity which has passed through the mercury. A little vane immersed in the mercury is used to register the rotations, the counting mechanism being so devised that the dials read off electric energy in Board of Trade units, on the assumption that the voltage of the circuit remains constant. The meter of Chamberlain and Hookham is of a very similar character, but the rotating portion consists of a copper disc fixed to a shaft, which carries another copper disc moving between the poles of an electromagnet. The first copper disc is immersed in a chamber filled with mercury, and the current to be measured passes radially through it from the circumference to the centre. Under the influence of the magnetic field which is created in a direction perpendicular to the plane of the disc, this disc is set in rotation; the associated disc is also rotating in the magnetic field, and is retarded by the so-called magnetic friction due to eddy currents set up in its mass. In these circumstances the speed of rotation of the two discs can be adjusted to be proportional to the current passing through the instrument, and hence the number of rotations in a given time is a measure of the electric quantity passed through the meter. Mordey and Fricker have designed an ingenious meter of a very simple character. A slate disc has a number of soft iron wires inserted in it. This is attached to the escapement wheel of a clock which has no pendulum or hair-spring. The disc is included within a coil through which the current to be measured passes. When the current flows, it creates a magnetic field which pulls the iron wires into line with it, and owing to the inertia of the disc an oscillating motion is produced. The rate of going of the clock is therefore proportional to the current, and its registration to the electric quantity which has passed.

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[1] A joule is 10^7 ergs, and a British Board of Trade unit is 1000 watt-hours, or 3600 joules.

Intermittent Integrating Meters.—All the above forms of house meters are called continuously integrating meters, in that the operation of recording or obtaining the time-integral of the current or the power is continuous. There is, however, a large class of meters known as intermittent integrating meters, which consist of two parts. The first is simply an ammeter or a wattmeter, while the second is simply a clock, provided with a mechanism by which the deflection of the ammeter or wattmeter is recorded at regular time-intervals, and the records added up. A good example of such an instrument is that of Johnson and Phillips. This instrument comprises an electrically-driven clock, which operates a counting mechanism through a gearing whose ratio is controlled by the current passing into the circuit. The ammeter part of the instrument is a coil of wire, through which the current to be integrated passes, and into which a soft iron plunger is drawn down by the magnetic force. The degree to which this plunger is sucked in regulates the amount by which the clock mechanism advances the recording mechanism at each revolution; hence the number of revolutions of the counting dials in any time is proportional to the time and to the deflection of the ammeter needle—that is, to the total quantity of electricity which has passed through the meter.

Different opinions are held by electricians as to the relative advantages of quantity and energy meters. Generally speaking, quantity meters have the advantage of simplicity of construction; but energy meters must be employed if true electric power is to be measured on a circuit where the voltage is constantly fluctuating. Intermittent integrating meters are not suitable for use in cases in which the current is liable to suffer very large variations in strength enduring but a short time, as in the case of the electric supply to a theatre. The ampere-hour meters as a rule absorb less energy internally than the watt-hour meters. Watt-hour meters must, however, be employed if the supply is by alternating currents and the power-absorbing devices are inductive, such as electric motors.

Ohmmeters.

Instruments for the measurement of electric resistance are called either *Bridges* or *Ohmmeters.* The simplest and most common form of resistance balance is that known as Wheatstone's bridge. As generally used in the laboratory, it consists of a box containing three sets of resistance coils; two of these sets are called the two ratio arms, while the third is the measuring arm. These coils are all joined up in series. In one ordinary form of Wheatstone's bridge, known as the series pattern plug-resistance bridge, there are a series of coils, two 1-ohm coils, two 10-ohm coils, two 100-ohm coils, and two 1000-ohm coils. These are joined up in series in the order 1000, 100, 10, 1; 1, 10, 100, 1000, and the junctions between each pair are connected to brass blocks, a series of which are mounted upon an ebonite slab that forms the top of the box. The blocks are bored out with a hole partly in one block and partly in the other, so that they can be connected by accurately-fitting conical plugs. When the blocks are interconnected by the plugs, all the coils are short-circuited; but if the plug or plugs are taken out, then a current flowing from one end of the series to the other is compelled to pass through the corresponding coils. In series with this set of coils is another set, the resistances of which are generally 1, 2, 3, 4, 10, 20, 30, 40, 100, 200, 300, 400, 1000, 2000, 3000, 4000 ohms. These form the measuring arm, and the junction between each pair of coils is connected as above described to a block, the blocks being interconnected by plugs. This series of coils is joined up with the resistance to be measured, and a galvanometer and a battery are added, as shown in Fig. 5.

This arrangement of six conductors joining four points is technically termed a Wheatstone's bridge arrangement. The values of the resistances forming the four arms of the bridge can then be so adjusted that if their values are called P, Q, R, and S, then when P : Q : : R : S a galvanometer circuit joined in between the junction of (P and Q) and (R and S) will not be traversed by any current when a battery is connected to a junction between (P and R) and (Q and S). To prove this statement, let the conductors P, Q, R, S, be arranged in a parallelogram form, and let B and G be the battery and the galvanometer circuit (Fig. 5), and let these letters stand for the resistances of these circuits respectively. Let E be the E.M.F. of the battery, and let $(x+y)$ be the current along P, y that along Q, and z that along B, then by Kirchhoff's laws

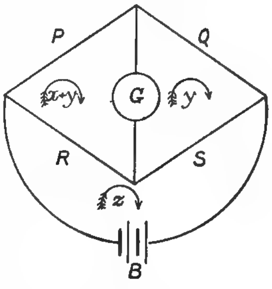

Fig. 5

$$\begin{aligned}(R+S+B)\,z-R\,(x+y)-Sy &= E,\\ (P+G+R)\,x+y-Gy-Rz &= O,\\ (Q+G+S)\,y-G\,(x+y)-Sz &= O.\end{aligned}$$

Rearranging the terms and solving for x, the current through the galvanometer, we obtain $x=E\delta/\Delta$ where $\delta=(QR-PS)$ and Δ is a function of P, Q, R, S, B, G, which does not concern us. Hence when $P : Q=R : S$ we have $x=o$, or the galvanometer current is zero.

An ordinary laboratory form of Wheatstone's bridge, as shown in Fig. 6, is known as the *dial pattern.* Ten brass blocks are arranged round a central brass block, and by means of a plug which fits into holes bored partly out of the central block and partly out of the surrounding blocks, any one of the latter can be connected with the central one. A series of nine equal resistances, say nine 1-ohm coils, or nine 10-ohm coils, or nine 100-ohm coils, are joined in between these circumferential blocks (Fig. 7). It will be seen that if a plug is placed so as to connect any outside block with the central block, the current can only pass from the zero block to the central block by passing through a certain number of the resistance coils. Hence according to the magni-

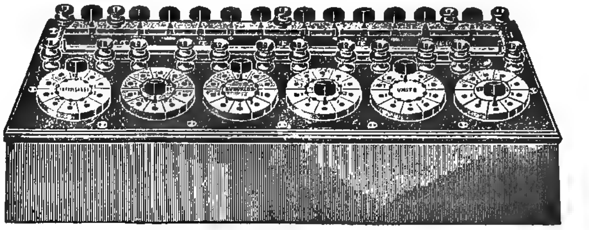
Fig. 6

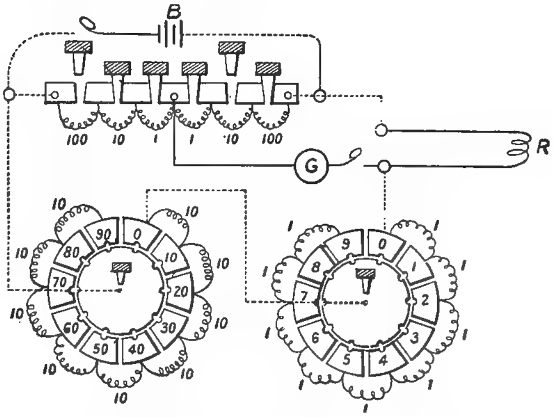

Fig. 7.

tude of each coil the total resistance may be made anything from 1 to 9, 10 to 90, or 100 to 900 ohms, &c. Three or four of the "dials" thus composed are arranged side by side, the brass blocks being mounted on a slab of ebonite and the coils contained in the box underneath, and they are so joined up that the central block of one dial is connected to the outside block of the next marked O. This arrangement forms the measuring arm of the bridge, the ratio arms being constructed on the series plug pattern just described. A bridge of this pattern has the advantage that the insertion or removal of a plug in the measuring arm does not tend to tighten or loosen all the rest of the plugs; moreover, there are fewer plugs to manipulate, and each plug is always occupied. The resistance coils themselves are generally wound on brass or copper bobbins, with silk-covered manganin wire, which should first be aged by heating for about ten hours to a temperature of 140° C., to remove the slight tendency to change in resistivity which would otherwise present itself. For the accurate comparison of resistance coils it is usual to make use of the Matthiessen and Hockin bridge, and to employ the method of differential comparison due to Carey Foster.[1] On a board is stretched a uniform metallic wire ($a\ b$), generally of platinum silver. The ends of this wire are connected to copper blocks, which themselves are connected to a series of four resistance coils, A, B, and P, Q (Fig. 8).

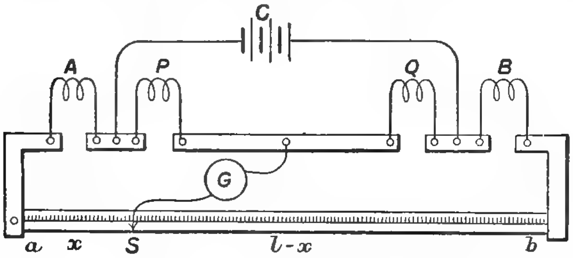

Fig. 8.

A and B are the coils to be compared, P and Q are two other coils of convenient value. Over the stretched wire moves a contact-maker S, which makes contact with it at any desired point, the position of which can be ascertained by means of an underlying scale. A battery C of two or three cells is connected to the extremities of the slide wire, and the sensitive galvanometer G is connected in between the contact-maker and the junction between the coils P and Q. The observer begins by moving the slider until the galvanometer shows no current. The position of the coils A and B is then interchanged, and a fresh balance in position on the bridge is obtained. It is then easily shown that the difference between the resistance of the coils A and B is equal to the resistance of the length of the slide wire intercepted between the two places at which the balance was found in the two observations. Let the balance be supposed to be attained, and let x be the position of the slider on the wire, so that x and $l-x$ are the two sections of the slide wire, then the relation between the resistances is

$$\frac{\mathrm{A}+x}{\mathrm{B}+\mathrm{L}-x}=\frac{\mathrm{P}}{\mathrm{Q}}.$$

Next, let the position of A and B be interchanged, and the slide-wire reading be x^1, then

$$\frac{\mathrm{B}+x^1}{\mathrm{A}+\mathrm{L}-x^1}=\frac{\mathrm{P}}{\mathrm{Q}}.$$

Hence it follows that $\mathrm{A}-\mathrm{B}=x-x^1$, or the difference of the resistances of the coils A and B is equal to the resistance of that length of the slide wire between the two points where balance is obtained.

Various plans have been suggested for effecting the rapid interchange of the two coils A and B; one of the most convenient was designed by J. A. Fleming in 1880, and has been since used by the British Association Committee on Electrical Units for making comparison between standard coils with great accuracy (see *Phil. Mag.*, Feb. 1880, and *Proc. Phys. Soc.*, Dec. 1879). In all very exact resistance measurements the chief difficulty, however, is not to determine the resistance of a coil, but to determine the temperature of the coil at the time when the resistance measurement is made. The difficulty is caused by the fact that the coil is heated by the current used to measure its resistance, which thus alters in value. In accurate comparisons, therefore, it is necessary that the coils to be compared should be immersed in melting ice, and that sufficient time should be allowed to elapse between the measurements for the heat generated in the coil to be removed.

The standard resistance coil employed as a means of comparison by which to regulate and check other coils consists of a wire, generally of manganin or platinum silver, insulated with silk, and wound on a brass cylinder (Fig. 9). This is soldered to two

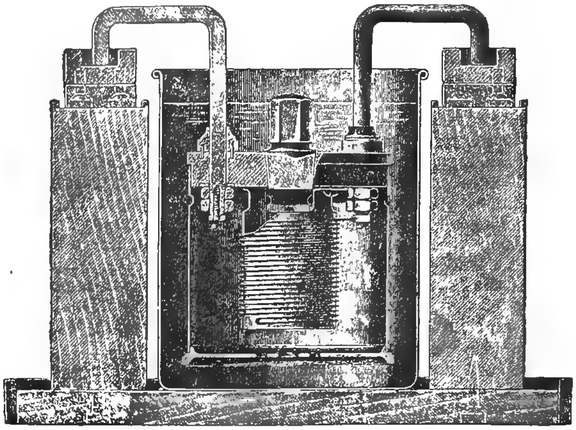

Fig. 9.

thick terminal rods of copper, and the coil is enclosed in a water-tight brass cylinder so that it can be placed in water, or preferably in paraffin oil, and brought to any required temperature. In the form of standard coil recommended by the Berlin Reichsanstalt the coil is immersed in an insulating oil which is kept stirred by means of a small electric motor during the time of making the measurement. The temperature of the oil can best be ascertained by means of a platinum resistance thermometer.

For the measurement of high resistance, such as the insulation resistance of house wiring, or of cables, we may employ either an ohmmeter or a direct method, in which the current sent through the insulation resistance by a large electromotive force is measured on a galvanometer. For example, if it is required to measure the insulation resistance of a length of cable such as is used for electric lighting purposes, the coil of cable, which should not be too short, is placed in a tank filled with water. Its copper conductors are then twisted together and connected to one terminal of a sensitive mirror galvanometer, whose other terminal is joined up with a battery of 200 to 300 secondary cells, which should be well insulated. The other terminal of the battery is connected to the tank. In these circumstances the battery will force a current through the insulating material with which the cable is covered, and this current will flow through the galvanometer. In order to prevent a leakage current also passing through the galvanometer, it is advisable to twist round the insulated conductor, at a short distance from the ends of the insulation nearest to the copper terminals, a fine wire, called a *guard wire*, which is connected to the junction between the battery and the galvanometer. Any leakage of current, therefore, taking place over the surface of the insulation will be conducted by the guard wire back to the battery, and prevented from passing through the galvanometer. In cable factories it is customary to employ a series of Leclanché cells varying from 100 to 1000 cells. The test is then made by applying the stated voltage to the conductor for a given time, generally one minute, and observing the current flowing through the galvanometer at the end of that time. Owing to the fact that the resistance of the dielectrics or insulators increases with the time of application of the electromotive force, it is necessary to state the time during which the electromotive force has been applied before the reading of the current is taken. With many dielectrics the resistance diminishes as the electromotive force is increased, even though applied in all cases for the same time. In the above measurement it is of course necessary that the galvanometer shall first be standardized; that is to say, we must discover the deflection produced by a known current. This is most easily done by sending through it a measured current, such as may be obtained by inserting in series with it a known high resistance, *e.g.*, a megohm, and applying a known electromotive force from a standard cell. For the details of these measurements standard treatises on electric measurement and testing must be consulted. In the ohmmeter of Evershed there are two coils at right angles, one of which is traversed by the current passing through the resistance to be measured, and the other by a current proportional to the fall of potential down that resistance. Hence a soft iron needle hung in the common field of the two coils will indicate by its direction the ratio of potential fall to current—in other words, the resistance of the conductor.

Many measurements peculiar to alternating currents have frequently to be made. One of the most important is the determination of the *wave form*. In the case

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[1] "On a Modified Form of Wheatstone's Bridge, and Methods of Measuring Small Resistances," by Prof. G. Carey Foster, *Proc. Soc. Telegraph Engineers*, vol. i., May 1872.

Wave form.

of periodic electric currents, if the periodic time be supposed to be divided into an equal number of parts, which are represented by equal divisions on a straight line, and if the value of the current or the electromotive force at each of these instants is represented by the magnitude of a line drawn perpendicularly to the time line at the corresponding instant, then a curve drawn through the tops of all these perpendiculars will be a wave curve or periodic curve representing the wave form of the current. A very large number of devices have been invented for delineating this wave form. One of the oldest and simplest, due to Joubert, consists in attaching to the shaft of the alternating-current generator an insulating disc having inserted in its edge a metallic slip. This slip is touched by a pair of steel springs or brushes, with which it makes contact once every revolution. The brushes are carried on a rocking arm, which can be moved into any position round an axis concentric with the shaft of the alternator. The current from the generator is passed through a non-inductive resistance, across the terminals of which an electrostatic voltmeter is joined, the circuit, however, being interrupted by the above-described rotating contact-maker. The terminals of the voltmeter are short-circuited by a condenser. When the alternator is in operation, the contact-maker connects the voltmeter with the ends of the non-inductive resistance at regular intervals corresponding to some fixed point in the cycle. After a few revolutions the condenser becomes charged to a constant potential, and the voltmeter therefore indicates by its deflection this potential difference, which is the instantaneous potential difference of the extremities of the non-inductive resistance corresponding to a certain fixed point in the periodic time. By rocking over, the contact-maker springs into different angular positions, as indicated on a scale of degrees; and reading the corresponding deflection of the voltmeter, it is possible to plot out a curve which represents the variation of the volt fall down the non-inductive resistance, taken at equidistant intervals during the period. This, therefore, enables us to delineate the wave form of the alternating current. Numerous modifications of this point-by-point method have been devised by various experimentalists, but owing to its extreme tediousness the process has now been superseded by the use of an instrument called an *Oscillograph.*

This was originally invented by M. Blondel, but it has been improved by Duddell and others. In principle it is merely a dead-beat galvanometer having a needle or coil with a very small periodic time. Duddell's form consists of an electromagnet excited by a constant current which provides a steady strong magnetic field (Fig. 10), in which is stretched a pair of loops of fine wire, each consisting of a single half-turn in the shape of a hairpin. These two wires are at right angles to the direction of the field; and when a current passes, one of them is forced forward and the other backward, owing to the tendency of a conductor conveying a current to move across the lines of force of a field. To the wires is attached a small mirror of silvered glass, by means of which a ray of light from an electric arc lamp can be reflected upon another mirror and thence upon a screen. This second mirror is kept in vibration by a small alternating current motor so as to be in step with the alternating current under examination; if it were at rest, the light reflected from the first mirror, owing to its simple to-and-fro vibration, would, in consequence of the persistence of vision, appear as a straight line upon the screen. The displacement of the spot of light at its zero position at any instant is proportional to the strength of the current flowing at that instant through the oscillograph wires. If, then, the second mirror is set in vibration synchronously, the spot of light will be displaced in a direction at right angles, and the combination of the two motions will produce a wavy line of light, which is the optical representation of the wave form of the current. In order to secure dead-beatness, the mirrors vibrate in a chamber filled with transparent oil. In testing alternating currents which have a periodic time of about 100, it is necessary to employ an oscillograph having a mirror whose periodic time is anything between 1/2000th and 1/10,000th of a second. The oscillograph in its modern form is a very perfect instrument for the examination of alternating-current phenomena, since a very large number of these effects are closely connected with the form of the wave of alternating current or electromotive force. Duddell has designed a form of portable oscillograph by means of which the wave form of any alternating current can be inspected by the eye.

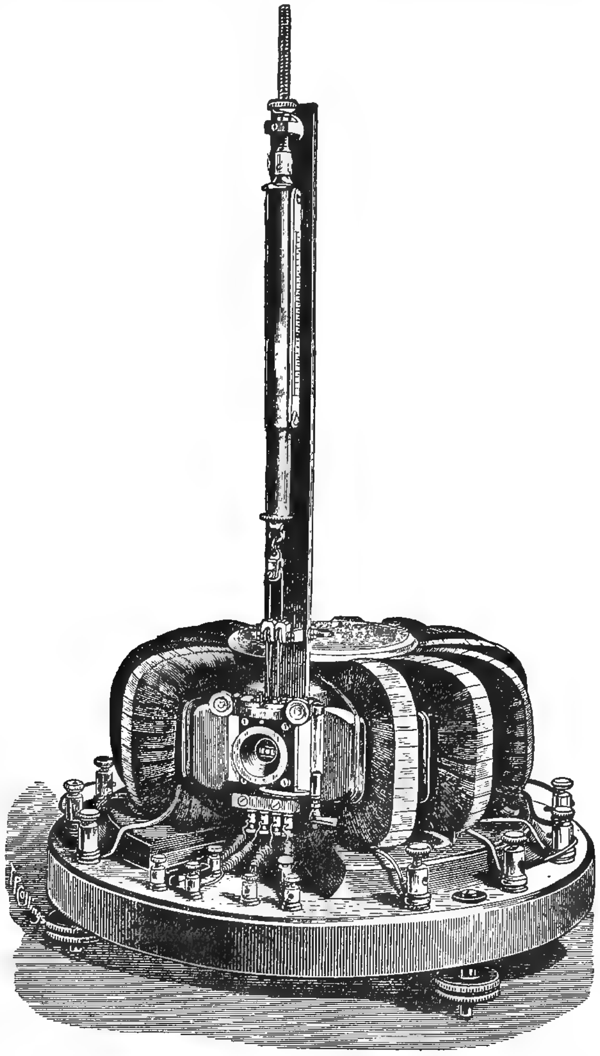

Fig. 10

Three-voltmeter method.

The exact measurement of the mean power given to an inductive circuit by an alternating current is an important matter. In this case the mean power cannot be estimated simply by the product of the root-mean-square values of the current and terminal difference of potential, commonly called the *apparent watts* or apparent power. If the circuit is inductive, this quantity is always greater than the true watts or true power, and this ratio of the true watts to the apparent watts, or of the true power to the apparent power, is called the *power-factor* of the circuit. Hence special means are necessary for the measurement of alternating power. In the three-voltmeter method due to Ayrton and Sumpner this measurement is carried out in the following manner:—In series with the inductive circuit another non-inductive circuit is joined, and the two circuits are traversed by an alternating current. A suitable voltmeter, preferably electrostatic, is then employed to measure the volt fall down each of these two conductors separately, and down the two taken together. This may of course be done simultaneously by three separate voltmeters, but on account of the difficulty of obtaining three absolutely identical instruments, it is in every way preferable to employ one voltmeter, and to make the three measurements with it as quickly as possible one after the other, maintaining the current during the time perfectly constant.

If R is the resistance of the non-inductive resistance in ohms, and if V_1 V_2 and V_3 are the voltmeter readings over the ends of the inductive, non-inductive, and total resistances, then the power in watts P absorbed in the inductive portion is

$$P = \frac{1}{2R}(V_3^2 - V_1^2 - V_2^2).$$

The three-voltmeter method involves, however, a possibility of producing a larger difference of potential than that which would be required to send the same current through the inductive resistance if it were employed alone. For instance, in measuring the power taken up in an alternating-current transformer worked say at 2000 volts pressure, in order to get accurate results it would be necessary to add in series a non-inductive resistance, and to employ a total electromotive force of about 4000 volts. It may not always be convenient to do this. Hence a modification was suggested by Fleming in which the current measurements are made either simultaneously with three ammeters or successively with one ammeter. The theory of the three-voltmeter method is as follows:—In the case of the three-voltmeter method let v_1 be the fall in potential down the inductive resistance, v_2 that down the non-inductive resistance, and v_3 that down the two together at any instant, then we have always

$$v_3 = v_1 + v_2 \therefore v_3^2 = v_1^2 + v_2^2 + 2v_1v_2.$$

Let R be the resistance of the non-inductive portion and i the current through it, then $iR = v_2$, and we have

$$v_3^2 = v_1^2 + v_2^2 + 2v_1 iR,$$

or

$$iv_1 = \frac{1}{2R}(v_3^2 - v_1^2 - v_2^2).$$

Hence, taking root-mean-square values throughout a period and calling these V_1 V_2 V_3, we have for the mean power P taken up in the inductive portion

$$P = \frac{1}{2R}(V_3^2 - V_1^2 - V_2^2).$$

Transformer testing.

As a general rule, by far the most convenient and accurate method of measuring alternating-current power is by a suitable alternating-current wattmeter—an instrument constructed on the same lines as the Siemens dynamometer already described. One of the coils, say the fixed one, is traversed by the current which flows into the power-absorbing circuit; the other movable coil is traversed by a current which must be in step with the difference of potential at the extremities of the power-absorbing circuit. When the voltage employed to transmit the current through this circuit is at a high pressure, say 2000 volts or more, then the most convenient method of obtaining a current in step is to employ an alternating-current transformer, which must be of the closed magnetic circuit type, without magnetic leakage. If the primary circuit of this transformer is connected across the terminals of the power-absorbing circuit, then the electromotive force in the secondary circuit is exactly in opposition as regards phase with this difference of potential; hence if the movable coil of the wattmeter is practically non-inductive, and is joined in series with a non-inductive circuit and with the secondary circuit of the transformer (called the *Auxiliary Transformer*), then the current through the movable coil of the wattmeter is in step with the difference of potential between the ends of the power-absorbing circuit. Hence the reading of the wattmeter is proportional to the mean value of the product of the instantaneous values of the current through the power-absorbing circuit and the difference of potential between its ends—in other words, is proportional to the mean power taken up in that circuit. The wattmeter can best be standardized by employing it to measure the known power taken up in an inductionless circuit, such as a bank of incandescent lamps. The measurement of the power taken up in polyphase transformers or motors involves some special arrangements, but can be effected by the use of two or three wattmeters. If the motor or transformer circuits are *star*-connected, the best plan is to employ three suitable alternating-current wattmeters simultaneously in each branch. If, however, they are *delta*-connected, then two wattmeters must be employed, with their series coils in two of the line wires and their shunts connected between these two and the third. If the power-absorbing circuit is inductive, then these two wattmeters will not give identical readings, and the real power taken up in the whole circuit is the sum or difference of their readings, according as the lag of current behind the voltage in each mesh circuit (assumed equal) is less or greater than 60°. The subject of power measurement in circuits of small power factor involves difficulties of a special kind, concerning which technical manuals must be consulted. For further information on the subject of transformer testing, see TRANSFORMERS.

See also the article WEIGHTS AND MEASURES. (J. A. F.)

Meath, a maritime county of Ireland, province of Leinster.

Population.—The area of the administrative county in 1900 was 577,743 acres, of which 114,812 were tillage, 414,837 pasture, 498 fallow, 9811 plantation, 8649 turf bog, 2369 marsh, 347 barren mountain, and 26,420 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county. The population in 1881 was 87,469; in 1891, 76,987; and in 1901, 67,463, of whom 34,717 were males and 32,746 females, divided as follows among the different religions:—Roman Catholics, 62,663; Protestant Episcopalians, 4359; Presbyterians, 323; Methodists, 61; and other denominations, 57. The decrease of population between 1881 and 1891 was 11·98 per cent., and between 1891 and 1901, 11·4 per cent. The average number of persons to an acre in 1891 was ·13, and of the total population 70,597 persons inhabited the rural districts, being an average of 85 persons to each square mile under crops and pasture. The following table gives the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R. C.	Pr.Ep.	Presb.	Meth.
Read and write	26,350	25,103	51,453	72·0	91·9	96·3	98·5
Read only .	3,529	3,655	7,184	10·8	3·5	1·6	
Illiterate .	5,882	5,573	11,455	17·2	4·6	2·1	1·5

The percentage of illiterates among Roman Catholics in 1881 was 24·7. In 1891 there were four superior schools with 135 pupils (Roman Catholics 119, and Protestants 16), and 183 primary schools with 11,590 pupils (Roman Catholics 10,844, and Protestants 746). The number of pupils on the rolls of the National schools on 31st December 1900 was 12,091, of whom 11,424 were Roman Catholics and 667 Protestants.

The following table gives the number of births, deaths, and marriages in various years:—

Year.	Births.	Deaths.	Marriages.
1881	1355	1116	247
1891	1467	1407	238
1900	1259	1291	264

In 1900 the birth-rate per thousand was 18·7, and the death-rate 19·1; the rate of illegitimacy was 1·4 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 64,943, of whom 33,997 were males and 30,946 females. The chief towns in the county, with their populations in 1901, are—Navan, 3839; Kells, 2427; Trim, 1493.

Administration.—The county is divided into two parliamentary divisions—North and South—the number of registered electors in 1901 being respectively 5814 and 6284. The ratable value in 1900 was £550,529. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises three urban and eight rural sanitary districts.

Agriculture.—The following tables show the acreage under crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1901:—

Year.	Wheat.	Oats.	Barley, Rye, Beans, &c.	Potatoes.	Turnips.	Other Green Crops.	Meadow and Clover.	Total.
1881	3119	32,099	2097	12,711	7048	3372	85,898	146,334
1891	1397	23,681	1184	10,941	5728	2843	78,984	124,758
1895	543	23,187	1034	10,380	5914	2630	77,395	121,083
1901	739	18,219	632	8,781	4989	2964	76,343	112,667

In 1900 the total value of the cereal and other crops was estimated at £634,306. The number of acres under pasture in 1881 was 386,374, in 1891, 405,912, and in 1900, 414,837.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	15,831	3174	173,341	156,099	13,730	5968	312,034
1891	17,714	2945	192,354	223,035	18,258	8887	350,549
1895	19,033	3236	201,089	177,178	15,216	7677	380,942
1901[1]	16,046	3223	211,745	222,184	11,477	6958	404,538

The number of milch cows in 1891 was 15,431, and in 1901, 15,863. It is estimated that the total value of cattle, sheep, and pigs for 1901 was £3,345,709, the largest amount of any county in the province. In 1900 the number of holdings not exceeding 1 acre was 3008; between 1 and 5, 1774; between 5 and 15, 2512; between 15 and 30, 1874; between 30 and 50, 1192; between 50 and 100, 1220; between 100 and 200, 921; between 200 and 500, 555; and above 500, 89—total, 13,145. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts, 1885, 1891, and 1896, up to 31st March 1901 was 492, amounting to £345,533. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1901, was 304, and the amount issued was £38,752. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £213,470. (W. H. Po.)

Meaux, chief town of arrondissement and railway station, department of Seine-et-Marne, 32 miles north-north-east of Melun. At its wool market some 200,000 fleeces are dealt in annually. A statue of General Raoult was erected in 1891. Population (1891), 11,350; (1901), 12,228.

Mechlin, or MALINES, a city of Belgium, on the Dyle, an important railway junction in the province of Antwerp, and the seat of an archbishopric. It lies in a level fertile plain, and is surrounded by promenades which have taken the place of the ancient ramparts. In contrast with other famous Flemish towns, Mechlin has no high towers, no grand buildings dominating the city, except the church belfries. In the 15th and 16th centuries the seat of important cloth manufactures, it has now for its principal branches of industry cabinet-making and carpentry, which employ 1200 workmen; chair-making, horticulture, and agriculture. It also contains extensive railway workshops of the State railways. Population (1875), 40,200; (1900), 55,705.

Mecklenburg, the common designation of two grand-duchies of the German empire, known as (i.) Mecklenburg-Schwerin and (ii.) Mecklenburg-Strelitz.

(i.) MECKLENBURG-SCHWERIN has an area of 5135 square miles, and population (1900), 607,835, giving a density of 118 inhabitants to the square mile. The population consisted of 300,419 males and 307,416 females. In 1895, 55·3 per cent. were rural and 44·7 per cent. urban; by religion nearly all the inhabitants are Protestant. The grand-duchy in 1895 embraced 97,069 farms, of which 65,531 were each less than 2½ acres in extent, 21,633 between 2½ and 25 acres, 8604 between 25 and 250 acres, and 1301 over 250 acres. The principal crops are potatoes, hay, wheat, oats, beetroot, rye, barley, and a little tobacco. The live stock in 1900 numbered 526,711 sheep, 452,635 pigs, 327,785 cattle, and 101,818 horses. The methods of farming have greatly improved since 1885. There is an agricultural experimental station at Rostock. In 1899–1900 the sugar factories of the two grand-duchies together produced 78,807 tons of sugar; the breweries, 10,494,000 gallons of beer; and the distilleries, 962,800 gallons (in 1897) of pure alcohol. The mercantile marine in 1900 numbered 65 sea-going vessels of 39,267 tons. Rostock, Warnemünde, and Wismar are the chief ports. There is a university at Rostock. The budget of the grand duke and estates together balanced in the year 1900–01 at £1,330,650. In 1900 the public debt amounted to £5,551,650; and in 1900 the state contribution to the imperial exchequer was fixed at £300,880. There were 730 miles of railway in 1900.

(ii.) MECKLENBURG-STRELITZ has an area of 1131 square miles, and population (1900), 102,628, of whom 50,870 were males and 51,758 females: density, 91 inhabitants to the square mile. With the exception of less than 1000, all the people belong to the Evangelical Lutheran Church. The number of farms in 1895 was 17,921, of which 13,844 were each less than 2½ acres in extent, 3846 between 2½ and 250 acres each, and 231 over 250 acres. The crops principally grown are potatoes, hay, wheat, rye, oats, beetroot, barley, and a little tobacco. In 1897 the live stock embraced 135,127 sheep, 61,598 pigs, 49,988 cattle, and 18,560 horses. The sugar, beer, and alcohol production are included in the returns for Mecklenburg-Schwerin. No statement of public revenue and expenditure is published; the state contribution to the imperial treasury was in 1900 fixed at £51,135; the public debt is estimated at £300,000. This duchy possessed only 154 miles of railway in 1900.

Medals. See NUMISMATICS.

Medellin, a city of the United States of Colombia, Central America, capital of the state of Antioquia, and also the seat of a bishopric. It is finely situated in a beautiful valley of a high plateau and on the Porce, a tributary of the Cauca, 150 miles north-west of Bogota. Founded as early as 1674, Medellin, after some centuries of comparative obscurity, has rapidly increased in wealth and importance, owing to the development of gold and silver mining, carried on mainly by British enterprise. While this has promoted a large general trade, many of the inhabitants are also employed in jewellery and other work in precious metals. The main hindrance to the growth of the city has been the lack of railway communication with the Magdalena river, only a small portion of the line from Puerto Berris being yet completed. The city possesses a university, a chemical laboratory, an elementary school, and other important educational institutions; also a mint, a theatre, a well-equipped hospital, and other public buildings. The streets are wide and regular, but badly paved. The principal exports are gold and silver, coffee, and hides. Population, about 50,000.

Medford, a city of Middlesex county, Massachusetts, U.S.A., on the Mystic river, 5 miles north of Boston, of which it is practically a suburb. It has large and varied manufactures, with (in 1900) a capital of $1,328,106, and products valued at $1,907,624. Tufts College, a Universalist institution, situated here, had, in 1899, 93 instructors, and was attended by 568 students, 148 of whom were women. Its property had a value of $1,980,000, and its income was $105,000. Population (1890), 11,079; (1900), 18,244, of whom 4327 were foreign-born and 244 were negroes.

Mediation, in the international sense, is the intervention of a third Power, on the invitation or with the consent of two other Powers, for the purpose of arranging differences between the latter without recourse to war. Mediation may also take place after war has broken out with a view to putting an end to it on terms. In either case the mediating Power negotiates on behalf of the parties who invoke or accept its aid, but does not go further. Unlike an arbitrating Power, the mediator pronounces no decision, but limits his intervention to suggestion and advice. His action is liable to be arrested at any time at the will of either party unless otherwise agreed, in which last case to arrest it prematurely would be a breach of good faith. The difference between mediation and arbitration may be stated in the words of the Digest (lib. iv. tit. 8, § 13): "Recepisse autem arbitrium videtur, ut ait Pedius, qui judicis partes suscepit finemque se sua sententia controversiis impositurum pollicetur. Quod si hactenus intervenit ut experiretur an concilio suo vel auctoritate discuti litem paterentur, non videtur arbitrium recepisse."

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[1] The figures for 1901 have not been revised.

Some writers distinguish mediation from "good offices," but the distinction is of little practical value. We may, if we please, regard "good offices" as inchoate mediation, and "mediation" as good offices brought to the birth. Thus we may say that a third Power renders "good offices" when it brings the parties together so as to make diplomatic negotiations between them possible; whilst if it takes an active part in those negotiations it becomes for the time being a mediator, whatever the result of its intervention may be.

There have been many instances of successful mediation; *e.g.*, of Great Britain, in 1825, between Portugal and Brazil; of France, in 1849–50, when differences arose between Great Britain and Greece; of the Great Powers, in 1868–69, when the relations of Greece and Turkey were strained to breaking-point by reason of the insurrection in Crete; of Pope Leo XIII., in 1885, between Germany and Spain in the matter of the Caroline Islands. In these cases mediation averted war, but it has been also resorted to for the purpose of putting an end to war already begun. The Austro-Prussian war of 1866, the war between Chile and Peru in 1882, and that between Greece and Turkey in 1897, not to mention other instances, were brought to a close through the mediation of neutral Powers. Mediation has also been occasionally employed where differences have arisen as to the interpretation of treaties or as to the mode in which they ought to be carried out, as when Great Britain mediated between France and the United States with regard to the treaty of Paris of 4th July 1830. In one case at least mediation has been successful after a proposal for arbitration had failed. In 1844, when war between Spain and Morocco was threatened by reason of the frequent raids by the inhabitants of Amalet el Rif on the neighbouring Spanish settlement of Ceuta, Spain declined arbitration on the ground that her rights were too clear for argument. But both she and Morocco subsequently accepted joint mediation at the hands of Great Britain and France.

The cause of mediation was considerably advanced by the Declaration of Paris of 1856. The plenipotentiaries of Great Britain, France, Austria, Russia, Sardinia, and Turkey then and there recorded in a protocol, at the instance of Lord Clarendon, their joint wish that "states between which any misunderstanding might arise should, before appealing to arms, have recourse so far as circumstances might allow (*en tant que les circonstances l'admettraient*) to the good offices of a friendly Power." Article 8 of the treaty of Paris, which was concluded in the same year, embodied this principle in a formal shape. The article stipulated that "if there should arise between the Sublime Porte and one or more of the other signing Powers any misunderstanding which might endanger the maintenance of their relations, the Porte and each of such Powers, before having recourse to the use of force, shall afford the other contracting parties the opportunity of preventing such an extremity by means of mediation." These precedents (in which it will be seen that "good offices" and "mediation" are used interchangeably) were followed in the general Acts agreed to at the Conference held at Berlin in 1885 and 1890, the object of which was to secure religious and commercial liberty and to limit warlike operations in the regions watered by the Congo and its affluents.

The proviso above quoted, "so far as circumstances might allow," obviously leaves open a door of escape whenever two states in difference are bent on war. Accordingly, during the War of Secession between the northern and southern states of the American Union, offers of mediation, tendered by Russia in 1861 and by France in 1862, were courteously declined by Mr Seward. On the strength of the protocol of 1856, Great Britain made a similar offer both to France and Prussia in 1870 when war between these countries was imminent; but the emperor of the French replied that the same protocol expressly left discretion unfettered where the dignity of a nation was concerned. Again when, in 1877, Turkey appealed to her co-signatories of the treaty of Paris to mediate between her and Russia, her appeal was rejected on the ground that oppression of the Christian populations under her sway had led to so many revolts on their part as to menace the peace of Europe. In fact, nations on both sides of the Atlantic have hitherto shown no more disposition to permit questions they deem vital to be dealt with by mediation than to permit them to be dealt with by arbitration.

A special form of mediation was proposed by a delegate from the United States at the Peace Conference held at The Hague in 1899, and was approved by the representatives of the Powers there assembled. The clause in which this proposal was embodied provided in effect that, whenever there is danger of a rupture between two Powers, each of them shall choose a third Power to which these differences shall be referred, and that, pending such reference, for a period not exceeding thirty days (unless the time is extended by agreement) the Powers at issue shall cease to negotiate with each other and leave the dispute entirely in the hands of the mediating Powers. It will be seen that the Powers thus appealed to occupy a position analogous to that of seconds in a duel, who are authorized to arrange an "affair of honour" between their principals. This novel device has the advantage of toning down, if not of eliminating, personal and national prejudices by which controversy is frequently embittered. It also gets over the difficulty, so often met with in arbitration, of choosing a common referee who shall be satisfactory to both parties. The closer the relations between states become, the more their commercial interests are intertwined, the larger the part which mediation seems destined to play in the future. It is true that states which have accepted the intervention of a mediator remain free to adopt or reject any advice he may give, but the advice of a disinterested Power must always add considerable moral weight to the side towards which it inclines.

For authorities on the subject see ARBITRATION, INTERNATIONAL. (M. H. C.)

Mediatization.—The unification of Germany, which began with the formation of the Confederation of the Rhine (1806) and was continued by the treaty of Vienna (1815), entailed the "mediatization" (or deprivation of their sovereign power) of a number of princely houses, formerly "immediate" (*reichsunmittelbar*, *i.e.* holding directly of the emperor). To such were, however, reserved certain privileges and equality of personal rank with the princes of reigning houses: cf. *Ency. Brit.* (9th edition), article GERMANY, vol. x. p. 492.

MEDICAL EDUCATION.

GREAT BRITAIN AND IRELAND.

UP to 1858 each University, Royal College of Physicians or of Surgeons, and Apothecaries' Hall in Great Britain and Ireland laid down its own regulations for study and examination, and granted its degree or licence without any State supervision. In that year, pursuant to the Medical Act, 21 and 22 Vict. c. 90, the General Medical Council of Medical Education and Registration was established, consisting of twenty-three members, of whom seventeen were appointed by the various licensing bodies and six by the Crown. This number was increased by the amended Act of 1886 to twenty-nine, three of the six additional members being elected by the profession as "direct" representatives. The object of the Act was "to enable persons requiring medical aid to distinguish qualified from unqualified practitioners." To this end the "Medical Register" was established, on which no person's name could be inscribed who did not hold a diploma or licence from one or more of the licensing bodies after examination. By the 1886 Act a qualifying examination was defined as "an examination in medicine, surgery, and midwifery," conducted by universities or by medical corporations, of which one must be capable of granting a diploma in medicine, and one in surgery. The powers of the Council over medical education consist in being authorized to require from the licensing bodies information as to courses of study and examinations, and generally as to the requisites for obtaining qualifications; and to visit and inspect examinations either personally or by deputy. If the visitors are of opinion that the course of study and examination of any licensing body is not sufficient to secure the possession by candidates obtaining its qualification of the requisite knowledge and skill for the efficient practice of their profession, on a report being made in these terms to the Council, the Council may represent the same to the Privy Council. Should the Privy Council be satisfied that the charge is substantial, it may, if it sees fit, deprive the accused body of its power to grant registrable qualifications. From this statement it will be seen that the powers of the Council are very limited; nevertheless, by their cautious application, and by the loyal manner in which the licensing bodies have acted on the recommendations and suggestions which have from time to time been made, the general condition of medical education has been materially improved; and although there is not a uniform standard of examination throughout the United Kingdom, the Council has succeeded in ensuring that the minimum requirements of any licensing body shall be sufficient for the production of trustworthy practitioners.

One of the first subjects the Council applied itself to was the establishment of a system of examinations in general knowledge. Such examinations have to be passed before commencement of medical study. On presentation of a certificate to the registrars of the Council, and on evidence being produced that the candidate is sixteen years of age, his name is inscribed on the "Students' Register." At present the subjects of examination are:—(*a*) English language, including grammar and composition (marks not exceeding 5 per cent. of the total obtainable in this section may be assigned to candidates who show a competent knowledge of shorthand); (*b*) Latin, including grammar, translation from specified authors, and translation of easy passages not taken from such authors; (*c*) mathematics, comprising arithmetic; algebra, as far as simple equations inclusive; geometry, the subject matter of Euclid, Books I., II., and III., with easy deductions; (*d*) one of the following optional subjects—Greek, French, German, Italian, or any other modern language. Certificates are accepted from all the universities of Great Britain and Ireland, from the leading Indian and colonial universities, from Government examination boards, and from certain chartered bodies. The German Abiturienten-Examen of the gymnasia and *real*-gymnasia, the French diplomas of Bachelier ès Lettres and Bachelier ès Sciences, and corresponding entrance examinations to other Continental universities are also accepted. Whilst anxious to raise the general standard of preliminary examinations, the Council has not found it expedient to do so. In point of fact, the condition of secondary education in Great Britain and Ireland is so moderate in character as to render it inadvisable to set a higher minimum test, inasmuch as depletion of the profession might be produced to an extent detrimental to the public interest. On the other hand, it is right to state that only a moderate proportion of registered students pass on to the register on mere minimum requirements.

As regards professional education, the Council divided its resolutions into "requirements" and "recommendations"; the former consisting of demands on the licensing bodies, non-compliance with which renders them liable to be reported to the Privy Council as not conforming to conditions necessary to secure sufficient knowledge and skill for the efficient practice of medicine, surgery, and midwifery; the latter are regarded merely as suggestions for the general conduct of education and examination. The requirements may be summarized as follows:—(*a*) Registration as a medical student. (*b*) Five years of *bonâ fide* study between the date of registration and the date of the final examination for any diploma entitling the holder to be registered under the Medical Acts. (*c*) In every course of professional study and examinations the following subjects must be contained, the Council offering no opinion as to the manner in which they should be distributed or combined for the purposes of teaching or examination, this being left to the discretion of the bodies or of the student:—(i.) Physics, including the elementary mechanics of solids and fluids, and the rudiments of heat, light, and electricity; (ii.) chemistry, including the principles of the science, and the details which bear on the study of medicine; (iii.) elementary biology; (iv.) anatomy; (v.) physiology; (vi.) materia medica and pharmacy; (vii.) pathology; (viii.) therapeutics; (ix.) medicine, including medical anatomy and clinical medicine; (x.) surgery, including surgical anatomy and clinical surgery; (xi.) midwifery, including diseases peculiar to women and to new-born children; (xii.) theory and practice of vaccination; (xiii.) forensic medicine; (xiv.) hygiene; (xv.) mental disease. (*d*) The first of the four years must be passed at a school or schools of medicine recognized by any of the licensing bodies; provided that the first year may be passed at a university or teaching institution where the subjects of physics, chemistry, and biology are taught; and that graduates in arts or science of any university recognized by the Council, who shall have spent a year in the study of these subjects, and have passed in them, shall be held to have completed the first of the five years of medical study. (*e*) The study of midwifery practice must consist of three months' attendance on the indoor practice of a lying-in hospital, or the student must have been present at not less than twenty labours, five of which shall have been conducted throughout under the direct supervision of a registered practitioner.

The fifth year of study is intended to be devoted to clinical work, and may be passed at any one or more public hospitals or dispensaries, British or foreign, recognized by the licensing authorities; six months of this year may be passed as a pupil to a practitioner possessing such opportunities of imparting practical knowledge as shall be satisfactory to the medical authorities. This latter method of study is very rarely employed by students.

The "recommendations" of the Council contain suggestions which may or may not be acted on by the bodies. For the most part they are complied with in connexion with the system of practical and clinical teaching.

The Council satisfies itself that its requirements are acted on, and that the examinations are "sufficient," by cycles of inspection, which occur about every five years. The examination of each licensing body is visited by an inspector, who forwards his report to the Council, which sends each report to the body for its information and remarks. As yet it has never been the duty of the Council to report to the Privy Council that any examination has not been found sufficient. As a rule, suggestions have been accepted and acted on, and thus a high order of professional examination has been attained throughout the kingdom by gradual pressure.

Most of the universities exact attendance at more classes than the colleges and halls; for instance, botany and natural history are taught to their students, who are also examined in them. But with these exceptions the system of professional education is fairly uniform. Since 1875 attendance on "practical" classes has been called for in all subjects. Under this system the larger classes in which the subjects are taught systematically are broken up, and the students are taught the use of apparatus and the employment of methods of investigation and observation. Tutorial instruction is superimposed on teaching by lecture. Much the same plan is adopted in respect of clinical instruction: not only is the student taught at the bedside by the lecturer, but he receives, either from the house-surgeon or house-physician, or from a specially-appointed clinical tutor, an insight into methods of examination of diseases, and learns practically the use of the stethoscope and other aids to diagnosis, and of surgical and obstetrical instruments. In fact, it may be said that each subject of instruction is duplicated. If this is taken into account, it must be evident that the time of the student is fully occupied, and the belief is rapidly growing that five years is too short a period of study. As a matter of fact, the average time taken to obtain a British licence to practise is upwards of six years. The probability is that the solution of the difficulty will be found in the inclusion of such subjects as physics, biology, and chemistry in a "preliminary scientific" examination, which may have to be undertaken before registration as a medical student, thus leaving the whole five years to be devoted to purely professional study.

GERMANY.

The German regulations in regard to professional study are few. They are those for the *Staats Examen*, for which the university degree is no longer a preliminary requisite. The regulations for the admission of candidates to the *Staats Examen* are contained in the royal proclamations of 22nd June 1883. They comprise—(*a*) Certificate of a course of study at a classical gymnasium of the German empire. In exceptional cases, the same from a classical gymnasium outside the German empire may be considered sufficient. (For full details of the course of study and examinations, see *Minutes of the General Medical Council*, vol. xxvii., Appendix 3.) (*b*) Certificate from a university, certifying a course of medical study of at least nine half-years at a university of the German empire. (*c*) Certificate that the candidate has passed, entirely at a German university, the medical *Vorprüfung*, and thereafter has attended for at least four half-years the medical studies of a university. (*d*) The special testimony of the clinical directors bearing witness that the candidate has taken part as *Praktikant* (clerk or dresser) during two half-years at the medical, surgical, and gynæcological clinics; has himself delivered two cases of labour in the presence of his teachers or assistant physicians; and has attended for a half-year as *Praktikant* the clinic for diseases of the eye. The medical *Vorprüfung* referred to is necessary alike for the *Staats Examen* and the degree of Doctor of Medicine. It takes place at the end of the second year (fourth *semester*), and includes the subjects of experimental physics, chemistry, botany, zoology, anatomy, and physiology. It is conducted by a board appointed yearly by the Minister of Education.

FRANCE.

No one can practise medicine in France who does not possess the diploma of Doctor of Medicine of a French university. The qualification of *Officier de santé* is no longer granted. Before he can inscribe as a student of medicine the applicant must have obtained the diploma of *Bachelier ès Lettres*, and the diploma of *Bachelier ès Sciences*. Although the course of professional study may be completed in four years, a longer time is generally taken before the student proceeds to the final examination for the doctor's degree. Each year is divided into four *trimestres;* at each *trimestre* the student must make a new inscription. The *trimestres* are (1) November and December, 56 days; (2) January, February, March, 86 days; (3) April, May, June, 86 days; (4) July, August, 56 days. Practically there are no regulations determining the division of the various subjects, or the number of lectures in each course, or requiring the student to attend the courses. The medical faculty of each university puts before the student a scheme recommending a certain order of studies (*Division des études*) for each of the four years of the medical course, and, as a matter of fact, this order of study is enforced by the system of intermediate examinations (*Examens du fin d'année*). All the lecture courses are free, as also are the clinics and the hospital service, and there is no system of ascertaining the regularity of attendance at lectures, or of certificate of attendance. If, however, the student fails to pass the *Examen du fin d'année* he is debarred from making the next trimestral inscription, and thus loses three months. The lectures are, however, closely attended. In contrast to the freedom in regard to attendance on systematic lectures, there are strict direction and control in regard to hospital attendance and practical courses. The student is required to sign a register *ad hoc* each time he goes in and out. From the beginning of the third year, *e.g.*, from the ninth quarterly inscription, hospital attendance is enforced till the end of the fourth year. No one can renew his trimestral inscription without producing a schedule of his last trimestral stage, showing that during it he had not absented himself more than five times without explanation. Practical work is obligatory during each of the four years. Besides systematic course of lectures, *Conférences* are held by the assistant-professors (*Agrégés*) in natural history, physiology, general pathology, internal pathology, external pathology. At the end of the first year the student is examined in physics, chemistry, natural history, osteology, myology, and the elements of physiology; at the end of the second year, in anatomy and physiology in all their branches; at the end of the third year, in medicine and surgery; at the end of the fourth year, an examination is held over the whole field of study.

Denmark.

No one is allowed to enter on the study of medicine without passing the *Artium Examen* of a secondary school. This is the equivalent of the German Abiturienten-Examen of a classical gymnasium. After study for two *semestres* an examination must be passed in psychology, logic, and history. The special professional examinations consist of (1) preliminary scientific, in botany, zoology, physics, chemistry; (2) first special or professional, anatomy (orally and by dissections), physiology, and pharmacology; (3) second special or professional, written examinations in medicine, surgery, medical jurisprudence; practical and oral in operative surgery, in clinical medicine, and clinical surgery; and oral in pathological anatomy, medicine, surgery, and midwifery.

Authorities.—The history of the development of medical education from the earliest times down to 1894 will be found treated of generally in Puschmann's *Geschichte des medicinischen Unterrichts* (Leipzig, 1889), translated by E. H. Hare (London, 1891). Those desiring more special information on the subject in regard to the details of British institutions should consult the annals of the various universities and colleges of Great Britain and Ireland. The following works supply much interesting information regarding the gradual rise and development of teaching and examination:—*Annals of the Barber Surgeons*, by Sydney Young, 1890.—*History of the Royal College of Surgeons of Ireland*, by Cameron, 1886.—*Early Days of the Royal College of Physicians of Edinburgh*, by Peel Ritchie, 1899.—*Historical Sketch of the Royal College of Surgeons of Edinburgh*, by Gairdner, 1860.—*Memorials of the Faculty of Physicians and Surgeons of Glasgow*, by Duncan, 1896.—*The Story of the University of Edinburgh*, by Sir A. Grant, 1884.—*University of Glasgow*, by Stewart, 1891. (J. B. T.)

United States.

In 1870 and even in 1880 medical education in the United States was in a deplorable condition. In the early history of the country, before and shortly after the beginning of the 19th century, the few medical colleges that were in existence had shown a disposition to require a liberal education on the part of those who entered upon their courses, and some effort also was made, through the agency of state boards, to control the licence to practise. But as the country increased in population and wealth, so far from this good beginning being followed out, preliminary requirements were practically abolished, the length of the courses given each year was shortened to four or five months or less, and in the second and final year there was simply a repetition of the courses given during the first year. This unfortunate condition of affairs is to be attributed mainly to the fact that there was no general national or state supervision of medical training. Medical colleges could obtain incorporation under state laws without difficulty, and brought considerable advantages in the way of prestige and increased practice to those concerned. That the existence of a college depended solely upon the fees of the students encouraged the tendency to make both entrance and graduation requirements as easy as possible, especially as there was no state supervision, and the mere possession of a diploma entitled the holder to practise. Fortunately, during this period the practical character of the clinical instruction given in the better colleges fitted the graduates in some measure for the actual necessities of practice, while the good traditions of medicine as a learned profession exerted a stimulating influence upon those who adopted it as a career, so that in the main the body of practitioners deserved and held the confidence and respect of the community. From the middle of the 19th century to the present time there has been a constant agitation on the part of the physicians themselves for an improvement in medical education. The first notable result of this agitation was an increase in the time of instruction from two to three years (Chicago Medical College, 1859; Harvard Medical School, 1871), the lengthening of each session to six months or more, and the introduction of graded courses instead of a repetition of the same lectures every year. The improvement thus begun became very marked during the decade 1890–1900, amounting in fact almost to a revolution in the rapidity with which the course of instruction was amplified. Many factors co-operated to produce this desirable result: general development of scientific instruction in the colleges and secondary schools, the influence of the large number of medical graduates who completed their training by study in European schools, the adoption by many states of stringent regulations regarding the licence to practise within their borders, the good examples set by many leading schools in voluntarily raising their requirements for entrance and graduation, and, perhaps above all in its general effect, the agitation continually maintained by several national or state associations which in a measure have exerted the general regulating control that in other countries has been enforced by national legislation. Among the most influential of these associations are the American Medical Association, the American Academy of Medicine, the Association of American Medical Colleges, the Illinois State Board of Health, and the University of the State of New York.

The conditions at present are improving rapidly, but are difficult to describe except in general terms, as the requirements for matriculation and graduation vary greatly in the different states of the Union, and the arrangement of the courses follows no uniform plan. There are 166 medical schools in the United States, of which 10 are graduate schools. Of these, 122 are classed as so-called regular schools, 21 as homœopathic, 7 as eclectic, and 3 as physio-medical. In 1885 out of the 102 existing schools, only 5 offered a course of three years. In 1897, 99 schools required a course of four years, while in 1899, 141 of the 156 undergraduate schools announced a course of four years as necessary to graduation. There is a gratifying tendency also to increase the standard of preliminary requirements for entrance to the medical schools. The colleges comprising the Association of American Medical Colleges, 82 in number, have agreed upon uniform entrance requirements that are practically equivalent to the completion of one year's study in a high school. In New York and Illinois there is a uniform minimal requirement equivalent to the completion of a high-school course of four years, and other states have announced that a similar requirement will be made in the future. The Johns Hopkins Medical School from its foundation in 1893 has admitted as students only those who are graduates of a recognized college, and has required, moreover, that the candidate shall possess a reading knowledge of French and German, and have had a year's training in physics, chemistry, and biology. The Harvard Medical School since 1901 has also required a degree in arts, sciences, literature, or philosophy as a condition for entrance, while the Rush Medical College (University of Chicago) and the medical departments of the University of Michigan and the University of California have announced entrance requirements that will practically demand two years of collegiate work. Following the initiative of the Johns Hopkins, these schools have specified that the preliminary training must include courses in physics, chemistry, biology, French, and German. The medical department of the Western Reserve University (Cleveland) requires certificates showing the completion of at least three years in a recognized college. The good examples set by these and other schools will doubtless result soon in a general increase in entrance requirements to the point that those entering upon the study of medicine must give evidence of a preliminary training equivalent at least to that required for matriculation in a college of good standing.

In regard to the medical curriculum itself there has been of late years much dissatisfaction, directed, it may be said, not so much towards the contents of the curriculum as towards the methods of instruction. The relative merits and demerits of the laboratory and the lecture system are being constantly debated, and such discussion, together with the practical trials of the two systems, will doubtless eventually lead to a substantial improvement in the character of medical instruction. As an outcome of this agitation the following general tendencies may be noted. A large number of the best medical colleges have entered into close affiliation with the leading universities, and there seems to be a distinct appreciation of the value of this organic union with institutions devoted to the higher learning. In a number of cases this affiliation has led to the development of what are known as combined courses, by means of which the total time required for obtaining both the collegiate and the professional degree is reduced by one or two years. The reduction is made possible by the acceptance on the part of the college faculty of the scientific work done in the first year or two of the medical course as fulfilling part of the requirements for the baccalaureate degree. There can be no doubt that this recognition of the scientific instruction in the medical schools is not only a testimonial to its thoroughness, but amounts to a guarantee that this work will be committed to the care of trained and capable specialists. It is probable, in fact, that in some instances the experiment will be made of leaving the instruction in the preparatory medical sciences entirely in the hands of the college faculty.

Some of the medical schools are making an effort to break away from the rigid system of graded courses that prevails generally, and instead to offer various alternative studies, particularly in the third and fourth years, adapted to meet the needs and stimulate the interests of individual students. In general, however, it may be said that the system of instruction for the required four years of medical study tends to follow the general lines laid down by Huxley in his well-known address upon "Universities, Actual and Ideal" (1874)—that is, the first two years are given up to the study, largely by laboratory methods, of what may be called the preparatory sciences, while in the last two years attention is directed mainly to practical instruction in the science and art of medicine in the hospital, the clinic, and the dispensary.

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(W. H. H.)

Medical Jurisprudence, or FORENSIC MEDICINE, is the science which deals with the application of medicine to certain questions of civil and criminal law, for the determination of which evidence derived from medical experience is required. During recent years no fundamental changes have been made in its principles as laid down in the older books upon the subject, but close observation, fresh experience, and more modern methods of investigation have thrown new light upon various branches, and have thus tended to place the whole subject upon a more scientific basis than formerly. The present article is confined to supplementing the topics dealt with in the ninth edition of the *Encyclopædia* under this heading and that of POISONS.

I. *The Signs of Death.*—The determination of the actual existence of death assumes a certain importance in tropical countries, where the necessity for speedy interment may involve a risk of burial alive. Such an accident cannot well occur where a medical man confirms the existence of death, and in the United Kingdom, where burial rarely takes place before the lapse of forty-eight hours, such changes usually occur in the body as to render any error practically impossible. Within a varying period, usually not more than twelve hours, the body becomes rigid, owing to the development of *rigor mortis* or *post-mortem* rigidity. The blood, which during life is equally distributed throughout the body, gravitates to the most dependent parts and develops a discoloration of the skin which is known as *post-mortem* lividity or *post-mortem* staining. At a variable period of time, dependent on the cause of death, also the temperature and moisture of the air to which the body is exposed, decomposition or putrefaction sets in. These changes which a body undergoes after death are of great importance, not only as affording certain proof of death, but also because they furnish valuable information as to the probable time at which it occurred, and from the fact that they may alter or destroy evidence as to the cause of death.

II. *Identity.*—In the case of the living, identification is rather a matter for the police officer than for the medical man. Bertillon and Galton have each devised methods for the identification of criminals which are much more certain than those formerly relied on (see also ANTHROPOMETRY). Bertillon's system consists in taking certain anthropometrical measurements of the cranium and face, and recording other general characteristics. Galton's method consists in taking impressions of the skin markings of the thumb and fingers, which give definite and distinctive patterns for each individual, so that by means of a proper system of classification it is possible to identify an individual within a few minutes. This system is largely used in India. Medical evidence may, however, be necessary to decide a question of identity in the living, as in the Tichborne case, where the deletion of tattoo marks, or the existence of scars, had to be determined. In the dead, identification is effected by means of clothes, bodily characteristics or peculiarities, photography, &c., or the body itself may be preserved for identification by keeping it at a low temperature, as in the Morgue at Paris.

III. *Injuries or Wounds.*—These include in a medicolegal sense not only those characterized as incised, punctured, contused, lacerated, stab wounds, but also burns, injuries produced by firearms, fractures, dislocations, &c. One of the chief questions which have to be decided in all forms of violent death is whether it was the result of accident, suicide, or murder. In cases of fatal wounding, among the points to be noted, which will help to decide the question, are the situation, direction, and extent of the wound, the position in which the body and any weapon may be found, together with the presence and distribution of any blood marks and the signs of a struggle. In wounds caused by firearms the injury, if suicidal, is usually situated in a vital and accessible part of the body, the temple, mouth, and chest being the favourite situations; but such an injury also presents, as a rule, the characteristic appearances resulting from the discharge of the weapon close to the body, viz., besides the wound of entrance of the bullet, there is singeing of the cuticle and hair, and blackening of the area immediately surrounding the wound, from particles of unconsumed powder being driven into the skin and from the smoke of the discharge. These effects are naturally not produced when the weapon is discharged at a distance exceeding 2 or 3 feet, as usually happens in cases of homicidal shooting. They may also be wanting in undoubted suicidal wounds produced by revolvers and cartridges filled with amberite or other smokeless powders. Death from burning is generally accidental, very rarely suicidal, and when homicidal, is usually employed to conceal traces of other violence inflicted upon the body. In large conflagrations death is not always due to burning. Charred bodies may be found presenting various injuries due to the fall of beams, crushing, the trampling of others trying to escape, &c., or fractures and lacerations may be due simply to the action of the heat. Death may result from such injuries, or from suffocation by the gases of combustion, before the victim is affected by the actual fire. Spontaneous combustion of the body has been stated to occur, but the evidence upon which the cases rest is not well authenticated.

IV. *Death from Asphyxia.*—Amongst the forms of violent death due to this cause are drowning, hanging, strangulation, garotting, smothering, suffocation from choking, mechanical interference with the expansion of the chest walls, as when persons are crushed together during a panic in a fire, breathing poisonous gases, such as carbonic acid or carbonic oxide. In connexion with the last form of death, which in the United Kingdom usually results accidentally from an escape of lighting gas, the danger has been much increased in many towns owing to the addition of carburetted water-gas to the ordinary supply. Carbonic oxide gas is contained in ordinary lighting gas to the extent of about 6 to 8 per cent., and is extremely fatal when inhaled. Carburetted water-gas contains about 28 per cent., and when mixed with ordinary lighting gas the percentage of carbonic oxide is thus very much increased.

V. *Criminal Abortion.*—This crime consists in unlawfully procuring the expulsion of the contents of the gravid uterus at any period short of full term. It must be noted that while this definition may be held to recognize the induction of premature labour by medical men in certain circumstances, yet, when the operation is necessary, a medical man should always protect himself from possible misconstruction of his action (*i.e.*, criminal intent) by having a consultation with another practitioner. The means employed in criminal abortion to procure the desired result may be classed under three heads: (1) general violence to the body, (2) administration of drugs supposed to have abortifacient qualities, (3) instrumental interference with the contents of the womb. Amongst the drugs frequently employed for the purpose, although by no means always successfully, are ergot, strong purgatives, iron, rue, pennyroyal, savin.

VI. *Infanticide.*—The killing of a recently-born infant which has been "born alive," *i.e.*, has lived after being completely born, is termed infanticide, and the crime amounts to murder. The Crown takes upon itself the *onus* of proving in every case that the child has been born alive. This is often a matter of difficulty, and hence an alternative charge of concealment of birth in England, or concealment of pregnancy in Scotland, is usually preferred in such cases, and, if proved, may entail a penalty of two years' imprisonment. The chief medical questions to be determined from an examination of the body of an infant in connexion with a charge of infanticide are: (1) as to its maturity, (2) whether it has breathed or not, (3) whether it was "born alive," (4) how long it survived its birth, (5) what was the cause of death. The proof of respiration having taken place is of prime importance, although it does not necessarily follow when a positive result is obtained that the child was "born alive." The fact of the lungs having respired is determined by their appearance and consistence, and by the hydrostatic test, which depends upon the difference in the specific gravity of the lungs before and after the entrance of air into them through respiration.

VII. *Rape* consists in the carnal knowledge of a woman by force and against her will. It is rape if the crime be perpetrated with consent obtained by a fraud, such as the impersonation of a woman's husband, or by producing mortal terror. Since the passing of the Criminal Law Amendment Act, 1885, it is a felony, entailing the same punishment as rape, to have carnal knowledge of a girl under thirteen years, whether she consent or not. Between thirteen and sixteen years of age it is a criminal offence punishable by two years' imprisonment, whether consent is given or not, and even if there be solicitation. Above sixteen years of age no offence is committed, if consent be given, provided the woman is not an idiot or an imbecile. The administration of any drug or matter, with intent, by producing stupor, to facilitate the accomplishment of the crime, is an offence punishable by two years' imprisonment. In all charges of rape, the woman and her assailant should be examined as soon as possible by a medical man, but such examination, it is important to remember, can only be carried out with the free consent of the party to be examined.

VIII. *Blood Stains.*—The examination of blood stains is a frequent and important operation in criminal charges. Blood stains when fresh and abundant can be recognized without difficulty, but when old, or after being acted upon by certain substances, their identity is not readily determined. The tests which may be applied to a suspected stain consist of:—(1) *The microscopic test.* A portion of the stain is soaked in a drop of some fluid which will soften and cause separation of the dried blood corpuscles without altering their characteristic appearance. Such fluids are solutions of glycerine and water of a specific gravity of 1028, or 30 per cent. caustic potash. The recognition of blood corpuscles affords evidence of the nature of the stain. (2) *Chemical tests.* (*a*) Heat applied to a solution obtained by soaking some of the stained fabric in cold water. A blood solution is red, and loses its red colour on application of heat, while at the same time a buff-coloured precipitate is formed. (*b*) On applying a drop of freshly prepared tincture of guaiacum and then some ozonic ether or peroxide of hydrogen to the stain, a blue colour is obtained if blood be present. Many other substances, however, give the same reaction. (*c*) If, even to the smallest particle of dried blood, a fragment of common salt and some glacial acetic acid be added, and the latter is then heated to ebullition and allowed to evaporate away, small brown rhomboid crystals—hæmin crystals—will be found to have formed, and they can be recognized under the microscope. (3) *Spectroscopic test.* A solution of blood obtained from a stain will show a spectrum having two dark bands between Fraunhofer's lines D and E (oxyhæmoglobin). On adding ammonium sulphide to the solution the hæmoglobin is reduced and only one broad dark band is seen (reduced hæmoglobin). On adding caustic potash to a solution of blood, alkaline hæmatin is formed, and this again is transformed on the further addition of ammonium sulphide into reduced hæmatin or hæmochromogen, which gives a very characteristic spectrum of two dark bands situated in the yellow part of the spectrum. The production of these three different spectra from a red-coloured solution is characteristic of blood. Old blood stains are insoluble in water, whereas recent stains are readily soluble in cold water, yielding a red solution. The application of hot water or washing with soap tends to fix or render blood stains insoluble. Vegetable dyes may likewise give red solutions, but they may be distinguished from blood by the addition of ammonia, which alters the colour of the former, but rather intensifies the red colour of a blood solution. The differentiation between human blood stains and those produced by the blood of other animals, more especially domestic animals, is a matter of great importance to the medical jurist. When the blood stain is fresh, measurement of the corpuscles may decide the question, but in the case of dry and old stains it is impossible to make the distinction. A method has been discovered, however, which enables the distinction to be made not only between human blood and that of other animals (with the exception of *Simiidæ*), but also between the bloods of different animals. The method depends upon the fact that if an animal (A), such as a dog or rabbit, is inoculated with the blood or serum of another animal (B), then the blood or serum of A is found to produce a specific reaction (namely, the production of a cloudiness or precipitate) when added to a solution of the blood of a similar animal to B, and that species of animal only. If, therefore, human blood serum is injected into an animal, its blood after a time affords an "anti-serum" which produces the specific reaction only in human blood solutions and not in those formed from the blood of other animals.

IX. *Poisoning.*—There is no exact definition of a poison. Popularly, substances which destroy or endanger life when swallowed in small quantity are called poisons, but a scientific definition would also include many substances which are injurious to health in large doses or only after repeated administration, and which act not only when swallowed, but also when taken into the system through other channels, *e.g.*, the skin or the lungs. The branch of science which relates to poisons, their nature, methods of detection, the symptoms produced by them, and treatment of poisoning, is called Toxicology, and is one of the most important subjects included under the term Medical Jurisprudence.

Poisons may be classified according to their effect upon the system. Those poisons which produce local action upon the tissues with which they come in contact, corroding or destroying them, are known under the name *Corrosive Poisons;* such are the concentrated mineral acids, sulphuric, nitric, and hydrochloric, the alkalies, potash, soda, and ammonia, and their carbonates, corrosive sublimate, butter of antimony, carbolic acid, and oxalic acid. Some of these, in addition to a local action, produce toxic symptoms due to a remote action upon other organs, the result of their absorption into the blood. Among the latter may be mentioned carbolic acid, which not only corrodes the tissues with which it comes in contact, but also causes rapid unconsciousness and death due to respiratory and cardiac paralysis. Poisoning by this substance, which is usually accidental or suicidal, rarely homicidal, has become very frequent, a rapid and progressive increase in deaths from it being observable year by year. In England and Wales from 1888 to 1897 it caused the deaths of 547 males and 584 females from suicide and 190 males and 130 females from accident or negligence. The total number of deaths in ten years thus amounted to 1451. The chief cause of the increasing frequency of deaths from this cause is to be traced to its common use as a household disinfectant. Some poisons, again, may be classed as *Irritants,* because one of their chief symptoms and effects on being swallowed is irritation of the stomach and intestines. In this class are included various metals and their salts, *e.g.*, arsenic, antimony, lead, and copper; non-metallic elements, *e.g.*, phosphorus; a large number of vegetable substances, *e.g.*, castor-oil, colocynth, elaterium, &c.; and some animal substances, *e.g.*, cantharides. In another class of poisons there is little or no local action, the symptoms produced being chiefly referable to an action on the brain and spinal cord; such poisons have been called *Neurotics.* Examples of this class are to be found in opium, prussic acid, belladonna, strychnine, and aconite. A few poisons may be further classified as *Gaseous,* since they act while in a vaporous condition, some producing a local irritant action upon the lining membrane of the air passages, *e.g.*, ammonia and chlorine; others, again, being absorbed through the lungs into the blood and producing their poisonous effects in this way, *e.g.*, chloroform, sulphuretted hydrogen.

The medical evidence in cases of poisoning rests upon —(1) the symptoms produced during life; (2) the *post-mortem* appearances; (3) the chemical analysis and detection of the substance in the body, or in the excretions and vomited matters, or in articles of food; (4) experiments on animals in the case of certain poisons where other conclusive evidence is difficult to obtain. The treatment of cases of poisoning will vary according to the substance taken, but the general principles which should be followed are: (*a*) to get rid of the poison by means of the stomach pump, or by washing out the stomach with water through a soft rubber tube, or by giving an emetic such as mustard, sulphate of zinc, ipecacuanha; (*b*) to neutralize the poison by giving a substance which will form with it an innocuous compound (*e.g.*, in the case of the strong acids by administering magnesia or common whiting), or which has an opposite physiological action (*e.g.*, atropine in opium poisoning); (*c*) to promote the elimination from the body of the poison which has been already absorbed; (*d*) general treatment of any dangerous symptoms which appear, as by stimulation in collapse or artificial respiration in asphyxia.

Many plants owe their poisonous properties to the presence in them of basic bodies called *alkaloids,* which are mostly solid, crystalline, and non-volatile, only a few (*e.g.*, conine and nicotine) being liquid and volatile. They are generally active poisons in minute doses, and the proof of their administration in criminal cases is surrounded with special difficulty, owing to the fact that they produce no very characteristic symptoms or marked changes in the body, while the chemical detection of the poison in the tissues is by no means easy or always successful. Amongst the many well-known alkaloids may be mentioned morphine, obtained from opium, strychnine and brucine from nux vomica, atropine from belladonna, cocaine from *Erythroxylon coca,* nicotine from tobacco, conine from the spotted hemlock. The power of manufacturing alkaloids is not confined to plants; they are also formed in the living body as a result of physiological processes, and in dead bodies as a result of the action of putrefactive bacteria. It is mainly owing to the investigations of Selmi and of Brieger that our knowledge of these animal alkaloids or *ptomaines* has assumed definite shape. The discovery that they may be formed in the body after death by the action of putrefactive bacteria was at first thought to be a great obstacle to the proof of criminal poisoning by means of vegetable alkaloids, but investigation has shown that this is not so, since it is found that, although many ptomaines are formed after death, yet practically very few possess active poisonous properties, *e.g.*, neurin and mydalein, and these do not appear until a considerable time after death, and then only in minute quantities. In addition, ptomaines do not respond to all the various tests and reactions which are characteristic of vegetable alkaloids.

Food Poisoning (see also ADULTERATION).—Foods may prove noxious from a variety of causes:—(1) The presence of metallic poisons, as in peas artificially coloured with copper salts, in tinned foods from dissolved tin salts, &c. (2) The contamination of any food with the specific germs of disease, as for example milk infected with the germ of enteric fever. (3) The presence in meat of parasites, such as the *Trichina spiralis*, or of disease in animals, capable of transmission to man, such as tuberculosis, or the presence of poison in the flesh of animals which have fed on substances harmless to them but poisonous to human beings. Grain may be infected with parasitic fungi of a poisonous character, as for example *Claviceps purpurea*, causing epidemics of ergotism. (4) Foods of various kinds may contain saprophytic bacteria which elaborate certain poisons, either before or after the food is taken. It is chiefly in relation to food poisoning from the last-mentioned cause that our knowledge has been increased in recent years.

Many cases of food poisoning, previously of mysterious origin, can now be explained by the action of bacteria and the products which they give rise to—tox-albumoses, ptomaines, toxins—by splitting up proteid substances. It is not necessary that the food should show evident signs of putrefaction. It may not do so, and yet on being eaten produce violent symptoms of gastro-intestinal irritation almost immediately, followed by various nervous symptoms. In such cases a chemical poison, developed by putrefactive bacteria before the food was eaten, quickly acts upon the system. On the other hand, symptoms may not appear for many hours after ingestion of the food, and then come on suddenly and with great severity—there has been a period of incubation. In such cases the food when swallowed has contained the bacteria, but the poisonous toxin has been elaborated by them afterwards in the system during the period preceding the onset of symptoms. In both varieties of poisoning the symptoms are similar, consisting of gastro-intestinal irritation—vomiting, purging, and pain in the abdomen—together with great prostration, fever, muscular twitchings, disturbances of vision, delirium, and coma. The varieties of meat which have most frequently given rise to poisoning (Botulismus) are pork, ham, veal, sausages, brawn, various kinds of meat pies, and potted meats. Pig flesh appears to be specially liable to become infected. A point of considerable interest, which has sometimes given rise to doubt as to the poisonous character of meat in certain instances, is, that the same food may be poisonous at one time and not at another. Thus it may be harmless when freshly prepared, cause fatal effects if eaten a day or two afterwards, and shortly after that again prove perfectly innocuous. This is explained by the fact that the toxic substances take some time to develop, and after development are still further split up by the bacteria into other bodies of a harmless nature.

In some fish, *e.g.*, *Trachinus draco* or sea weaver, the poison is a physiological product of certain glands. In others the poison is not known, as in the family *Scombridæ*, to which the disease Kakkè has been attributed. In the United Kingdom the poisonous effects produced by fish are due to bacterial agency after death, and instances have occurred from the eating of herrings, mackerel, dried salt cod-fish, caviare, tinned salmon, and tinned sardines. Shell-fish may produce poisonous effects from putrefactive changes or from the development in them (oysters and mussels) of ptomaines. Brieger discovered a ptomaine in poisonous mussels to which he gave the name mytilotoxin. It is now fully proved that oysters and mussels may become contaminated with the organism of enteric fever if placed in specifically polluted water, and thus transmit the disease to human beings. Milk, as already stated, may be contaminated and convey the infection of scarlet fever and other diseases. It may also contain substances of bacterial origin, which are possibly the cause of infantile diarrhœa, and others, having a fatal effect upon adults. Cheese has frequently caused poisoning. Vaughan discovered a toxic substance in milk and cheese—tyrotoxicon—but there are other toxic substances of bacterial origin sometimes present in cheese to which poisonous effects have probably been due. Mushroom poisoning results from the eating of poisonous fungi in mistake for the edible mushroom. The poisonous element in most cases is either muscarin contained in the fungus *Amanita muscaria*, or phallin in *Amanita phalloides*.

For death from starvation, cold and exposure, and from lightning and electrical currents, and for a discussion of questions with regard to pregnancy, delivery, sterility, and impotence, see MEDICAL JURISPRUDENCE (*Ency. Brit.* vol. xv.). For mental unsoundness, insanity, and testamentary capacity, see INSANITY (*Ency. Brit.* vol. xiii.). See also under SUICIDE. Further information may be found in the following works:—TAYLOR. *The Principles and Practice of Medical Jurisprudence.* London, 1894.—DIXON MANN. *Forensic Medicine and Toxicology.* London, 1902.—WYNTER BLYTH. *Poisons: Their Effects and Detection.* London, 1895.—ALLBUTT. *A System of Medicine.* Vol. ii. "Intoxications." London, 1897.—VAUGHAN. *Twentieth Century Practice of Medicine*, vol. xiii., article, "Ptomaines, Toxins and Leucomaines." London, 1898.—MASCHKA. *Handbuch der Gerichtlichen Medicin.* Tübingen. (1881–82.—HOFMANN. *Lehrbuch der Gerichtlichen Medicin.* Wien, 1898.—STRASSMANN. *Lehrbuch der Gerichtlichen Medicin.* Stuttgart, 1895.—KUNKEL. *Handbuch der Toxikologie.* Jena, 1899.—BROUARDEL. *L'Infanticide, La Pendaison, &c.* Paris, 1897. (H. H. L.)

Medici, Giacomo, MARQUIS OF THE "VASCELLO" (1817–1882), Italian patriot and soldier, was born at Milan in January 1817. Exiled in 1836, he fought in Spain against the Carlists between 1836 and 1840, and in 1846 joined Garibaldi at Montevideo in the war with the dictator Rosas. Returning to Italy with Garibaldi in 1848, he raised a company of volunteers to fight against Austria, and commanded the volunteer vanguard in Lombardy, proceeding thence to Rome, where he gained distinction by his defence of the "Vascello," a position near the Porta San Pancrazio. During the siege he himself was wounded. In the war of 1859 he commanded a volunteer regiment, and was sent by Cavour into the Tirol. In 1860 he tried to dissuade Garibaldi from the Marsala expedition, but, after his chief's departure, sailed for Sicily with the second expedition, taking part in the whole campaign, during which he forced Messina to capitulate after an eight days' siege. Joining the regular army, he was appointed military commandant of Palermo, in which capacity he facilitated the abortive Garibaldian campaign of 1862. In 1866 he commanded the division which invaded Trent, but the effect of his victories was neutralized by the conclusion of peace. Returning to Palermo with instructions to suppress brigandage and crush the Maffia, he became involved in a quarrel with the procurator-general Tajaní, and relinquished his post. Created senator in 1870, and marquis of the "Vascello" and first aide-de-camp to the king in 1876, he exercised the latter functions until his death on 9th March 1882. (H. W. S.)

MEDICINE.

In the admirable survey of the history of Medicine in the ninth edition of this work the author carried the subject down to the middle of the 19th century. To appreciate and compare the various tendencies and achievements of our contemporaries in so large a sphere as that of medicine is very difficult, and in some sense impossible; yet at the beginning of the 20th century an attempt must be made to indicate the main lines on which medicine is advancing, and probably will advance. The progress of medicine, as of other arts depending directly on physical science, has been prodigious; both through the purgation and reform of its methods and through the discovery of new knowledge of wide practical bearings and of immediate utility. Medicine in the past has been variably dominated by three tendencies: in certain periods its professors pursued their study as naturalists—for example, Hippocrates, Sydenham, and Graves; or again as dialecticians, or reasoners in abstract terms—for example, the school of the "Methodists," the vitalist school of Montpellier, the animists, the iatro-physical school in which the body was regarded as an engine, the iatro-chemical in which it was regarded as an alembic, the Brunonian, and so forth. Finally, the modern school, though still naturalistic in its methods of clinical observation, has founded its methods more securely upon the tests of verification, after the example of Harvey and indeed of Galen himself, adding to experience the *experientia quœsita* without which natural observation is incomplete. We shall not forget that the most scientific physician of our own day may fall into sophistry, and that the most abstract dialecticians of other times have deviated occasionally into positive methods, but it is mainly true that the prevailing bent of successive schools has varied after this fashion and that. Medicine, like other departments of human activity, has taken its colour from the character of the thought of the times. If sometimes medicine has seemed curiously independent of the philosophy of its age, it has never been really independent of it, nor could it possibly have such an independence. In our own day the positive bent of modern knowledge and methods in other spheres of science and thought, and especially in biology, has influenced medicine profoundly. Minuter accuracy of observation was inculcated by the labours and the teaching of the great anatomists of the 17th century; and, for modern times, experimental physiology was instituted by Harvey, anatomy having done little to interpret life in its dynamic aspects. For medicine in England Harvey did what Gilbert did for physics and Boyle for chemistry: he insisted upon direct interrogation of natural processes, and thereby annihilated the ascendancy of mere authority, which, while nations were in the making, was an essential principle in the welding together of heterogeneous and turbulent peoples. The degradation of medicine between Galen and Harvey, if in part it consisted in the blind following of the authority of the former physician, was primarily due to other causes; and its new development in the last two centuries is not due to the discovery of the experimental method alone: social and political causes also are concerned in the advance even of the exact sciences. Among such contributory causes is the more familiar intercourse of settled nations which we enjoy in our own day; the ideas of one nation rapidly permeate neighbouring nations, and by the means of printed books penetrate into remoter provinces and into distant lands. Hence in this article the description of the advance of medicine in western Europe and America may be taken as a whole, without that separate treatment, nation by nation, which in the history of earlier times was necessary. Italy lost the leading place she had taken in the new development of science. The several influences of modern Germany, France, and America became of the first importance to English medicine; but these tides, instead of pursuing their courses as independent streams, have become confluent. The work of Schwann, Müller, Virchow, and Ludwig in Germany, of Laennec and Bernard in France, was accepted in England, as that of Matthew Baillie, Charles Bell, Bright, Graves, and others of the British school, quickly made itself felt abroad. Our survey of the medicine of the latter half of the 19th century then will not be divided into national histories; though in passing some special features in the work of each nation may have due notice.

General Progress.

Experimental method recognized.

The character of modern medicine cannot be summed in a word, as, with more or less aptness, that of some previous periods may be. Modern medicine, like modern science, is as boldly speculative as it has been in any age, and yet it is as observant as in any naturalistic period; its success lies in the addition to these qualities of the method of verification; the fault of previous times being not the activity of the speculative faculty, without which no science can be fertile, but the lack of vigilant reference of all and sundry propositions, and parts of propositions, to the test of experiment. In no department is the experimental method more continually justified than in that of the natural history of disease; which at first sight would seem to have a certain independence of it and a somewhat exclusive value of its own. Hippocrates had no opportunity of verification by necropsy, and Sydenham neglected pathology; yet the clinical features of many but recently described diseases, such, for example, as that named after Graves, and myxœdema, both associated with perversions of the thyroid gland, lay as open to the eye of physicians in the past as to our own. Again, to the naturalist the symptoms of tabes dorsalis were visible enough, had he noted them. No aid to the trained eye was necessary for such observations, and for many other such; yet, if we take Sir Thomas Watson as a modern Sydenham, we find in his lectures no suspicion that there may be a palsy of muscular co-ordination apart from deprivation of strength. Indeed, it does not seem to have occurred to any one to test the muscular strength in the various kinds of paraplegia. Thus it was, partly because the habit of acceptance of authority, waning but far from extirpated, dictated to the clinical observer what he should see; partly because the eye of the clinical observer lacked that special training which the habit and influence of experimental verification alone can give, that physicians, even acute and practised physicians, failed to see many and many a symptom-group which went through its evolutions conspicuously enough, and needed for its appreciation no unknown aids or methods of research, nor any farther advances of pathology. We see that the practice of the experimental method endows with a new vision both the experimenter himself and, through his influence, those who are associated with him in medical science, even if the latter be not themselves engaged actually in experiment; a new discipline imposed upon old faculties, which is seen as well in other sciences as in those on which medicine more directly depends. And it is not only the perceptions of eye or ear which tell, but also the association of concepts behind these adits of the mind. It was the concepts derived from the experimental methods of Harvey, Lavoisier, Liebig, Claude Bernard, Helmholtz, Darwin, Pasteur, Lister, and others, which, directly or indirectly, trained the eyes of clinicians to observe more closely and accurately; and not of clinicians only, but also of pathologists, such as Matthew Baillie, Cruveilhier, Rokitansky, Bright, Virchow—to name but a few of those who, with (as must be admitted) new facilities for necropsies, began to pile upon us discoveries in morbid anatomy and histology. If at first in the 18th century, and in the earlier 19th, the discoveries in this branch of medical knowledge had a certain isolation, due perhaps to the prepossessions of the school of Sydenham, they soon became the property of the physician, and were brought into co-ordination with the clinical phenomena of disease. The great Morgagni, the founder of morbid anatomy, himself set the example of carrying on this study parallel with clinical observation; and always insisted that the clinical story of the case should be brought side by side with the revelations of the necropsy. In pathology, indeed, Virchow's influence in the transfiguration of this branch of science may almost be compared to that of Darwin and Pasteur in their respective domains (see PATHOLOGY). In the last quarter of the 19th century the conception grew clearer that morbid anatomy for the most part demonstrates disease in its static aspects only, and also for the most part in the static aspect of final demolition; and, as pathology and clinical medicine became more and more thoroughly integrated, it became manifest that the processes which initiate and are concerned in this dissolution were not revealed by the scalpel.

Again, the physician as naturalist, though stimulated by the pathologist to delineate disease in its fuller manifestations, yet was hampered in a measure by the didactic method of constructing "types" which should command the attention of the disciple and rivet themselves on his memory; thus too often those incipient and transitory phases which initiate the paths of dissolution were missed. Not only so, but the physician, thus fascinated by "types," and impressed by the silent monuments of the pathological museum, was led to localize disease too much, to isolate the acts of nature, and to forget not only the continuity of the phases which lead up to the exemplary forms, or link them together, but to forget also that even between the types themselves relations of affinity must exist—and these oftentimes none the less intimate for apparent diversities of form, for types of widely different form may be, and indeed often are, more closely allied than types which have more superficial resemblance—and to forget, moreover, how largely negative is the process of abstraction by which types are imagined. Upon this too static a view, both of clinical type and of *post-mortem* room pathology, came a despairing spirit, almost of fatalism, which in the contemplation of organic ruins lost the hope of cure of organic diseases. So prognosis became pessimistic, and the therapeutics of the abler men negative, until fresh hopes arose of stemming the tides of evil at their earliest flow.

Influence of Darwin.

Such was medicine, statically ordered in pathology, statically ordered in its clinical concepts, when, on the 24th of November 1859, the *Origin of Species* was published. It is no exaggeration to say that this epoch-making work brought to birth a world of conceptions as new as the work of Copernicus. For the natural philosopher the whole point of view of things was changed; in biology not only was the anthropocentric point of view banished, but the notion of perpetual flux was brought home to ordinary men, and entered for good into the common framework of thought. The study of comparative pathology, yet in an inchoate stage, and of embryology, illuminated and enlarged biological conceptions, both normal and abnormal; and the *ens reale subsistens in corpore* disappeared for ever—at any rate from physiology and medicine. Before Darwin—if the name of Darwin may be used to signify the transfiguration of thought of which he was the chief artificer—natural objects were regarded, not in medicine and pathology only, as a set of hidebound events; and natural operations as moving in fixed grooves, after a fashion which it is now difficult for us to realize. With the melting of the ice the more daring spirits dashed into the new current with such ardour that for them all traditions, all institutions, were thrown into hotchpot; even elderly and sober physicians took enough of the infection to liberate their minds, and, in the field of the several diseases and in that of *post-mortem* pathology, the hollowness of classification by superficial resemblance, the transitoriness of forms, and the flow of processes, broke upon the view. Thus it came about not only that classifications of disease based on superficial likeness—such as jaundice, dropsy, inflammation—were broken up, and their parts redistributed, but also that even more set diseases began to lose their settlements, and were recognized as terms of series, as transitory or culminating phases of perturbations which might be traced to their origins, and in their earlier stages perhaps withstood.

The doctrine of heredity in disease thus took a larger aspect; the view of morbid series was no longer bounded even by the life of the individual; and the propagation of taints, and of morbid varieties of man, from generation to generation proved to be no mere repetition of fixed features but, even more frequently, to be modes of development or of dissolution betraying themselves often in widely dissimilar forms, in series often extending over many lives, the terms of which at first sight had seemed wholly disparate. Thus, for example, as generations succeed one another, nervous disorders appear in various guise; epilepsy, megrim, insanity, asthma, hysteria, neurasthenia, a motley array at first sight, seemed to reveal themselves as terms of a morbid series; not only so, but certain disorders of other systems also appeared to be members of the series, such as certain diseases of the skin, and even peculiar susceptibilities or immunities in respect of infections from without. On the other hand, not a few disorders proved to be alien to classes to which narrower views of causation had referred them; of such are tabes dorsalis, neuritis, infantile palsy, or tetanus, now removed from the category of primary nervous diseases and placed in one or other of the series of infections; or, conversely, certain forms of disease of the joints are now regarded with some certainty as members of more than one series of diseases chiefly manifest in the nervous system. In the effects of simpler poisons the recognition of unity in diversity, as in the affiliation of a peripheral neuritis to arsenic, illustrated more definitely this serial or etiological method of classifying diseases. On the other hand, inheritance was dismissed, or survived only as a "susceptibility," in the cases of tubercle, leprosy, and some other maladies now recognized as infectious; while in others, as in syphilis, it was seen to depend upon a translation of the infectious element from parent to offspring. These new conceptions of the multiplicity in unity of disease, and of the fluidity and continuity of morbid processes, might have led to vagueness and over-boldness in speculation and reconstruction, had not the experimental method been at hand with clues and tests for these series. Against such dangers the rise and wonderful extension of the science of bacteriology also furnished no inconsiderable safeguard.

In the disease of the scalp called favus, Schönlein had discovered a minute mycelial fungus—a remarkable discovery; for it was the first conspicuous step in the attribution of diseases to the action of minute parasites. Schönlein thus did something to introduce new and positive conceptions and exacter methods into Germany; but unfortunately his own mind retained the abstract habit of his country, and his abilities were dissipated in the mere speculations of Schelling. Similarly Karl Hoffmann of Würzburg wasted his appreciations of the newer schools of developmental biology in fanciful notions of human diseases as reversions to normal stages of lower animals; scrofula being for him a reversion to the insect, rickets to the mollusc, epilepsy to the oscillaria, and so forth. Even that distinguished physiologist Johannes Müller remained a staunch vitalist. Fortunately Germany, which at the beginning of the century was delivered over to Brownism and vitalism and was deaf to Bichat, was rescued from this sort of barrenness by the brilliant experimental work of Claude Bernard and Pasteur in France—work which, as regards the attenuated virus, was a development of that of Edward Jenner, and indeed of Schwann—Koch worthily following Pasteur with his work on the bacillus of anthrax and with his discovery of that of tuberculosis; and by the cellular doctrine and abundant labours in pathology of Virchow (see PATHOLOGY). Brieger then discovered the toxins of certain infections; and Behring completed the sphere of the new study by his discovery of the antitoxins of diphtheria and tetanus. Although in practical medicine the subsequent results of Behring and his followers have hitherto been somewhat disappointing, for in diphtheria alone have these discoveries attained a signal therapeutical success (indeed toxic action and capacity for combining with antitoxin are unfortunately not identical), yet in transforming our conceptions of nosology, and in destroying the last strongholds of vitalism and teleology, they have been most fertile. If the striking conceptions of Ehrlich continue to prove as fertile in inspiring and directing research as at present they seem to be, another wide sphere of conceptions will be opened out not in bacteriology only, but also in pathological chemistry, and in molecular physics. Again, besides giving us the clue to the nature of many diseases and to the continuity of many morbid series, by bacteriology certain diseases, such as actinomycosis, have been recognized for the first time.

Bacteriology.

As the prevalence of the conceptions signified and inspired by the word "phlogiston" kept alive ontological notions of disease, so the dissipation of vitalistic conceptions in the field of physics prepared men's minds in pathology for the new views opened by the discoveries of Pasteur on the side of pathogeny, and of Cohnheim and of Metschnikoff on the dynamical side of histology. Of the older ontological notions of disease the strongest were those of the essence of fever and of the essence of inflammation. Broussais had done much to destroy the notion of fever as an entity, but by extravagances in other directions he had discredited the value of his main propositions. Yet, although, as Andral and other French physicians proved, it was extravagant to say that all fevers take their origin from some local inflammation, it was true and most useful to insist, as he vehemently insisted, that "fever" is no substance, but a generalization drawn from symptoms common to many and various diseases springing from many, various, and often local causes; from diseases agreeing perhaps only in the factor of elevation of the temperature of the body. To the establishment of this new conception the improvement and general use of the *clinical thermometer* gave invaluable advantages. This instrument, now indispensable in our daily work at the bedside, had indeed long been known both to physiologists (Haller) and to clinicians. In the 19th century de Haen, and, in the United Kingdom, Cleghorn of Dublin and Currie, carried on the use of the thermometer in fevers; and on the Continent in later years von Bärensprung and Traube did the same service; but it is to the work of Wunderlich that we owe the establishment of this means of precision as a method of regular observation both in pathology and in clinical medicine. By his almost exhaustive comparison of febrile movements as symptomatic processes Wunderlich dealt the last blow to the expiring doctrine of the "entity" of "fever"; while on the clinical side Bretonneau and Louis, in 1862–72, by their careful clinical and pathological studies of forms of fever, relieved the new doctrine of the extravagances of Broussais, and prepared the way for the important distinction of enteric from typhus fever by A. P. Stewart, William Jenner, Budd, Murchison, Louis, Autenrieth, Magnus of Philadelphia, Huss, Gerhard, and others. By the learned and accomplished Trousseau British and German influences were brought into France. Meanwhile Cohnheim and Metschnikoff were also engaged in destroying the ontological conception not of fever only, but also of inflammation, of which, as a local event, an ontological conception was no less strongly implanted. By his researches on the migration of the white corpuscles of the blood Cohnheim, on the bases laid by Virchow, brought the processes of inflammation within the scope of the normal, seeing in them but a modification of normal processes under perturbations of relatively external incidence; even the formation of abscess was thus brought by him within the limits of perversion of processes not differing essentially from those of health; and "new formations," "plastic exudations," and other discontinuous origins of an "essential" pathology, fell into oblivion. And it is not alien from the present point of view to turn for a moment to the light thrown on the cardio-arterial pulse and the measurement of its motions by the more intimate researches into the phenomena of the circulation by many observers, among whom in the 19th century Hope, Marey, and Ludwig will always take a leading place. By them the demonstration of Harvey that the circulation of the blood is in large part a mechanical process, and nowhere independent of mechanical laws, was considerably enlarged and extended. In particular the fluctuations of the pulse in fevers and inflammations were better understood, and accurately registered; and we can scarcely realize now that before Harvey the time of the pulse seems not to have been counted by the watch. Discovery in these various directions then led physicians to regard fever and inflammation not as separable entities, but as fluctuating symptom-groups, due to swervings of function from the normal balance under contingent forces.

Fevers and inflammations.

As to such reforms in our conceptions of disease the advances of bacteriology profoundly contributed, so under the stress of consequent discoveries, almost prodigious in their extent and revolutionary effect, the conceptions of the etiology of disease underwent no less a transformation than the conceptions of disease itself. It is proper to point out here how intimately a pathology thus regenerated modified current conceptions of disease, in the linking of disease to oscillations of health, and the regarding many diseases as modifications of the normal set up by the impingement of external causes; not a few of which indeed may be generated within the body itself—"autogenetic poisoning." The appreciation of such modifications, and of the working of such causes, has been facilitated greatly by the light thrown upon normal processes by advances in physiology; so dependent is each branch of knowledge upon the advances of contiguous and incident studies. To physiological

New conceptions of etiology.

chemistry we have been deeply indebted during the latter half of the 19th century. In Würzburg, in 1872, Hoppe Seyler gave a new beginning to our knowledge of the chemistry of secretion and of excretion; and later students have increased the range of physiological and pathological chemistry by investigations not only into the several stages of albuminoid material and the transitions which all food-stuffs undergo in digestion, but even into the structure of protoplasm itself. Digestion, regarded a generation ago as little more than a trituration and "coction" of ingesta, to fit them for absorption and transfer them to the tissues, now appears as an elaboration of peptones and kindred intermediate products which, so far from being always bland, and mere bricks and mortar for repair or fuel for combustion, pass through phases of change during which they become so unfit for assimilation as to be positively poisonous. The formation of prussic acid at a certain period of the vital processes of the lotus may be given as a simple example of such phases; and poisons akin to muscarin seem to arise frequently in development or regression, both in animals and plants. Thus the digestive function, in its largest sense, is now seen to consist not only in preparation and supply, but in no small measure also of protective and antidotal conversions of the matters submitted to it; coincidently with agents of digestion proper are found in the circuit of normal digestion "anti-substances" which neutralize or convert peptones in their poisonous phases; an autochthonous ferment, such as rennet for instance, calling forth an anti-rennet, and so on. Now as our own bodies thus manipulate substances poisonous and antidotal, if in every hour of health we are averting self-intoxication, so likewise are we concerned with the various intruding organisms, whose processes of digestion are as dangerous as our own; if these destructive agents, incessantly no doubt gaining admission to our bodies, do not meet within us each its appropriate compensatory defensive agent, dissolution will begin. Thus, much of infection and immunity are proving to be but special cases of digestion, and teleological conceptions of protective processes are modified.

Natural resistance.

Under the name of chemotaxis (Pfeffer) are designated certain of the regulative adaptations by which such ends are attained. By chemical warnings the defensive processes seem to be awakened, or summoned; and when we think of the infinite variety of such possible phases, and of the multitude of corresponding defensive agents, we may form some dim notion of the complexity of the animal blood and tissues, and within them of the organic molecules. Even in normal circumstances their play and counterplay, attractive and repellent, must be manifold almost beyond conception; for the body may be regarded as a collective organization consisting of a huge colony of micro-organisms become capable of a common life by common and mutual arrangement and differentiation of function, and by toleration and utilization of each other's peculiar products; some organs, such as the liver, for example, being credited with a special power of neutralizing poisons, whether generated under normal conditions or under abnormal, which gain entrance from the intestinal tract. As a part of these discoveries has arisen another but kindred doctrine, that of "internal secretions" of juices prepared, not for excretion, or even to be poured into channels of partial excretion, but for the fulfilment of physiological ends in the processes of metabolism. It is probable not only that the secreted juices of specialized cells are thus set one against another in the body, but also that the blood itself in its cellular and fluid parts contains elements potent in the destruction of bacteria and of their secretions. Thus endowed, the blood, unless overwhelmed by extraordinary invasions, does not fail in stability or self-purification, and bacteria are not detected in its current. So various are the conditions of self-regulation in various animals, both in respect of their peculiar and several modes of assimilating different foods, and of protecting themselves against particular dangers from without, that, as we might have expected, the bloods taken from different species, or even perhaps from different individuals, are found to be so different that the healthy serum of one species may be, and often is, poisonous to another; not in respect of adventitious substances, but because the phases of physiological change in different species do not harmonize, each by its peculiar needs having been modified in different ways until, in their several conditions of life, they vary so much about the mean as to become almost if not quite alien one to another.

In the preservation of immunity then, in its various degrees and kinds, not only is the chemistry of the blood to be studied, but also its histology. By his eminent labours in cellular pathology Virchow, and Metschnikoff later, gave the last blow to the mere humoral pathology which, after an almost unchallenged prevalence for some two thousand years, now finds a resting-place only in our nurseries. Now the cellular pathology of the blood, investigated by the aid of modern staining methods, is as important as that of the solid organs; no clinical investigator, indeed, apart from research, no practitioner at this day, can dispense with examination of the blood for purposes of diagnosis; its coagulability and the kinds and the variations of the cells it contains being evidence of many definitely morbid states of the body. Again, not only in certain diseases may strange cells be found in the blood (*e.g.*, in Myelogenic Leucæmia), but parasites also, certain protozoa (malaria), and even certain higher forms of animal life (Filaria, Tsetse disease, Texas fever) having been discovered therein, to the great advantage of medicine (see PATHOLOGY: *Parasitic Diseases*). It is interesting to note that even the large and well-known parasites of the intestinal canal come into line with the microbes, for it is now suspected that even the *Bothriocephalus latus*, for example, is not merely a mechanical irritant, or a mere competitor for nutriment, but is injurious to its host by an intoxication.

Specialism.

It is obvious that the results of such advances prescribe for the clinical physician methods which cannot be pursued without expert assistance; a physician engaged in busy practice cannot himself undertake even the verifications required in the conduct of individual cases. Skill in modern laboratory work is as far out of the reach of the untaught as performance on a musical instrument. In spite, therefore, of the encyclopædic tradition which has persisted from Aristotle through the Arab and mediæval schools down to Mr Herbert Spencer, it is forced upon us in our own day that in a pursuit so many-sided as medicine, whether in its scientific or in its practical aspect, we have to submit more and more to that division of labour which has been a condition of advance in all other walks of life. It is now fully recognized that diseases of infants and children, of the insane, of the generative organs of women, of the larynx, of the eye, have been brought successively into the light of modern knowledge by "specialists," and by them distributed to the profession; and that in no other way could this end have been attained. That the division of labour, which may seem to disintegrate our calling, really unites it, is well seen in the clinical laboratories which were initiated in the later 19th century, and which are destined to a great future. By the approach of skilled pathologists to the clinical wards, a link is forged between practitioners and the men of science who pursue pathology disinterestedly. The first clinical laboratory seems to have been that of von Ziemssen at Munich, founded in 1885; and, although his example has not yet been followed as it ought to have been, enough has been done in this way, at Johns Hopkins University and elsewhere, to prove the vital importance of the system to the progress of modern medicine. At the same time provision must be made for the integration of knowledge as well as for the winning of it by several adits. A conspicuous example of the incalculable evil wrought by lack of integration is well seen in the radical divorce of surgery from inner medicine, which is one of the most mischievous legacies of the Middle Ages—one whose mischief is scarcely yet fully recognized, and yet which is so deeply rooted in our institutions, in the United Kingdom at any rate, as to be hard to obliterate. That the methods and the subject matter of surgery and of medicine are substantially the same, and that the advance of one is the advance of the other, the division being purely artificial and founded merely on accidents of personal bent and skill, must be insisted upon at this time of our history. The distinction was never a scientific one, even in the sense in which the word science can be used of the Middle Ages; it originated in social conceits and in the contempt for mechanical arts which came of the cultivation of "ideas" as opposed to converse with "matter," and which, in the dawn of modern methods, led to the derision of Boyle by Oxford humanists as one given up to "base and mechanical pursuits." Had physicians been brought into contact with facts as hard as were the surgeons of the 16th century (cf. Ambrose Paré, SURGERY, *Ency. Brit.* vol. xxii. p. 676), our art would not have lain so long in degradation. It is under this closer occupation with mechanical conditions that surgery to-day is said—not without excuse, but with no more than superficial truth—to have made more progress than medicine. Medicine and surgery are but two aspects of one art; yet even the history of modern medicine is thus divided, and it is from another article that the reader must learn how by the brilliant services of modern surgeons have been enforced the same methods and truths as we are learning in the field of medicine proper; how Pasteur shed light on both surgery and medicine, and how Lister, his disciple, penetrated into the secrets of wound fevers and septicæmia, whereby he illuminated surgery and medicine alike, and, in the one sphere as in the other, co-operated in the destruction of the idea of "essential fevers" and of inflammation as an "entity" (see LISTER). Together, then, with the necessary multiplication of specialism, one of the chief lessons of the latter moiety of the 19th century was the unity of medicine in all its branches—a unity strengthened rather than weakened by special researches, such as those into "medical" and "surgical" pathology, which are daily making more manifest the absurdity of the distinction. Surgeons, physicians, oculists, laryngologists, gynæcologists, neurologists and the rest, all are working in allotments of the same field, and combine to a common harvest.

Medical training.

While pathology then, which is especially the "science of medicine," was winning territory on one side from physiology, of which in a sense it is but an aspect, and on another by making ground of its own in the *post-mortem* room and museum of morbid anatomy, and was fusing these gains in the laboratory so as to claim for itself, as a special branch of science by virtue of peculiar concepts, its due place and provision—provision in the establishment of chairs and of special laboratories for its chemical and biological subdivisions—clinical medicine, by the formal provision of disciplinary classes, was illustrating the truth of the experience that teaching and research must go hand in hand, the one reinforcing the other; that no teacher can attain great success unless he be engaged in research also: nay, that for the most part even the investigator needs the encouragement of disciples. Yet it was scarcely until the last quarter of the 19th century that the apprenticeship system, which was a mere initiation into the art and mystery of a craft, was recognized as antiquated; in its virtual exclusion of academic study, even mischievous; and that in place of it systematic clinical classes became part of the scheme of every efficient school of medicine. A condition of this advance was the need of a preliminary training of the mind of the pupil in pure science, even in physics and chemistry; that is to say, before his introduction into his professional studies. The founding of new teaching universities, in which England, and even France, had been at some disadvantage as compared with Scotland and Germany, strengthened the movement in favour of enlarging and liberalizing technical training, and of anticipating technical instruction by some broader scientific discipline; though, as in all times of transition, something was lost temporarily by a departure from the old discipline of the grammar school before a new scheme of training the mind in scientific habits and conceptions was established or fully apprehended. Yet on the whole, even from the beginning, the revolt was useful in that it shook the position of the "learned physician," who took a literary, fastidious, and meditative rather than an experimental interest in his profession, and, as in great part a descendant of the humanists, was never in full sympathy with natural science. At the risk no doubt of some defects of culture, the newer education cleared the way for a more positive temper, awoke a new sense of accuracy and of verification, and created a sceptical attitude towards all conventions, whether of argument or of practice. Among the drawbacks of this temper, which on the whole made for progress, was the rise of a school of excessive scepticism, which, forgetting the value of the accumulated stores of empiricism, despised those degrees of moral certainty that, in so complex a study and so tentative a practice as medicine, must be our portion for the present, and even for a long future; however great the triumphs of medicine may become. This scepticism took form in the school, most active between 1860 and 1880, known as the school of "Expectant Medicine." These teachers, genuinely touched with a sense of the scantiness of our knowledge, of our confidence in abstract terms, of the insecurity of our alleged "facts," case-histories, and observations, alienated by traditional dogmatisms and disgusted by meddlesome polypharmacy—enlightened, moreover, by the issue of cases treated by means such as the homœopathic, which were practically "expectant"—urged that the only course open to the physician, duly conscious of his own ignorance and of the mystery of nature, is to put his patient under diet and nursing, and, relying on the tendency of all equilibriums to recover themselves under perturbation, to await events (*Vis medicatrix naturæ*). Those physicians who had occupied themselves in the study of the exacter sciences, or more closely or more exclusively of the wreckage of the *post-mortem* room, were the strongest men of this school, whether in England or abroad.

Therapeutics.

But to sit down helpless before human suffering is an unendurable attitude. Moreover, the insight into origins, into initial morbid processes revealed by the pathologists, awoke more and more the hope of dealing with the elements of disease, with its first beginnings; and in the field of therapeutics, chemical and biological experiment was rapidly simplifying remedies and defining their virtues (PHARMACOLOGY), as in the case of digitalis, mercury, and the iodides, so that these agents could be used at the bedside with more precision. Furthermore, the aversion from drugging had the advantage of directing men's minds to remedies taken from the region of the physical forces, of electricity (Duchenne), of gymnastics (Ling), of hydropathy (Priessnitz), of massage (Weir Mitchell), of climate (Sir James Clarke), of diet (Todd, King Chambers, &c.), and even of hypnotism (Baird); while with the improvement of the means of locomotion came the renewal of the old faith and the establishment of new methods in the use of mineral springs. These and such means, often in combination, took much of the place formerly given to the use of drugs.

Hygiene.

Again, a like spirit dictated the use of the physical or "natural" methods on a larger scale in the field of prevention. From the new regard given by physiologists and pathologists to the study of origins, and in the new hopes of thus dealing with disease at its springs, not in individuals only but in cities and nations, issued the great school of Preventive Medicine, initiated in England (Parkes, Simon, Richardson, Acland, Buchanan), and forwarded in Germany by Pettenkofer. Hygiene became for pathology what "milieu" is for physiology. By the modification of physical conditions on a national scale a prodigious advance was made in the art of preventing disease. The ghastly roll of infantile mortality was quickly purged of its darkest features (Ballard and others); aided by bacteriology, sanitary measures attained some considerable degree of exactness; public medicine gained such an ascendancy that special training and diplomas were offered at universities; and in 1875 a consolidated Act was passed for the United Kingdom establishing medical officers of health, and responsible lay sanitary authorities, with no inconsiderable powers of enforcing the means of public health in rural, urban, port, and other jurisdictions, with summary methods of procedure. A department of public health was formed within the precincts of the Local Government Board; Government laboratories were established, and machinery was devised for the notification of infectious diseases. The enormous growth of towns during the second half of the 19th century was thus attended with comparative safety to these great aggregates of mankind; and the death-rates, so far from being increased, relatively decreased in substantial proportions. In 1878 an Act was passed giving like powers in the case of the infectious diseases of animals. The establishment in England of the Register of qualified practitioners and of the General Medical Council (in 1858) did something, however imperfectly, to give unity to the profession, unhappily bisected by "the two colleges"; and did much to organize, to strengthen, and to purify medical education and qualification. In 1876 women were admitted to the Register kept by the Council. In 1871 the Anatomical Act of 1832 was amended; and in 1876 the Vivisection Act was passed, a measure which investigators engaged in the medical sciences of physiology and pathology resented as likely to prevent in England the advance of knowledge of living function, both in its normal balance and in its aberrancies, and moreover to slacken that habit of incessant reference of propositions to verification which is as necessary to the clinical observer as to the experimentalist. However the opinion of later generations may stand in respect of the Vivisection Act, it will surely appear to them that the other Acts, largely based upon the results of experimental methods, strengthening and consolidating the medical profession, and fortifying the advance of medical education, led directly to a fundamental change in the circumstances of the people in respect of health. The intelligent classes have become far better educated in the laws of health, and less disposed to quackery; the less intelligent are better cared for and protected by municipal and central authority. Thus the housing of the poor has been improved, though this difficult problem is yet far from solution; not the large towns only, but the larger villages also, are cleansed and drained; food has been submitted to inspection by skilled officers; water supplies have been undertaken on a vast scale; personal cleanliness has been encouraged, and with wonderful success efforts have been made to bring civilized Europe back from the effects of a long wave of Oriental asceticism, which in its neglect and contempt of the body led men to regard filth even as a virtue, to its pristine cleanliness under the Greeks and Romans. During the latter half of the 19th century the death-rate of many towns was reduced by something like 50 per cent. Some plagues, such as typhus fever, have been dispelled; others, such as enteric fever, have been almost banished from large areas; and there is much reason to hope that cholera and plague, if introduced, could not get a footing in western Europe, or in any case could be combated on scientific principles, and greatly reduced. Temperance in the use of alcohol has followed the demonstration not only of the gross exaggeration of its nutritive value, but also of its harmfulness, save in very small quantities. In the earlier part of the 19th century, and in remoter districts even in its later years, the use of alcohol was regarded not as a mere indulgence, but as essential to health: the example of teetotallers, as seen in private life and in the returns of the insurance offices, has undermined this mischievous belief. From the time of Plato medicine has been accused of ministering to the survival of unfit persons, and to their propagation of children. But bodily defect is largely a result of evil circumstances, in the prevention of which the physician is not unsuccessfully engaged. Thus the mean standard of health will be raised, perhaps enormously.

In the tropics, as well as in Europe, such methods and such researches threw new light upon the causes and paths of the terrible infections of these climates. In 1880, two years before Koch discovered the bacillus of tubercle, Laveran discovered the amœba of malaria, and truly conceived its relations to the disease; thus within two years were made two discoveries either of which was sufficient to make the honour of a century. Before the end of the 19th century this discovery of the blood parasite of malaria was crowned by the hypothesis of Manson, proved by Ross, that malaria is propagated by a certain genus of gnat, which acts as an intermediate host of the parasite. The 20th century, by means of this illumination of one of the darkest regions of disease, may diminish human suffering enormously, and may make habitable rich and beautiful regions of the earth's surface now, so far as man's work is concerned, condemned to sterility. Moreover, freedom of trade and of travel has been promoted by a reform of the antiquated, cumbrous, and too often futile methods of quarantine—a reform as yet very far from complete, but founded upon a better understanding of the nature and propagation of disease.

SPECIAL DEPARTMENTS.

Infections.

Hitherto we have presented a survey of the progress of the science and practice of medicine on general lines; it remains to give some indication of the advance of these subjects of study and practice in particular departments. As regards infections, it is not to be supposed that our knowledge of these maladies has been advanced by pathology and bacteriology only. In the clinical field also it has received a great enlargement. Diphtheria, long no doubt a plague among mankind, was not carefully described until by Bretonneau in 1826; and since his time our conception of this disease has been extended by the study of later, secondary, and incidental phases of it, such as neuritis, which had always formed part of the diphtheritic series, though their intimate connexion with it had not been suspected. Influenza, again, was well known to us in 1836–40, yet clinical observers had not traced out those sequels which, in the form of neuritis and mental disorder, have impressed upon our minds the persistent malignity of this infection, and the manifold forms of its activity. By the discovery of the bacillus of tubercle, the physician has been enabled to piece together a long and varied list of maladies under several names, such as scrofula and lupus, many of them long suspected to be tuberculous, but now known to be of the same series. It is on clinical grounds, for their respective specific agents are as yet unknown, that syphilis, beriberi, scarlet fever, measles, &c., are recognized as belonging to the same class, and evolving in phases which differ not in intimate nature but in the more superficial and inessential characters of time, rate, and polymorphism. On clinical grounds also the impression is gaining strength that acute rheumatism belongs to the group of the infections; and that certain sore throats, chorea, and other maladies apparently distinct, are terms of this series. Thus the field of disease arising not from essential defect in the body, but from external contingencies, is enlarging; while on the other hand the great variability of individuals in susceptibility explains the very variable results of such extrinsic causes. Coincidently therewith, the hope of neutralizing infections by fortifying individual immunity has grown brighter, for it appears that immunity is not a very radical character, but one which, as in the case of vaccination, admits of modification and accurate adjustment in the individual, in no long time and by no very tedious methods. In a few years we may be able to do for other infections what we have done already for smallpox, for diphtheria, and perhaps for typhoid fever and cholera. The field of antitoxic treatment will also prove wider and wider as one disease after another falls into the category of contingent infection. Leprosy, for instance, is now traced to its own bacillus, and, the fatalist notion of heredity being thereby dispelled, the hope of prevention, based on a discovery of the nature of the infection, is awakened. Cholera seems to be falling into the power of the pathologist (Haffkine), and evidence is accumulating which may end in the explanation and perhaps in the prevention of the direst of human woes—cancer itself.

Neurology.

When, leaving the infections, we look for evidence of progress in our knowledge of more or less local diseases, we may begin with the nervous system. It is in this department, from its abstruseness and complexity, that we should expect the advance of anatomy and physiology—normal and morbid—to be most delayed. If we consult the medical works even of the middle of the 19th century we shall find that, in the light of the present time, accurate knowledge in this sphere, whether clinical, pathological, or therapeutical, could scarcely be said to exist. Even in the hands of Lockhart Clarke, one of the earliest investigators of nervous pathology, the improvement of the compound microscope had not attained the achromatism, the penetration, and the magnification which have since enabled Schröder von der Kolk, Kölliker, Ramon i Cajal, Golgi, and others to reveal the minute anatomy of the nervous centres; while the discrimination of tissues and morbid products by stains, as in the silver and osmic acid methods, and in those known by the names of Weigert or Marchi, had scarcely begun. In England the Hospital for the Paralysed and Epileptic was founded in 1859, when Brown-Séquard, Hughlings-Jackson, Buzzard, Bastian, Gowers, and Ferrier found an adequate field for the clinical and pathological parts of their work. In France, in the wards of the Hôtel Dieu, Duchenne of Boulogne, in association with Trousseau and in his private clinic, pursued his memorable clinical and therapeutical researches into the diseases of the nervous system; and Charcot in that great asylum for the wreckage of humanity—the Salpêtrière—discovered an unworked mine of chronic nervous disease. Romberg and Meynert also were pioneers in the study of nervous diseases, but it was not till later in the century that Germany took a high place in this department of medicine. The discoveries of the separate paths of sensory and motor impulses in the spinal cord, and consequently of the laws of reflex action, by Charles Bell and Marshall Hall respectively, in their illumination of the phenomena of nervous function, may be compared with the discovery in the region of the vascular system of the circulation of the blood; for therein a key to large classes of normal and aberrant functions and a fertile principle of interpretation were obtained. Nor was the theory of reflex action confined to the more "mechanical" functions. By G. H. Lewes and others the doctrine of "cerebral reflex" was established, whereby actions, at first achieved only by incessant attention, become organized as habits; as for instance in the playing on musical or other instruments, when acts even of a very elaborate kind may follow directly the impulses of sensations, conscious adaptation and the deliberate choice of means being thus economized. This law has important ethical and political bearings; but in the province of disease this advance of what may be called the interlocking of points and signals has had wide influence not only in altering our conceptions of disease itself, but also in enlarging our views of all perturbations of function. The paths whereby such impulses travel and become associated in the nervous system have been made out by the physiologist working on the healthy animal, as well as by the record of disease; and not by spontaneous disease alone, for the artificial institution of morbid processes in animals has led to many such discoveries, as in the method of Waller, who tracked the line of nervous strands by experimental sections, and showed that when particular strands are cut off from their nutritive centres the consequent degeneration follows the line of the separated strands. By similar methods nature, unassisted, betrays herself but too often; in many instances—probably originating primarily in the nervous tissues themselves—the course of disease is observed to follow certain paths with remarkable consistency, as for instance in diseases of particular tracts of the spinal cord. In such cases the paths of degeneration are so neatly defined that, when the tissues are prepared after death by modern methods, they are plainly to be seen running along certain columns, the subdivisions of which in the normal state are not to be distinguished one from another: some run in strips along the periphery of the spinal cord, at its anterior, middle, or posterior segments, as the case may be; or in other cases such strips occur within its substance, whether along columns of cells or of white matter. It is needless to point out how such paths of disease, in their association with characteristic symptoms, have illuminated the clinical features of disease as well as the processes of normal function.

Not, however, all diseases of the nervous system conduct themselves on these definite paths, for some of them pay no attention to the geography of function, but, as one may say, blunder indiscriminately among the several parts; others, again, pick out particular parts definitely enough, but not parts immediately continuous, or even contiguous. Diseases of the latter kind are especially interesting, as in them we see that parts of the nervous structure, separated in space, may nevertheless be associated in function; for instance, wasting of a group of muscles associated in function may depend on a set of central degenerations concurring in parts which, in spite of dissociation in space, we thus infer to be connected. The undiscriminating diseases, on the other hand, we suspect not to be primarily of nervous origin, but to depend rather on the agency of other constituent tissues of this system, as of the blood-vessels or the connective elements. Thus, arguing inversely, we may learn something of the respective natures of these influences and of the way in which the nervous system is affected secondarily.

Even the distribution of toxic matters by the blood is not necessarily followed by general and indiscriminate injury to the nervous elements. In infantile palsy, for example, and in tabes dorsalis, there is good reason to believe that, definitely as the traces of the disease are found in certain physiologically distinct nervous strands, they are due nevertheless to toxic agents arriving by way of the blood. Here we enter upon one of the most interesting chapters of disorders and modes of disorder of this and of other systems. It has come out more and more clearly of late years that poisons do not betray even an approximately indifferent affinity for all tissues, which indeed a little reflection would tell us to be *à priori* improbable, but that each tends to fix itself to this cell group or to that, picking out parts for which they severally have an affinity. Neither chemical, physiological, nor pathological research has explained the secret of these more refined kinds of "anchorage" of molecules. In 1880 Drs Crum Brown and Fraser demonstrated the remarkable fact that by substitution of molecules in certain compounds a stimulant could be converted into a sedative action; thus by the addition of the methyl group CH_2 to the molecule of strychnine, thebaine, or brucine, the tetanizing action of these drugs is converted into a paralysing action. The number of these instances, and the variety of them, are now known to be very large; and it is supposed that what is true of these simpler agents is true also of far more elaborate phases of vital metabolism. Now, what is remarkable in these and many other reactions is not only that effects apparently very opposite may result from minute differences of molecular construction, but also that, whatever the construction, agents not wholly indifferent to the body or part tend to anchor themselves to organic molecules in some way correlated with them. Highly complex as are all animal tissues, or nearly all, yet in this category of high complexity are degrees higher and higher again of which we can form little conception; so elaborate they are, so peculiar in their respective properties, and probably so fugitive. It is this wide range of dynamic peculiarities above the common range of known chemical molecules which excites our wonder; and a reflection of these peculiar properties is seen in their affinities for this or that toxic or constructive agent, whereby the peculiarity, for example, of a particular kind of nerve cell may be altered, antagonized, reinforced, or converted. On the other hand, the reagents by which such modifications are apt to be produced are not necessarily simple; many of them likewise are known to be of very high degrees of complexity, nearly as complex perhaps as the molecules to which they are akin. Of such probably are the toxins and antitoxins of certain infections, which, anchoring themselves not by any means indiscriminately, but to particular and concerted molecules, antagonize or convert them by such anchorage to favourable or unfavourable issues. Toxins, thus finding an anchorage in certain tissue molecules, may become so closely keyed into their corresponding atom groups, as for instance in tetanus, that they are no longer free to combine with the antitoxin; or, again, an antitoxin injected before a toxin may anticipate the anchorage of the latter and, preventing its mischievous adhesion, may dismiss it for excretion. In the mutual behaviour of such cells, toxins and antitoxins, and again of microbes themselves, we may demonstrate even on the field of the microscope some of the modes of such actions, which seem to partake in great measure at any rate of a chemical character (agglutinins, coagulins, chemotaxis). It is convenient here to add that such reactions and modifications, if more conspicuous in the nervous system, are of course not confined to it, but are concerned in their degree in all the processes of metabolism, being most readily perceived by us in the blood.

Anchorage of molecules.

Many other diseases formerly regarded as primarily diseases of the nervous system are not such; but, by means of agents either introduced into the body or modified there, establish themselves after the affinities of these in contiguous associated parts of the structure, as in vessels, membranes, or indeed in distant and peripheral parts; the perturbations of nervous function being secondary and consequential. Of such are tetanus and diphtheria, now known to be due to the establishment from without of a local microbic infection, from which focus a toxin is diffused to the nervous matter. The terrible nervous consequences of some forms of inflammation of the membranes of the brain, again, are due primarily to microbic invasion rather of the membranes than of their nervous contents; and many other diseases may be added to this list. The grave palsies in such diseases as influenza, diphtheria, beriberi, or ensuing on the absorption of lead, are not mainly central, but due to a symmetrical peripheral neuritis.

Among diseases not primarily nervous, but exhibited in certain phenomena of nervous disorder, are diseases of the blood-vessels. Much light has been thrown upon the variations of arterial and venous blood pressures by Ludwig and his many followers: by them not only the diseases of the circulatory system itself are elucidated, but also those of other systems—the nervous, for instance—which depend intimately on the mechanical integrity of the circulation of the blood as well as on the chemical integrity of the blood itself. With changes of the pressures of the blood in arteries, veins, or capillaries, and in the heart itself and its respective chambers, static changes are apt to take place in these parts; such as degeneration of the coats of the arteries, due either to the silent tooth of time, to persistent high blood pressures, or to the action of poisons such as lead or syphilis. Syphilitic lesion of the arteries, and likewise of other fibrous tissues, often involves grave consequential damage to nervous structures fed or supported by such parts. Some of the most successful of the advances of medicine as a healing art have followed the detection of syphilitic disease of the vessels, or of the supporting tissues of nervous centres and of the peripheral nerves; so that the treatment of paralytic, convulsive, and other terrible manifestations of nervous disease thus secondarily induced is now undertaken in early stages with definite prospect of cure, by means of specific medication.

Individual forms of disease.

Not of less importance in this respect, and in other disorders, many of them of grave incidence, is the knowledge of the phenomena of embolism and of thrombosis, also gained during the latter half of the 19th century (Kirkes, Virchow). By embolism is meant the more or less sudden stoppage of a vessel by a plug of solid matter carried thither by the current of the blood, be it a little clot from the heart or, what is far more pernicious, an infective fragment from some centre of infection in the body, by which messengers new foci of infection may be scattered about the body. Thrombosis is an accident of not dissimilar character, whereby a vessel is blocked not by a travelling particle, but by a clotting of the blood *in situ*, probably on the occasion of some injury to the epithelial lining of the vessel. Such injuries are apt to occur in syphilitic endarteritis, whereby an artery may be blocked permanently, as if with an embolus, and the area supplied by it, in so far as it was dependent upon this vessel, deprived of nutrition. These events, although far more injurious in the brain, the functions of which are far-reaching, and the collateral circulation of which is ill-provided, are seen very commonly in other organs also.

It is in the structure of the brain itself that modern research has attained the most remarkable success. In 1861 the centre of speech was detected, by a combination of clinical and pathological researches, by Broca. By these means also, in the hands of Hughlings-Jackson, and more conclusively by experimental research initiated by Fritsch and Hitzig, but pursued independently and far more systematically and thoroughly by Ferrier and his disciples, it has been proved that large areas of the cerebrum are occupied by many such centres, which preside over the formulation of sensations into purposive groups of motions (kinæsthesis of Bastian). The results of Ferrier's experimental researches on the constitution of the brain have transformed our conceptions of cerebral physiology, and thrown a flood of light on the phenomena of the diseases of the brain. Not only so, but this accurate mapping of the brain in areas of function now often enables the clinical physician to localize the position of disease; and, in a certain few cases of tumour or abscess, so precisely that he may be enabled to open the skull above the part affected and to extirpate it—an operation which is surely a triumph of science and technical skill (Lister, Macewen, Horsley). For the bearings of the conception of the neuron on physiology, and so on pathological processes, the reader is referred to the article under PHYSIOLOGY, VI.

In mental diseases little of first-rate importance has been done. The chief work has been the detection of chronic changes in the cortex of the brain, by staining and other histological methods, in degenerative affections of this organ (Meynert, Griesinger, Bevan Lewis); and in the separation from insanity as a primary disease of nerve substance of such diseases as general paralysis of the insane, which probably arise, as we have said, in contiguous structures—such as blood-vessels and connective elements—and invade the nervous matter secondarily. Furthermore, it has become more and more probable that general paralysis of the insane, like tabes dorsalis, belongs to the class of the infections, and of these to the syphilitic series. Other infections in like manner seem to injure the mental fabric; and more intrinsic toxic processes also are suspected on the detection of neurin and cholin in the fluids of the brain (Mott). Truer conceptions of normal psychology have transformed for us those of the morbid (Pinel, Griesinger, Maudsley, Mercier), and indicated more truly the relations of sanity to insanity. In the treatment of insanity little has been done but to complete the non-restraint system which in principle belongs to the earlier part of the century (Pinel, Tuke, Hill, Conolly) (see INSANITY, vols. xiii. and xxix.). An enormous accumulation of lunatics of all sorts and degrees seems to have paralysed public authorities, who, at vast expense in buildings, mass them more or less indiscriminately in barracks, and expect that their sundry and difficult disorders can be properly studied and treated by a medical superintendent at a comparatively low salary, with but young assistants under him, who may have a couple of thousand patients in his charge, together with the management of a huge institution. The life of these insane patients is as bright, and the treatment as humane, as a barrack life can be; but of science, whether in pathology or medicine, there can be little. A step in advance has been made by the London County Council, which has established a central laboratory for its asylums, and placed an eminent pathologist at the head of it: from this laboratory valuable reports have already been issued. Provision for the reception and treatment of insanity in its earliest and more curable stages can scarcely be said to exist. Sufferers from mental disease are not to be regarded as troublesome persons to be hidden away in humane keeping, but as cases of manifold and obscure disease, to be studied and treated by physicians of the highest skill, whose attention to their proper work is undivided. The care and education of idiots, initiated by Guggenbuhl and others, has made good way in England, and if as yet insufficient, is good of its kind.

By the genius of Laennec diseases of the lungs and heart were laid on a foundation so broad that his successors have been occupied in detail and refinement rather than in reconstruction. In heart disease the chief work of the latter half of the 19th century was, in the first quarter, such clinical work as that of Stokes and Latham; and in the second quarter the fuller comprehension of the vascular system as a whole, with its cycles and variations of blood pressure, venous and arterial. By the greater thoroughness of our knowledge of the physics of the circulation (Marey, Ludwig) we have attained to a better conception of such events as arterial disease, apoplexy, "shock," and so forth. To the discovery of the parts played in disease by thrombosis and embolism we have referred above. With this broader and more accurate knowledge of the conditions of the health of the circulation a corresponding efficiency has been gained in the manipulation of certain remedies and new methods of treatment of heart diseases, as by baths and gymnastics, of which a more particular account will be found in the article on THERAPEUTICS.

As regards pulmonary disease, pneumonia has passed more and more definitely into the category of the infections: the invasion of the lungs and pleura by tuberculosis, now definitely recognized as an infection, has been more and more accurately followed; and the treatment of these diseases, in the spheres both of prevention and of cure, has undergone a radical change. Instead of the close protection from the outer air, the respirators, and the fancy diets of our fathers, the modern *poitrinaire* camps out in the open air in all weathers, is fed with solid food, and in his exercise and otherwise is regulated with minute particularity according to the indications of the clinical thermometer and other symptoms. The almost reckless reliance on climate, which, at Davos for instance, marked the transition from the older to the modern methods, has of late been sobered, and supplemented by more systematic attention to all that concerns the mode of life of the invalid. The result is that, both in physicians and in the public, a more hopeful attitude in respect of the cure of phthisis has led to a more earnest grappling with the infection in its earliest stages and in every phase, with a correspondingly large improvement in the methods of treatment. Indeed, in such early stages, and in patients who are enabled to command the means of an expensive method of cure, phthisis is no longer regarded as desperate; while for those who of their own means are unable to obtain these advantages, steps are being taken to provide by the erection of special sanatoriums on a more or less charitable basis. Perhaps no advance in medicine has done so much as the study of tuberculosis to educate the public in the methods and value of research in medical subjects, for the results, and even the methods, of such labours have been brought home not only to patients and their friends, but also to the farmer, the dairyman, the butcher, the proprietors of public vehicles, and, indeed, to every home in the land.

It was in the management of pleurisies that the aid of surgical means first became eminent in inner disease. In the treatment of effusions into the pleura, and, though with less success, of pericardial effusions, direct mechanical interference was practised by one physician and another, till these means of attaining rapid and complete cure took their place as indispensable, and were extended from thoracic diseases to those of the abdominal and other inner parts formerly beyond the reach of direct therapeutics. Lister's discoveries brought these new methods to bear with a certainty and a celerity previously undreamed of; and many visceral maladies, such as stone of the kidney or gall-bladder, perityphlitis, ovarian dropsy, and even cancer of the stomach—which in the earlier part of the 19th century were either fatal or crippling—are now taken promptly and safely in hand, and dealt with successfully. We have said that this advance is often quoted, not very wisely, to signify that in modern progress "medicine" has fallen behind surgery—as if the art of the physician were not one and indivisible. A disease which cannot be got at by one method is reached by another; the division of the art being, as we have said, an unreal and mischievous survival of old and erroneous customs, perpetuated in England by a merely mechanical severance. That certain Fellows of the College of Physicians have personally taken operative procedures in hand is some good omen that in time this schism may be healed.

In the department of abdominal disease progress has been made, not only in this enormous extension of means of cure by operative methods, but also by similar means for the verification of diagnosis. The first recognition of a disease may be at a necropsy, but then usually by irresponsible pathologists; it is another matter when the physician himself comes under rebuke for failing to seize a way to cure, which he might have discovered, while the chance remained to him, by section of the abdomen during life. The abdomen is still "full of surprises"; and he who has most experience of this deceptive region will have least confidence in expressing positive opinions in particular cases of disease without operative investigation. Besides the attainments mentioned above, in respect of operative progress, many important revisions of older rule-of-thumb knowledge have come about, and not a few other substantial discoveries. Among the revisions may be adduced the new accuracy of our knowledge of dyspepsia, attained by analytic investigations into the contents of the stomach at various stages of digestion. By physical signs, and by examining the contents of the viscus recovered, for instance, after "test meals," the defects, whether of this secretion or of that, and again of its motor activity, the state of the pyloric orifice, the volume of the sac, and even its position in the cavity of the abdomen, may be surmised or ascertained, and dealt with as far as may be; so that the application of remedies after a mere traditional routine is no longer excusable. In our conceptions of the later stages of assimilation and of excretion, with the generation of poisons (auto-intoxication) in the intestinal tract, there is still much obscurity and much guess-work; but in some directions positive knowledge has been gained, partly by the physiologist, partly by the physician himself. Of such are the better understanding of the functions of the liver in normal catabolism, in the neutralization of poisons absorbed from the intestines or elsewhere, in the causation of jaundice, and in diabetes (Naunyn, Pavy). Nor must we forget the unfolding of a new chapter of disease, in the nosology of the pancreas. In diabetes this organ seems to play a part which is not yet precisely determined; and one fell disease at least has been traced to a violent access of inflammation of this organ, caused perhaps by entry of foreign matters into its duct. The parts of the pancreas and spleen in digestion also are better understood, and this knowledge is turned to good effect in the interpretation of the motley group of dyspepsias and anæmias.

The peritoneum is no longer regarded with awe as inviolable; by modern methods, if not as manageable as other lymphatic sacs, it is at any rate accessible enough without substantial risk to life. Not only in its bacteriological relations are the conditions of peritonitis recognized in its various kinds, but also the state known as "shock" turns out to be largely mechanical, and avoidable by measures belonging in considerable part to this category. Thus, by the avoidance both of toxæmia and of shock, peritonitis and other dangers of the abdomen, such as strangulations or intussusceptions of the bowels, formerly desperate, can in many cases be dealt with hopefully and efficiently.

Our knowledge of diseases of the kidneys has made no great advance since the time of Bright. In the sphere of physiology and in the interpretation of associated arterial diseases much obscurity still remains; as, for instance, concerning the nature of the toxic substances which produce those bilateral changes in the kidneys which we call Bright's disease, and bring about the "uræmia" which is characteristic of it. Lardaceous disease, however, here and in other regions, now appears to be due to the specific toxins of pyogenetic micro-organisms. In stone of the kidney a great advance has been made in treatment by operative means, and the formation of these stones seems to recent observers to depend less upon constitutional bent (gout) than upon unhealthy local conditions of the passages, which in their turn again may be due to the action of micro-organisms.

To Addison's descriptions of pernicious anæmia, and of the disease of the suprarenal capsules which bears his name, little has been added: but Hunter's researches may explain the causes of the former; the latter proves to be tuberculous, and on its fall of blood pressure physiologists have thrown some light.

The secret of the terrible puerperal septicæmia was read by Semmelweiss (*q.v.*), wherein he proved himself to be the greatest of Lister's forerunners (see LISTER).

The diseases peculiar to women have received attention from early times, but little progress had been made in their interpretation till the 19th century. In the middle part of the century, by a natural exaggeration of the importance of newly-discovered local changes in the pelvic organs, much harm was done to women by too narrow an attention to the site, characters, and treatment of these; that which in the physician was meddlesomeness becoming in the temperament of woman a morbid obsession. To Matthews Duncan we chiefly owe a saner and broader comprehension of the relative importance of the local and the general conditions which enter into the causation of uterine and ovarian disorders. For the success of operative means in diseases of the pelvis, in ovarian dropsy, in cancer of the uterus, and in other grave diseases of the region, a success which may be called stupendous, the reader is referred to the article on SURGERY.

In the subject of diseases of the skin much has been done, in the minuter observation of their forms, in the description of forms previously unrecognized, and in respect of causation and treatment. In the former line of research the comparison of observations in various climates and peoples has had some weight; while in the better knowledge of their causes their treatment has found permanent advantage. Not only is the influence of bacteria in the causation of many of them newly revealed, but it is now recognized also that, even in skin diseases not initiated by microbic action, microbes play a considerable and often a determining part in their perpetuation; and that the rules of modern aseptic surgery are applicable with no little success to skin therapeutics. We have learned that "constitutional" causes play a smaller part in them than was supposed, that a large number of diseases of the skin are local diseases, either initiated by local infection or perpetuated thereby, and that, generally speaking, they are to be cured by local means.

The diseases of children have not lacked the renewed attention, the successful investigation, and the valuable new lights which have been given to other departments of medicine. That infantile palsy is an infection, and that its unhappy sequels are now treated with more hope of restoration, has been indicated already. Infantile diarrhœa has also been recognized as an infection (Ballard), and the means of its avoidance and cure ascertained; the conditions of digestion in children are now far better understood, and many of their maladies, formerly regarded as organic or incomprehensible, are referred to errors in diet, and cured or prevented by dietetic rules. Rickets, scurvy, and "tabes" may be instanced as diet diseases in children. Acute inflammation of the ear, with its alarming extensions to the cerebral cavity, is now often dealt with successfully by surgical means, and infected sinuses or encephalic abscesses are reached and cleansed. The origins, kinds, and processes of meningitis are more clearly distinguished, and referred each to its proper cause—for the most part bacterial.

Diagnosis.

As by the discovery of stethoscopy by Laennec a new field of medical science and art was opened up, so, more recently, inventions of other new methods of investigation in medicine have opened to us other fields of little less interest and importance. Of such is the ophthalmoscope, invented by Helmholtz in 1851. By the revelations of this instrument not only have the diseases of the eye been illuminated, but much light has been thrown also upon the part of the eye in more general maladies; as, for instance, in syphilis, in diabetes, in kidney diseases, and in diseases of the brain (Donders, von Graefe, and others). A remarkable help to the cure of headaches and other nervous disorders has come out of the better appreciation and correction of errors of refraction in the eye. Radiography has done great things for surgery; for medicine its services are already appreciable, and may prove more and more valuable hereafter. In 1879 the use of the spectroscope in medicine was pointed out by Dr M'Munn. By du Bois-Reymond, Remak, Matteucci, Duchenne, the value of electricity in medicine, greater in diagnosis perhaps than in therapeutics, was demonstrated. By the sphygmograph (Marey, 1863) attention was drawn to the physical features of the circulation, to the signs of degeneration of the arterial tree, and less definitely to the fluctuations of blood pressure; but the kymographs of Ludwig and his pupils brought out these features far more accurately and completely, as we have said under the consideration of diseases of the heart. By these, and other instruments of precision, such as the thermometer, of which we have already spoken, the eminently scientific discipline of the measurement of functional movements, so difficult in the complex science of biology, has been cultivated. By the laryngoscope, invented about 1850 by Manuel Garcia, the celebrated singing-master, and perfected by Czermak and others, the diseases of the larynx also have been brought into the general light which has been shed on all fields of disease; and many of them, previously known more or less empirically, were submitted to precise definition and cure. Of such we may cite tuberculosis of the larynx, formerly as incurable as distressing; and "adenoids"—a disease revealed by intrascopic methods—which used to thwart and stifle the growth both of mind and body in children, but are now removed early and promptly, to the infinite advantage of the rising generation. To the value of stains in clinical diagnosis, especially in investigation of perversions of the blood in leucæmia, and so forth, we have already made some reference. The discovery of the Röntgen rays has also extended the physician's power of vision, as in aortic aneurysm, and other thoracic diseases.

By photography and diagrammatic records the clinical work of hospital wards has been brought into some better definition, and teaching made more accurate and more impressive. The separation of the alkaloids belongs rather to the earlier part of the 19th century, but the administration of these more accurate medications by means of hypodermic injection (see THERAPEUTICS) belongs to the latter. The ancient practice of transfusion has been placed on a more intelligible footing, and made more manageable as a means of cure or relief. Finally, calculation by statistics (Farr and others) has been brought into line with other scientific methods: although the method is a difficult one, and one full of pitfalls for the unwary, yet when perfected and the sources of its materials purified, its services will appear more and more indispensable.

Among the achievements of the medicine of the 19th century, the growth of the medical press must not be forgotten. In England, by the boldness of the *Lancet* (founded in 1823) the tyranny of prescription, inveterate custom, and privilege abused was defied and broken down; freedom of learning was regained, and promotion thrown open to the competent, independently of family and professional status. For the record and diffusion of rapidly growing knowledge, learned societies, universities, and laboratories, greatly increased in number and activity, issue their transactions in various fields; and by means of year-books and central news-sheets the accumulation of knowledge is organized and made accessible.

It is interesting to find that, with all this activity in the present, reformed methods of research and verification are not confined to the work of the passing day; in the brilliant achievements of modern research and reconstruction the maxim that "Truth is the daughter of Time" has not been forgotten. In the field of the History of Medicine the work of scholars such as Greenhill and Creighton in England, Daremberg in France, and Haeser and Hirsch in Germany, will prove to our children that tradition was as safe in our hands as progress itself.

(T. C. A.)

Medina, a city of Orleans county, New York, U.S.A., in the north-western part of the state, on the Erie canal and the New York Central and Hudson River railroad. Its site is level and its plan regular. It has varied manufactures, and there are quarries of Medina sandstone in the vicinity. Population (1890), 4492; (1900), 4716, of whom 857 were foreign-born and 30 were negroes.

Medina, Jose Toribio (1852–——), Chilian bibliographer, was born at Santiago in 1852, and was educated for the bar. His first publication, when a very young man, was a metrical translation of Longfellow's *Evangeline*. At the early age of twenty-two he was appointed secretary to the legation at Lima. After his return he published a history of Chilian literature (1878), and a work upon the aboriginal tribes (1884). In this latter year he was appointed secretary of legation in Spain, and availed himself of the opportunity of examining the treasures of the old Spanish libraries. These researches, repeated on occasion of subsequent visits to Spain, and also to France and England, enriched him with a mass of historical and bibliographical material, which he turned to account in a series of publications evincing almost incredible activity and industry. Among them may be specially mentioned the *Biblioteca Hispano-Americana*, a verbatim catalogue of all books and pamphlets relating to Spanish America printed in Spain; the *Biblioteca Hispano-Chilena*, a similar work, commenced in 1897; the standard and magnificent history of printing in the La Plata countries (1892); comprehensive works on the Inquisition in Chile, Peru, and the Philippines; and the standard treatise on South American medals (1899). In addition, Señor Medina produced the fullest bibliographies yet attainable of books printed at Lima, Mexico, and Manila, and a number of memoirs and other minor writings. No other man had rendered anything like the same amount of service to the literary history and bibliography of the Spanish colonies. Most of his later works were printed at his own house.

Medina Sidonia, a town and railway station of Spain, in the province of Cadiz. The population in 1897 was 10,929. It is the centre of the trade of the surrounding district in agricultural products, particularly wheat, olives, and oats, and contains two parish churches, several convents, a large town hall, a fine Gothic church, and the ancestral palace of the dukes of Medina Sidonia, the title conferred by John II. in 1445 on Juan Alonzo de Guzman, count of Niebla, a descendant of the famous Alonzo Perez de Guzman el Bueno. From this house sprang a long line of statesmen, generals, colonial viceroys, including the Duke Alonzo Perez de Guzman, captain-general of the ocean and commander of the Invincible Armada that came to grief on the shores of Great Britain. The titles and grandeeships passed, in accordance with Castilian law, by marriage of a daughter and heiress in 1777, to the marquess of Villafranca, and have since remained in that noble house.

Medinet-el-Fayum, a city of Middle Egypt, capital of the province of Fayum, connected by a branch line 5 miles long with El Wasta, which is a station on the Nile Valley railway, 56 miles from Cairo. It is a great agricultural centre, with a population which increased from 26,000 in 1882 to 40,000 in 1900, and has several large bazaars, mosques, baths, and a much-frequented weekly market. The town stands on one of the two main branches of the Bahr Yusuf, which conduct the flood waters of the Nile to the Fayum, and have here the aspect of natural rivers. The neighbouring mounds mark the site of Arsinoë (Crocodilopolis), that is, the Egyptian city of Shat, where was worshipped the sacred crocodile kept in Lake Mœris.

Mediterranean Sea.—The Mediterranean is all that remains of a great ocean which at an early geological epoch, before the formation of the Atlantic, encircled half the globe along a line of latitude. This ocean, already diminished in area, retreated after Oligocene times from the Iranian plateau, Turkestan, Asia Minor, and the region of the north-west Alps. Next the plains of eastern Europe were lost, then the Aralo-Caspian region, southern Russia, and finally the valley of the Danube. The "Mediterranean region," as a geographical unit, includes all this area; the Black Sea and the Sea of Marmora are within its submerged portion, and the climate of the whole is controlled by the oceanic influences of the Mediterranean Sea. Prof. Suess, to whom the above description is due, finds that the Mediterranean forms no exception to the rule in affording no evidence of elevation or depression within historic times; but it is noteworthy that its present basin is remarkable in Europe for its volcanic and seismic activity. Submarine earthquakes are in some parts sufficiently frequent and violent as to seriously interfere with the working of telegraph cables. Suess divides the Mediterranean basin into four physical regions, which afford probably the best means of description:—(1) The western Mediterranean, from Gibraltar to Malta and Sicily, enclosed by the Apennines, the mountains of northern Africa, and of southern and south-eastern Spain (*Cordillère bétique*). (2) The Adriatic, occupying the space between the Apennines and the Dinaric group (Suess compares the Adriatic to the valley of the Brahmaputra). (3) A part surrounded by the fragments of the Dinaro-Taurus arch, especially by Crete and Cyprus. This includes the Ægean and the Black Sea, and its margin skirts the south coast of Asia Minor. These three parts belong strictly to Eurasia. (4) Part of the coastal region of Indo-Africa, terraced downwards in successive horizontal planes from the Shot, reaching the sea in the Little Syrte, and continuing to the southern depressions of Syria. Malta and Gozo are the only islands of the Mediterranean which can be associated with this section, and, *per contra*, the mountain chain of north-west Africa belongs to Eurasia. Murray (1888) estimates the total area of the Mediterranean at 813,000 square miles. Karstens (1894) breaks it up into parts as follows:—

Western Mediterranean . . .	841,593	sq. km.
Sicilian-Ionian basin	767,658	,,
Greece and Levant basin . . .	769,652	,,
Adriatic Sea	130,656	,,
Total . .	2,509,559	,,

Murray estimates the total surface of the Mediterranean drainage area, with which must be included the Black Sea, at 2, 934,500 square miles, of which 1,420,800 are Eurasian and 1,513,700 are African. The principal rivers entering the Mediterranean directly are the Nile from Africa, and the Po, Rhone, and Ebro from Europe.

The physical divisions of the Mediterranean given above hold good in describing the form of the sea-bed. The western Mediterranean is cut off by a bank crossing the narrow strait between Sicily and Cape Bon, usually known as the Adventure Bank, on which the depth is nowhere 200 fathoms. The mean depth of the western basin is estimated at 881 fathoms, and the deepest sounding recorded is 2040 fathoms. In the eastern Mediterranean the mean depth is nearly the same as in the western basin. The Sicilian-Ionian basin has a mean depth of 885 fathoms, and the Levant basin, 793 fathoms. Deep water is found close up to the coast of Sicily, Greece, Crete, and the edge of the African plateau. The steepest slope observed occurs off the island of Sapienza, near Navarino, where 1720 fathoms has been obtained only 10 miles from land. In 1897 the ship *Washington* obtained depths of 2220 fathoms in the middle of the eastern Mediterranean, and the Austrian expeditions in the *Pola* discovered in the "Pola Deep" (35° 44′ N., 21° 45′ E.), south-west of Cape Matapan, a maximum depth of 2406 fathoms. Between these two deep areas a ridge runs in a north-westerly direction 550 fathoms from the surface—possibly a projection from the African plateau. Another bank 1100 fathoms from the surface runs south from the east end of Crete, separating the Pola Deep from the depths of the Levant basin, in which a depth of 1960 fathoms was recorded near Makri on the coast of Asia Minor. The later expedition of the *Pola* discovered the "Rhodes Deep" (36° 5′ N., 28° 36′ E.), with a maximum depth of 2110 fathoms: this deep is closed to the south-east by a ridge running south-east, over which the depth is 1050 fathoms. Off the coast of Syria the *Pola* obtained four soundings of more than 1100 fathoms, and between Cyprus and the coast of Asia Minor only two over 550 fathoms. Murray gives the following figures for the areas and volumes of the Mediterranean at different depths:—

Depth. Fathoms.	Area. Sq. Miles.	Volume. Cub. Miles.
0– 100	201,300	80,950
100– 500	251,650	220,850
500–1000	81,300	189,200
1000–2000	263,250	217,050
Over 2000	15,500	1,750
	813,000	709,800

which gives a mean depth over all of 768 fathoms. The following table is due to Karstens:—

	Volume. Cub. Km.	Mean Depth. Fathoms.
Western Mediterranean	1,356,512	881
Sicilian-Ionian basin	1,242,549	885
Levant	1,116,599	793
Adriatic Sea	31,844	133

Meteorology.—As already stated, the "Mediterranean region" forms a distinct climatic unit, due to the Mediterranean Sea. The prevailing winds in this region, which the sea traverses longitudinally, are westerly, but the sea itself causes the formation of bands of low barometric pressure during the winter season, within which cyclonic disturbances frequently develop, while in summer the region comes under the influence of the polar margin of the tropical high-pressure belt. Hence the Mediterranean region is characteristically one of winter rains, the distinctive feature becoming less sharply defined from south to north, and the amount of total annual fall increasing in the same direction. The climate becomes, on the whole, more continental in type from west to east, but there are great local irregularities—the elevated plateaux of Algeria and Spain cause a rise of pressure in winter and delay the rainy seasons: the rains set in earlier in the west than in the east, and the total fall is greater. Temperature varies greatly, the annual mean varying from 56° F. to 77° F. In the west the Atlantic influence limits the mean annual range to about 10°–12° F., but in the east this increases to 36° and even 40°. Autumn is warmer than spring, especially in the coastal regions, and this is exaggerated in the eastern region by local land winds, which replace the cool sea-breezes of summer: overcoats are ordinarily worn in Spain and Italy till July, and are then put aside till October. Local winds form an important feature in nearly all the coast climates of the Mediterranean, especially in winter, where they are primarily caused by the rapid change of temperature from the sea to the snow-clad hinterlands. Cold dry winds, often of great violence, occur in the Rhone valley (the Mistral), in Istria, and Dalmatia (the Bora), and in the western Caucasus. In summer a north-west "trade" wind, the Maestro, occurs in the Adriatic. The Sirocco is a cyclonic wind characteristic of the winter rainy season; in the Adriatic it is usually accompanied by cloud and moisture, often by rain. In Sicily and southern Italy the Sirocco occurs at all seasons; it is a dry, dusty wind from south-east or south-west. The dust is chiefly of local origin, but partly comes from the Sahara. Similar winds are met with in Spain (the Leveche), but they reach their greatest development in the Simooms of Algeria and Syria, and the Khamsin of Egypt.

Temperature.—The mean surface temperature of the waters of the Mediterranean falls from south-east, where it is over 70°, to north-west, the average at the coast of the Gulf of Lyons being 60°. The isothermal of 65° runs from Gibraltar to the north of Sardinia, and thence by the Strait of Messina to the Gulf of Corinth. A similar distribution is found 100 fathoms from the surface, temperature falling from 60° in the Levant to 55° east of Gibraltar. At 200 fathoms temperature falls in the same way from 58° to 55°, but below 250 fathoms temperatures are practically uniform to the bottom, 55·5° in the western basin and 56·5° in the eastern. The bottom temperature observed in the Pola Deep was 56·3°.

Salinity.—In the extreme west the salinity of the surface water is about 36·3 *per mille*, and it increases eastwards to 37·6 east of Sardinia and 39·0 and upwards in the Levant. Observations of salinity in the depths of the western Mediterranean are very deficient, but the average is probably between 38·0 and 38·5. In the eastern basin the *Pola* expedition observed salinities of 38·7 to 39·0 to the east of a line joining Cape Matapan with Alexandria, and 38·2 to 38·7 to the west of it. The salter waters apparently tend to make their way westwards close to the African coast, and at the bottom the highest salinities have been observed south of Crete. Evnitzki states that the saltest water of the whole basin occurs in the Ægean Sea.

Circulation.—There is little definite circulation of water within the Mediterranean itself. In the straits joining it with the Atlantic and the Black Sea the fresher surface waters of these seas flow inwards to assist in making good the loss by evaporation at the surface of the Mediterranean, and in both cases dense water makes its way outwards along the bottom of the channels, the outflowing currents being less in volume and delivery than the inflowing. Elsewhere local surface currents are developed, either drifts due to the direct action of the winds, or streams produced by wind action heaping water up against the land, but these nowhere rise to the dignity of a distinct current system, although they are often sufficient to obliterate the feeble tidal action characteristic of the Mediterranean. Dr Natterer, the chemist of the *Pola* expeditions, has expressed the opinion that the poverty of the pelagic fauna is solely due to the want of circulation in the depths.

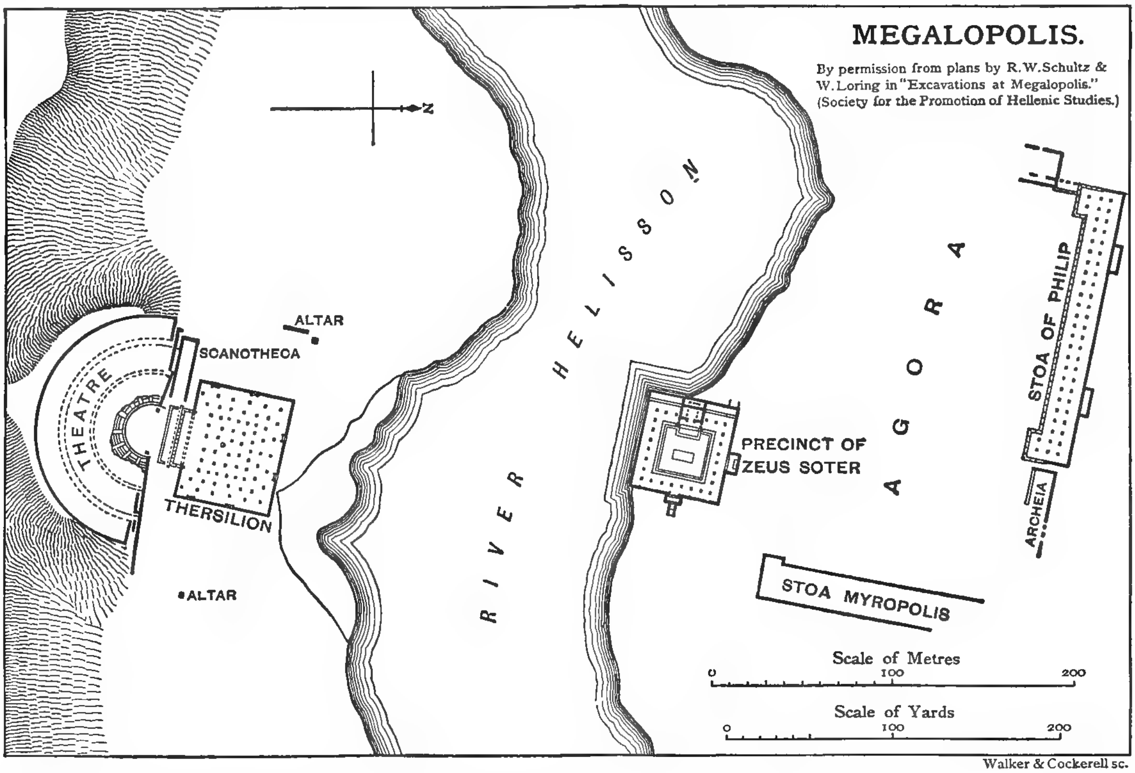
Deposits.—A great part of the bottom of the Mediterranean is covered with blue muds, frequently with a yellow upper layer containing a considerable proportion of carbonate of lime, chiefly shells of pelagic Foraminifera. In many parts a calcareous or silicious crust, from half an inch to three inches in thickness, is met with; and Natterer suggested that the formation of this crust may be due to the production of carbonate of ammonium where deposits containing organic matter are undergoing oxidation, and the consequent precipitation of carbonate of lime and other substances from the waters nearer the surface. This view, however, has not met as yet with very general acceptance. (H. N. D.)

Meerane, a town in Germany, 9 miles by rail north of the town and in the circle of Zwickau, kingdom of Saxony; station on the Gössnitz–Glauchau railway. It has *real*, commercial, and technical schools, and is one of the most important places in Germany for the manufacture of woollens and mixed cloths, having, in addition to work done in houses, 9 weaving mills, a worsted-spinning mill, and other factories. Population (1890), 22,446; (1901), 23,797.

Meerut, a city, district, and division of British India, in the North-West Provinces. The city is half-way between the Ganges and the Jumna, and has two stations on the North-Western railway, 37 miles north-east from Delhi. Population (1881), 99,965; (1891), 119,390; (1901), 118,642; municipal income (1897–98), Rs.2,06,111, mainly derived from octroi; incidence of taxation, R.1:2:1 per head; registered death-rate (1897), 35·7 per thousand. It is the headquarters of a military division, with accommodation for horse and field artillery, British and native cavalry and infantry. The aided college, opened in 1895, had 63 students in 1896–97. There are 3 high schools, and 25 printing-presses, most of which issue a vernacular newspaper, besides 3 literary associations. The municipal water-works provides 7 gallons a day of filtered water per head, at a total cost of about 6 annas per thousand gallons.

The district of Meerut forms part of the upper Doab, or tract between the Ganges and the Jumna, extending from river to river. Area, 2370 square miles; population (1881), 1,313,137; (1891), 1,391,458; (1901), 1,539,917, showing an increase of 6 per cent. between 1881 and 1891, and of 10·7 per cent. between 1891 and 1901; average density, 649 persons per square mile. The land revenue and rates were Rs.26,31,762, the incidence of assessment being R.1 : 7 : 5 per acre; the cultivated area in 1896–97 was 1,068,375 acres, of which 265,912 were irrigated, including 172,254 from Government canals; number of police, 3009; number of vernacular schools, 294, with 8119 pupils; registered death-rate (1897), 27·8 per thousand. The principal crops are wheat, pulse, millet, sugar-cane, cotton, and indigo. There are 63 indigo factories, with an out-turn valued at Rs.4,58,000. The district is watered by the eastern Jumna canal, and also by two branches of the Ganges canal. It is traversed by the North-Western railway, and also contains Ghaziabad, the terminus of the East Indian system, whence a branch runs to Delhi and another (under construction) to Moradabad.

The division of Meerut comprises the northern portion of the Doab. It consists of the six districts of Dehra Dun, Saharanpur, Muzaffarnagar, Meerut, Bulandshahr, and Aligarh. Area, 11,326 square miles; population (1881), 5,141,204; (1891), 5,326,833; (1901), 5,983,302, showing an increase of 12·3 per cent. between 1891 and 1901; average density, 528 persons per square mile.


MEGALOPOLIS.

By permission from plans by R. W. Schultz & W. Loring in "Excavations at Megalopolis." (Society for the Promotion of Hellenic Studies.)

Walker & Cockerell sc.

Megalopolis.—The site of Megalopolis was excavated by members of the British School at Athens in the years 1890–92. No early remains were to be expected, since the city was founded by Epaminondas in 370 B.C. to unite the scattered Arcadians as a counterpoise to the power of Sparta; but on the other hand, the description of Pausanias indicated that the town was laid out on a plan specially adapted to the federal capital, and this description is so clear and explicit that it enables Curtius, in his *Peloponnesos*, to give a conjectural plan that was found to tally in most respects with the reality. The town was divided into two approximately equal parts by the river Helisson, which flows through it from east to west. The line of the walls may still be traced, partly by extant remains, partly by the contours it must have followed, and confirms the estimate of Polybius that they had a circuit of 50 stades or about 5½ miles. It is difficult to see how the river bed, now a broad and shingly waste, was dealt with in ancient times; it must have been embanked in some way, but there are no remains to show whether the fortification wall was carried across the river at either end, or along the parallel embankments so as to make two separate enclosures. There must have been, in all probability, a bridge to connect the two halves of the city, but the foundations seen by Leake and others, and commonly supposed to belong to such a bridge, proved to be only the substructures of the precinct of Zeus Soter. The buildings to the north of the river were of a municipal character, and were grouped round the square agora. One, of which the complete plan has been recovered, is the portico of Philip, a splendid building, which bounded the agora on the north; it was 300 feet long, with three rows of columns running its whole length, three in the outer line to each one in the two inner lines; it had a slightly projecting wing at either end. At the south-west of the agora was found the precinct of Zeus Soter: it consists of a square court surrounded by a double colonnade, and faced on the west side by a small temple; on the east side was an entrance or propylaeum approached by a ramp. In the midst of the court was a great substructure which has been variously interpreted as an altar or as the base of the great group of Zeus and Megalopolis, which is recorded to have stood here. North of this was the Stoa Myropolis, forming the east boundary of the agora, and, between this and the Stoa of Philip, the Archeia or municipal offices. These buildings were of various dates, but seem all to fit into a harmonious plan. The buildings on the south and west of the agora have been almost entirely destroyed by the Helisson and a tributary brook. On the south bank of the river were the chief federal buildings, the theatre (noted by Pausanias as the largest in Greece), and the Thersilion or parliament hall of the ten thousand Arcadians. These two buildings form part of a common design, the great portico of the Thersilion facing the orchestra of the theatre. As a consequence of this arrangement, the plan of the theatre is abnormal. The auditorium has as its lowest row of seats a set of "thrones" or ornamental benches, which, as well as the gutter in front, were dedicated by a certain Antiochus; the orchestra is about 100 feet in diameter; and in place of the western parados is a closed room called the Scanotheca. The chief peculiarity, however, lies in the great portico already mentioned, which has its base about 4 feet 6 inches above the level of the orchestra. It was much too lofty to serve as a proscenium; yet, if a proscenium of the ordinary Greek type were erected in front, it would hide the lower part of the columns. Such a proscenium was actually erected in later times; and beneath it were the foundations for an earlier wooden proscenium, which was probably erected only when required. In later times steps were added, leading from the base of the portico to the level of the orchestra. The theatre was probably used, like the theatre at Athens, for political assemblies; but the adjoining Thersilion provided covered accommodation for the Arcadian ten thousand in wet weather. It is a building unique in plan, sloping up from the centre towards all sides like a theatre. The roof was supported by columns that were placed in lines radiating from the centre, so as to obscure as little as possible the view of an orator in this position from all parts of the building; there were two entrances in each side. It needs but a little imagination to appreciate the public buildings of Megalopolis as a splendid and unique example of federal and municipal architecture on a scale worthy of the principles which they represented.

See *Excavations at Megalopolis* (E. A. Gardner, W. Loring, G. C. Richards, W. J. Woodhouse; Architecture, by R. W. Schultz).—Supplementary Paper issued by the Society for the Promotion of Hellenic Studies, 1892; *Journal of Hellenic Studies*, xiii. p. 328, A. G. Bather; p. 319, E. F. Benson ("Thersilion"); 1898, p. 15, J. B. Bury ("Double City"); Dörpfeld ("Das Griechische Theater"); Puchstein, "Griechische Buhne" (Theatre). (E. GR.)

Meiderich, a commune of Prussia, in the Rhine province, 2½ miles north-east of Ruhrort, whose harbour is in great part within its confines. Large iron and steel works, coal-mines, saw-mills, brick-works, machine-shops, and rope-walks furnish the principal occupations of the inhabitants. Population (1885), 16,105; (1900), 33,684.

Meiktila, a division and district in Upper Burma. The division includes the districts of Meiktila, Kyauksè, Yamèthin, and Myingyan, with a total area of 10,854 square miles, and a population of (1891) 902,370, and (1901) 994,432, showing an increase of 10·2 per cent., and giving a density of 91 inhabitants to the square mile. There were 3573 villages in 1898–99, paying a revenue of Rs.23,23,193. All but a small portion of the division lies in the so-called rainless district or dry zone, and the bulk of the cultivation is dependent on irrigation.

MEIKTILA DISTRICT is the most easterly of the districts in the dry zone, and has an area of 2178 square miles. It lies between Kyauksè, Myingyan, Yamèthin, and on the east touches the Shan States. The general character of the district is that of a slightly undulating plain, the gentle slopes of which are composed of black "cotton" soil and are somewhat arid. The only hills above 300 feet are on the slopes of the Shan hills. The lake is the chief feature of the district. It is artificial, and according to Burmese legend was begun 2400 years ago by the grandfather of the Buddha Gautama. It is 7 miles long, averages half a mile broad, and covers an area of 3½ square miles. Its depth is considerable, and with the Minhla and other connected lakes it irrigates a large extent of country.

There are small forest reserves, chiefly of cutch, in the district. Large numbers of cattle are bred. The chief agricultural products are, in their order, rice, sesamum, cotton, peas, maize, millet, and grain. The population of the district was (1891) 206,794; and (1901) 252,702, which gives an average of 116 to the square mile. Famines in 1891, 1895, and 1896 led to considerable emigration. Many families have returned, but the population is thought to have decreased. The climate is healthy except in the sub-montane townships. The temperature rises to 100° and over between the months of March and June, and the mean minimum in January is about 61°. The rainfall is very uncertain. The highest recorded has been 36·79 inches in 1893, and the lowest 25·59 in 1891. The district has the name of being the healthiest in Upper Burma. There were 1066 villages in 1898–99, paying Rs.4,67,190 revenue. The vast majority of the population are Buddhists. The headquarters town, MEIKTILA, stands on the banks of the lake. It had a population of 4685 in 1891. A wing of a British regiment is stationed here. A branch railway connects it at Thazi station with the Rangoon–Mandalay line, and continues westward to its terminus on the Irrawaddy at Myingyan.

Meilhac, Henri (1831–1897), French dramatist, was born in Paris in 1831, and while still a young man began writing fanciful articles for the newspapers and *vaudevilles* for the theatres, in a vivacious *boulevardier* spirit which brought him to the front. About 1860 he met Ludovic Halévy, and the two began a system of collaboration in writing for the stage which lasted for twenty years. An account of their work is given under HALÉVY. Meilhac wrote a few pieces also with lesser collaborators. In 1888 he was elected to the Academy. He died at Paris in 1897.

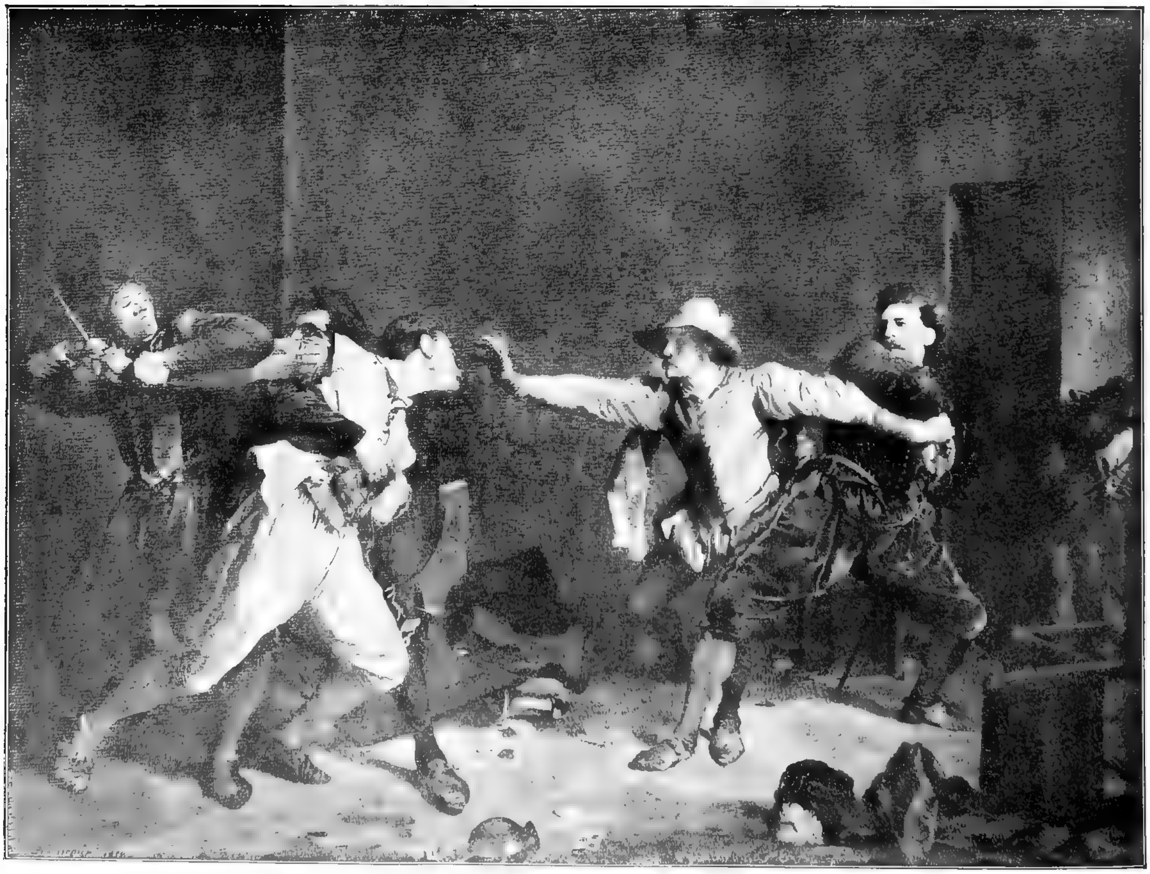
Meiningen, a town of Germany, capital of the duchy of Saxe-Meiningen, on the right bank of the Werra, embowered in forests, 39 miles south of Eisenach by rail. In the town are the Henneberg House, with the collections of the Henneberg Antiquarian Society; an arsenal, hall of the diet, and high school (with natural history collection). The Meiningen Company of actors, which won unstinted applause for the general level of excellence it attained and the effective *tout ensemble* of its staging, was dissolved in 1890 after a career of sixteen years. A new parish church was built in 1888. Busts of Brahms (1899) and Jean Paul (who lived here in 1801–03) adorn the town. Population (1885), 11,448; (1900), 14,518.

Meissen, a town of Germany, at the influx of the Triebisch and the Meisse into the Elbe, 14 miles by rail north-west by west of the town and in the circle of Dresden, kingdom of Saxony. It has a progymnasium, a *real* school and a commercial school, and a monument to Böttger (1892). The royal porcelain manufactory employs from 700 to 800 workmen. Population (1890), 17,875; (1900), 20,123. On 1st January 1901 Cölln (11,309 in 1900), on the Elbe, was incorporated with Meissen, giving the latter a total population of 31,432.

Meissonier, Jean Louis Ernest (1815–1891), French painter, was born at Lyons on 21st February 1815. From his schooldays he showed a marked taste for painting, to which some early sketches, dated 1823, bear witness. After being placed with a druggist, he obtained leave from his parents to become an artist, and, owing to the recommendation of a painter named Potier, himself a second class Prix de Rome, he was admitted to Léon Cogniet's studio. He paid short visits to Rome and to Switzerland, and exhibited in the Salon of 1831 a picture then called "Les Bourgeois Flamands" ("Dutch Burghers"), but also known as "The Visit to the Burgomaster," subsequently purchased by Sir Richard Wallace, in whose collection (at Hertford House, London) it is, with fifteen other examples of this painter. It was the first

"1814." By MEISSONIER.

(From a Photograph by Braun, Clement, and Co., Dornach (Alsace), Paris, and New York.)



"LA RIXE." By MEISSONIER.

(Buckingham Palace.)

attempt in France in the particular *genre* which was destined to make Meissonier famous: microscopic painting—miniature in oils. Working hard for daily bread at illustrations for the publishers—Curmer, Hetzel, and Dubocher—he also exhibited at the Salon of 1836 the "Chess Player" and the "Errand Boy." After some not very happy attempts at religious painting, he returned, under the influence of Chenavard, to the class of work he was born to excel in, and exhibited with much success the "Game of Chess" (1841), the "Young Man playing the 'Cello" (1842), "The Painter in his Studio" (1843), "The Guard Room," the "Young Man looking at Drawings," the "Game of Piquet" (1845), and the "Game of Bowls"—works which show the finish and certainty of his technique, and which assured his success. After his "Soldiers" (1848) he began "A Day in June," which was never finished, and exhibited "A Smoker" (1849) and "Bravos" ("Les Bravi," 1852). In 1855 he touched the highest mark of his achievement with "The Gamblers" and "The Quarrel" ("La Rixe"), which was presented by Napoleon III. to the English Court (see Plate). His triumph was sustained at the Salon of 1857, when he exhibited nine pictures and drawings; among them the "Young Man of the Time of the Regency," "The Painter," "The Shoeing Smith," "The Musician," and "A Reading at Diderot's." To the Salon of 1861 he sent "The Emperor at Solferino," "A Shoeing Smith," "A Musician," "A Painter," and "M. Louis Fould"; to that of 1864 another version of "The Emperor at Solferino," and "1814" (see Plate). He subsequently exhibited "A Gamblers' Quarrel" (1865), and "Desaix and the Army of the Rhine" (1867). Unspoiled by his success, Meissonier continued to work with elaborate care and a scrupulous observation of nature. Some of his works, as for instance his "1807," remained ten years in course of execution. To the great Exhibition of 1878 he contributed sixteen pictures: the portrait of Alexandre Dumas which had been seen at the Salon of 1877, "Cuirassiers of 1805," "A Venetian Painter," "Moreau and his Staff before Hohenlinden," a "Portrait of a Lady," the "Road to La Salice," "The Two Friends," "The Outpost of the Grand Guard," "A Scout," and "Dictating his Memoirs." Thenceforward he exhibited less in the Salons, and sent his works to smaller exhibitions. Being chosen as president of the Great National Exhibition in 1883, he was represented there by such works as "The Pioneer," "The Army of the Rhine," "The Arrival of the Guests," and "Saint Mark." On 24th May 1884 an exhibition was opened at the Petit Gallery of Meissonier's collected works, including 146 examples. As president of the jury on painting at the Exhibition of 1889 he contributed some new pictures. In the following year the New Salon was formed (the National Society of Fine Arts), and Meissonier was the president. He exhibited there in 1890 his picture "1807"; and in 1891, shortly after his death, his "Barricade" was displayed in the same place. A less well-known class of work than his painting is a series of etchings: "The Last Supper," "The Skill of Vuillaume the Lute Player," "The Little Smoker," "The Old Smoker," the "Preparations for a Duel," "Anglers," "Troopers," "The Reporting Sergeant," and "Polichinelle," in the Hertford House collection. He also tried his hand at lithography, but the prints are now scarcely to be found. Of all the painters of the century, Meissonier was one of the most fortunate in the matter of payments. His "Cuirassiers," now in the late duc d'Aumale's collection at Chantilly, was bought from the artist for £10,000, sold at Brussels for £11,000, and finally resold for £16,000. Besides his *genre* portraits, he painted some others: those of "Doctor Lefevre," of "Chenavard," of "Vanderbilt," of "Doctor Guyon," and of "Stanford." He also collaborated with the painter Français in a picture of "The Park at St Cloud." In 1838 Meissonier married the sister of M. Steinheil, a painter. Meissonier was attached by Napoleon III. to the Imperial Staff, and accompanied him during the campaign in Italy and at the beginning of the war in 1870. During the siege of Paris in 1871 he was colonel of a marching regiment. In 1840 he was awarded a third-class medal, a second-class medal in 1841, first-class medals in 1843 and 1844, and Medals of Honour at the great exhibitions. In 1846 he was appointed Knight of the Legion of Honour and promoted to the higher grades in 1856, 1867 (29th June), and 1880 (12th July), receiving the Grand Cross in 1889 (29th October). He nevertheless cherished certain ambitions which remained unfulfilled. He hoped to become a professor at the École des Beaux Arts, but the appointment he desired was never given to him. On various occasions, too, he aspired to be chosen deputy or made senator, but he was not elected. In 1861 he succeeded Abel de Pujol as member of the Academy of Fine Arts. On the occasion of the centenary festival in honour of Michael Angelo in 1875 he was the delegate of the Institute of France to Florence, and spoke as its representative. Meissonier was in his day an admirable draughtsman upon wood, his illustrations to *Les Contes Rémois* (engraved by Lavoignat), to Lamartine's *Fall of an Angel*, to *Paul and Virginia*, and to *The French painted by Themselves* being among the best known. The leading engravers and etchers of France have been engaged upon plates from the works of Meissonier, and many of these plates command the highest esteem of collectors. Meissonier died in Paris on 21st January 1891. His son, Jean Charles Meissonier, also a painter, was his father's pupil, and was admitted to the Legion of Honour in 1889.

See ALEXANDRE. *Histoire de la peinture militaire en France.* Paris, 1891.—LAURENS. *Notice sur Meissonier.* Paris, 1892.—GRÉARD. *Meissonier.* Paris and London, 1897.—T. G. DUMAS. *Maîtres modernes.* Paris, 1884.—CH. FORMENTIN. *Meissonier, sa vie—son œuvre.* Paris, 1901.—J. W. MOLLETT. *Illustrated Biographies of Modern Artists: Meissonier.* London, 1882. (H. FR.)

Me Kong, or ME NAM KONG (pronounced *Kawng*), sometimes known as the Cambodia river, the great river of Indo-China, and one of the most interesting of the remarkable rivers of south-eastern Asia which have their origin in the Tibetan highlands. Rising in about 33° 17′ N. and 94° 25′ E., it is known as the Gergu river, and flows south-eastwards through Chinese Tibetan territories to Chiamdo, on the great east and west caravan route from China to Lhasa. At this point it is about 10,000 feet above sea-level. From here, under the name Nam Chu or Chiamdo Chu, it flows southwards through little-known mountain wastes. Below Dayul in lat. 29° it is known by the Chinese name of Lantsan Kiang. For the next 300 miles of its course the Lantsan Kiang, or, as it soon becomes known among the Tai peoples inhabiting its rugged valley, the Me Kong, is very little known to us. The river flows beneath bare and rocky walls. A few scattered villages of Lusus and Mossos exist in this region: there is no trade from north to south. In 25° 18′ N. the Tali-Bhamo caravan route, which has been so ably described by Colborne Baker, crosses the river by one of those iron suspension bridges which are a feature of Yunnan, at a height of 4700 feet above sea-level. From this point to Chieng or Keng Hung, the head of the old confederacy of the Sibsawng Punna or Twelve States, it is little known; the fact that it falls some 900 feet for each degree of latitude is sufficient indication of the character of the river. Between the 22nd and 23rd parallels the Burma Yunnan railway, which is being pushed up through the Shan States, will cross into Chinese territory. Under the provisions of the Anglo-French agreement of January 1896, from the Chinese frontier southwards to the mouth of the Nam Huok the Me Kong forms the frontier between the British Shan States on the west and the territories acquired from Siam by France in 1893. By the treaty of 1893, from that point southwards to about 13° 30′ N. it is also the frontier between French Indo-China and Siam, and a special zone extends 25 kilometres inland from the right bank, within which the Siamese Government agreed not to construct any fortified port or maintain any armed force. Below the Siamese Shan town of Chieng Sen the river takes its first great easterly bend to Luang Prabang, being joined by some rather important tributaries. This portion of the river is considerably obstructed by rapids. The country is mountainous, and the vegetation at the lower heights begins to assume a thoroughly tropical aspect. From Luang Prabang the river cuts its way southwards for two degrees through a lonely jungle country among fast-receding hills of low elevation. From Chieng Kan the river again turns eastwards along the 18th parallel, forcing its way through one of the most serious rapid-barriers with which the native navigator has to contend, receiving some important tributaries from the highlands of Tung Chieng Kum and Chieng Kwang, the finest country in Indo-China. In 104° E. the river resumes a southerly course through a country but thinly peopled. At Kemarat (16° N.) the fourth serious rapid-barrier occurs, some 60 miles in length, and the last at Kawng in 14° N. From here to its outfall in the China Sea the great river winds for some 400 miles through the French territories of Cambodia and Cochin China, and to its annual overflow these countries owe the extraordinary fertility of their soil. The uselessness of this great river as a commercial highway has been amply demonstrated, and it is noticeable that, with the exception of Luang Prabang and Pnompenh, there is not a single populous town along the whole 2000 miles of its stormy course.

Authorities.—Major Bower. *Geogr. Journal*, vol. i. No. 5.—Woodville Rockhill. *Geogr. Journal*, vol. iii. No. 5.—Garnier, Francis. *Voyage d'Exploration en Indo-Chine.*—Colborne Baker. Report of the Grosvenor Mission, in *R. G. S. Suppl. Papers*, vol. i. pt. i.—Cooper. *Travels of a Pioneer of Commerce.* 1871.—L'Abbé Desgodins. *Le Thibet.*—Henri Mouhot. *Travels in Indo-China.*—Prince Henri d'Orléans. *Geogr. Journal*, vol. viii. No. 6; and *Around Tonkin and Siam*, 1894; and *Tonkin to India*, 1898.—Lord Lamington. *Proc. R. G. S.* vol. xiii. No. 12.—Archer, W. J. *Report on a Journey in the Me Kong Valley.*—General Woodthorpe. *Geogr. Journal*, vol. vii. No. 6.—Beckett, W. R. D. *Report on Korat Plateau and Lower Me Kong.*—Lord Curzon. "Journeys in French Indo-China," *Geogr. Journal*, vol. ii. No. 3.—M'Carthy. *Report on a Survey in Siam.* 1894.—*Bulletins*, Paris Geographical Society.—H. Warrington Smyth. *Five Years in Siam.* 1898. (H. W. Sm.)

Melanesia.—In 1880 this insular region was almost a "No Man's Land," but has since been entirely partitioned between the Netherlands, Great Britain, Germany, and France, as shown in the subjoined table. A change of nomenclature has also been introduced in the insular section of the German possessions in Melanesia. But protests have been raised against these innovations, as contrary to all precedent and international etiquette, while the new names, although now figuring on many maps, have not yet been officially adopted. The chief group affected is the New Britain archipelago, which thus becomes the Bismarck archipelago; the several members of the group—New Britain, New Ireland, and Duke of York—also becoming Neu Pommern, Neu Mecklenburg, and Neu Lauenburg respectively. It should also be noticed that the section of New Guinea assigned to Germany takes the official designation of Kaiser Wilhelm's Land. Of the Solomon group, which by previous treaties had been distributed in nearly equal parts between Germany and Great Britain, the former Power retains only the northern island of Bougainville, having ceded to Great Britain the two large islands of Choiseul and Ysabel by the convention of November 1899. Consequently, the parting line between the British and German possessions in the western Pacific, which formerly ran from New Guinea eastwards, and was then deflected in the Solomon group a long way to the south, must now be shifted northwards so as to run nearly due east through Bougainville Strait, and then north-eastwards between the Gilbert and Marshall groups, but so as to leave Ongtong-Java to Germany.

Political Divisions of Melanesia (1900)

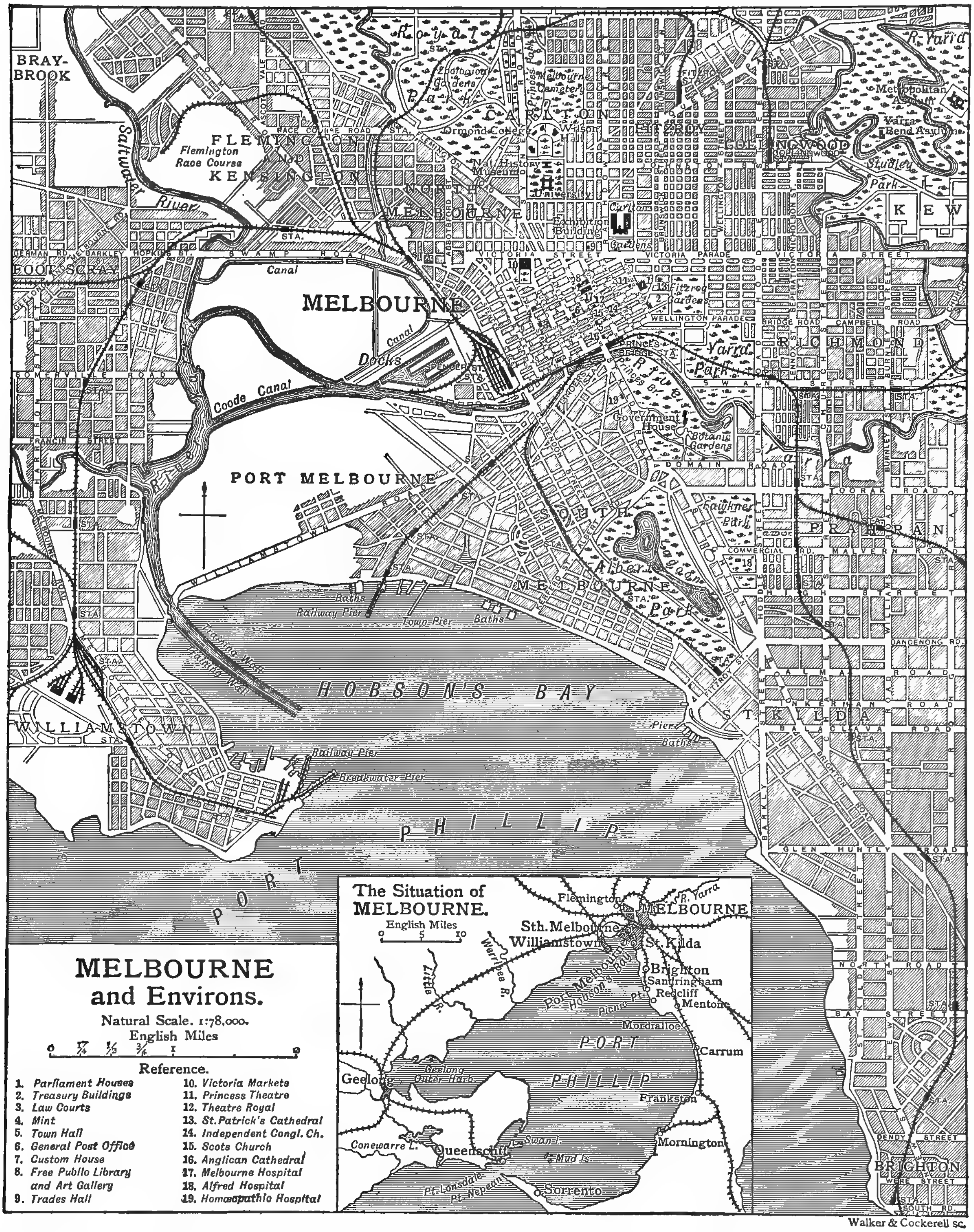
	Area in sq. miles.	Pop. (est.)
Dutch Possessions—		
West New Guinea	152,000	240,000
German Possessions—		
North-East New Guinea (Kaiser Wilhelm's Land)	72,000	110,000
New Britain (Bismarck) and Admiralty Archipelagos	28,000	180,000
Bougainville	6,000	(?) 10,000
British Possessions—		
South-East New Guinea, with the D'Entrecasteaux and Louisiade groups	90,540	...
Solomon group (except Bougainville)	20,000	200,000
Santa Cruz and Banks groups	950	9,000
Fiji with Rotuma	8,000	122,000
French Possessions—		
New Caledonia and Loyalties	7,630	51,000
Anglo-French Dual Control—		
New Hebrides	8,000	70,000
Total Melanesia	393,120	992,000

Dutch New Guinea, which comprises the western half of the island as far as a conventional line coinciding with 1410 E., is dependent on the Residency of Ternate, in the Moluccas. Kaiser Wilhelm's Land was declared a German protectorate in 1884, and since 1896 the territory has been entrusted for administrative and general purposes to the German New Guinea Company, which has also taken charge of the other German possessions in Melanesia and the Pacific Ocean. Over the New Britain archipelago and neighbouring islands a German protectorate was proclaimed in 1884. (For these and British New Guinea see New Guinea. For the British Solomon Islands see Solomon Islands. For Anglo-French Melanesia see New Hebrides. For Fiji and New Caledonia see the respective articles.)

Authorities.—Dr R. H. Codrington. *The Melanesian Languages.* Oxford, 1885; and *The Melanesians.* Oxford, 1891.—Dr F. H. H. Guillemard. *Australasia*, vol. ii. London, 1894.—Joachim Graf Pfeil. *Studien, &c., aus der Südsee.* Brunswick, 1899.—Woodford, Resident Commissioner. *Report on the British Solomon Islands*, No. 275, 1897–98.—Sir W. MacGregor. *Journey across New Guinea.* London, 1897.—H. C. Webster. *Through New Guinea, &c.* London, 1878. (A. H. K.)

Melbourne, the capital of the state of Victoria, and the most populous city in Australia, situated at the head of the large bay of Port Phillip, on its northern bend, known as Hobson's Bay, about 500 miles south-west of Sydney by land and 770 by sea, the position of the observatory being 37° 49′ 53″ S. and 144° 58′ 32″ E. The entrance to Port Phillip is narrow, and a bar, called "The Rip," occupies the entrance. Within the port there are a number of suburbs on either side, such as Sorrento and Queenscliff, at the Heads, and then Mentone, Carrum, Mordialloc, Frankston, Redcliff, Picnic Point, Brighton, and St Kilda. Then the busy wharfs of Port Melbourne and Williamstown are reached. Port Melbourne (formerly known as Sandridge) is one of the most important of the shipping suburbs of Hobson's Bay, as the northern end of Port Phillip is called. It is connected with the city by railway and by cable tram, and besides its busy piers, it is a large manufacturing centre. On the opposite side of the bay to Port Melbourne is Williamstown.

Here the deep-sea mail liners are berthed beside the long piers, upon which a railway runs connecting the wharf with the city. The river Yarra, which runs into Hobson's Bay, is a winding narrow stream which has, by means of a system of canals and by dredging, been made navigable right into the heart of Melbourne for large



Walker & Cockerell sc.

steamers. Navigation for large vessels ends at the Falls Bridge, but above that bridge the river is devoted to rowing and pleasure boats. The port of Melbourne is under the control of a Harbour Trust, established in 1877, which has borrowed over £2,000,000 for the improvement of the port, for constructing canals, dredging, and otherwise overcoming the natural disadvantages in the way of the safe navigation of the river and port.

The city proper is built upon long undulating hills, rising from a shallow valley, once occupied by a small but densely-wooded stream running into the river Yarra. This is now the site of Elizabeth Street, one of the principal streets of Melbourne. The original plan appears to have been to construct alternately wide and narrow streets running parallel with the river, the narrow streets to give access to the big business houses which would, it was foreseen, be built on the frontages of the main streets. The plan miscarried, for city space grew so valuable that large stores and business establishments have been erected in these lanes. The main streets are 99 feet wide, and the lanes or "little" streets somewhat less than half that width. On the crown of the eastern hill stand the Parliament Houses, a massive square building, with a pillared façade to which broad steps lead up. This building is as yet unfinished, lacking the central tower. Within are the two legislative chambers—the assembly and the council. There are a fine library of reference for members, dining-rooms, billiard-room, committee-room, Speaker's room, and spacious well-kept grounds at the back of the building. Most of the streets are paved with hardwood blocks, and the main streets are traversed by cable trams, which radiate in all directions. The footpaths are broad and well paved, the streets are well lighted, and tree-planting has in many parts been successfully carried on. The public buildings and business houses are generally fine architecturally. At the top of Collins Street are the Treasury Buildings, a splendid block in brown freestone. A little farther on is St Patrick's Roman Catholic Cathedral, built of hard bluestone, the sombre appearance of which detracts somewhat from the architectural beauty of the structure. There are two other churches in Collins Street, viz., the Independent Congregational Church and the Scots Church, on opposite corners of Russell and Collins Streets. The architecture of both churches is very striking, and their commanding site on the hill makes the spire of the latter and the campanile of the former landmarks from all parts of the environs. St Paul's Cathedral (Anglican) is at the corner of Swanston Street and Flinders Street, near the Princes Bridge. The choice of a site was not a happy one, and this fine structure is hidden away on low-lying ground. The law courts are contained in a square block of buildings of classic design, with a central dome in the style of that of the Capitol at Washington. To these buildings all the courts have been removed, and are thus now under one roof. The Free Public Library and Art Gallery in Swanston Street possesses a splendid collection of volumes—considerably over 100,000 in number. It is open on week-days, and is free. In the Art Gallery the lower storey is devoted to sculpture. To the rear is the picture gallery, containing a fine collection of paintings by modern European and Australian artists. In connexion with the picture gallery there is a travelling scholarship for students, subsidized by the state, which gives a large sum annually to enable the prize-winners to pursue their studies in Paris, London, Rome, or Berlin. There are also in this building a technological museum and a collection of ethnical exhibits in the shape of Australian aboriginal and South Sea Island weapons of war, domestic utensils, and native manufactures. The Exhibition Building occupies a commanding position on a hill in Carlton Gardens, its dome being the first object which strikes the visitor approaching the city either by land or water. The building, which housed the first International Exhibition held in Victoria, was opened in 1880. It consists of a nave 500 feet long and 160 feet broad, surmounted by the dome, with two annexes 460 feet long. A good deal of the building is now used for the purposes of an aquarium and picture gallery. Government House is situated at Toorak, and is surrounded by a large domain. To the northward are Melbourne University, Wilson Hall, and Ormond College. The General Post Office is situated at the corner of Bourke and Elizabeth Streets, a site which may be described as the very centre of the city. The Town Hall is at the corner of Collins and Swanston Streets, and possesses a large concert hall of good acoustic properties and a fine organ. The Trades Hall, Carlton, is a building of some importance, being the central meeting rooms of the trades unionists of Victoria and the focus of much political power. Melbourne University is undenominational, and was established in 1855. It received in 1898 a Government endowment of £12,750. There are three affiliated colleges, viz., Trinity (Episcopalian), Ormond (Presbyterian), and Queen's (Wesleyan). Ormond College is called after the late Frances Ormond, who contributed a sum of £82,000 towards its erection and endowment. The University Hall was built by the late Sir Samuel Wilson, after whom it is called Wilson Hall. In 1880 women were admitted to the University, and since then there have been 139 lady graduates. Behind the University is the Natural History Museum. The Mint is situated between Latrobe and Lonsdale Streets. From the opening in 1869 to the end of 1898, 20,892,650 oz. of gold had been received, valued at £82,873,785, and issued from the Mint as coin or bullion. There were 76,117,421 sovereigns and 884,564 half-sovereigns issued, besides bullion to the value of £6,310,693. Other buildings subserving useful public ends are the Melbourne Hospital, the Victoria Markets, the Custom House, the Alfred Hospital, and the Homœopathic Hospital on St Kilda Road. There are also a deaf, dumb, and blind institution, and a lunatic asylum at Yarra Bend. The most notorious feature in connexion with later developments of the city architecture was the erection of the "sky-scraper" buildings, which were the product of the "boom" period. They soar into the sunshine to a height of thirteen or fourteen storeys, with lifts, electric light, and all modern embellishments; but so far they have not been a financial success.

Melbourne is up to date in all respects, and in none more so than in its means of communication. There are in all the important buildings swift and secure elevators; the telephone service is effective, the streets and many shops are lighted by electricity. But the tramway system is the best evidence of the modernity of the city. From the central area lines of swift-moving cable trams run to all the suburban environs, such as St Kilda, Prahran, Williamstown, Port Melbourne, Richmond, South Melbourne, Fitzroy, Collingwood, Carlton, Hotham, &c. A tramway trust, representing twelve of the metropolitan municipalities, was formed under statutory authority, and was entrusted with powers to construct tramways through the streets of the municipalities concerned. The trust has leased the tramways to a private company on a 32 years' lease, which in 1900 had 17 years to run; and on the expiration of this period the councils have the power to acquire the system. Melbourne is the chief city of Australia from the point of view of population. In 1901 the population numbered 494,129; in 1891 it was 490,896. The slight advance in the decade was due to the commercial depression and bank failures, and the exodus to West Australia consequent upon the discovery of gold in that colony. The proportion of the population in Melbourne compared with that of the whole colony was, in 1871, 28·27, in 1889, 32·81, and in 1891, 43·05. These figures are noteworthy as an example of the remarkable aggregation of populations in the principal cities which is such a marked feature of Australian life. Melbourne is favoured in the matter of parks, gardens, and open spaces. The extent of the open spaces in the metropolitan area is 5329 acres, including 604 acres under the joint control of the Government and the City Council. Royal Park has an area of 600 acres. It contains in the centre a splendid Zoological Gardens, having the finest collection of wild animals and native fauna in Australia. The Botanic Gardens are situated on the banks of the river Yarra. They comprise 83 acres. But the most popular of the open-air resorts around Melbourne is the Flemington racecourse, where the "Cup" is run. This is the great Australian horse-racing event of the year, and during Cup week there is a large influx of visitors from the other states. The race takes place on the first Tuesday in November, and the average attendance on Cup day has, for some years, been 100,000 people. The principal theatre is the Princess, in Spring Street, opposite the Parliament Houses. It is a modern house, fitted with electric light and every convenience. The Theatre Royal, in Bourke Street, is one of the oldest as it is the largest of Melbourne theatres. The drainage of the city was for many years a subject of frequent denunciation, and is still decidedly defective. Broad deep gutters, with footbridges over them, carried off the house and surface drainage. But now a comprehensive scheme of sewerage is being worked out throughout the city and suburbs, and in time even in point of drainage Melbourne will rank as a modern city. The city is supplied with water from the Yan Yean water-works, an artificial lake at the foot of the Plenty Ranges, nearly 19 miles away. From thence the water has been brought into the city and suburbs at a cost of £3,677,000. The Water and Sewerage Board, which manages this scheme, has a revenue of £1,251,000 per annum. Melbourne was constituted a municipality in 1842. The value of rateable property, which grew enormously after the incorporation of the city, has declined since the year 1891. In that year, according to *The Seven Colonies of Australasia,* the annual value of rateable property was £6,533,717, and the capital value £89,939,287. In 1898 the annual value was only £3,973,357, and the capital value £60,626,915. However, the comparative position of Melbourne is still important. "The annual value of Melbourne," says the authority quoted above, "is only surpassed by London, and to a small extent by Glasgow, in the British dominions." The city is governed municipally by a council consisting of 24 aldermen, presided over by a mayor, and is divided into seven wards. For parliamentary purposes Melbourne is divided into 25 electorates, returning 30 members.

The suburbs are important communities in themselves, and are thickly populated. They have their separate municipal governments, and most of their town halls are fine buildings, which vie with the public buildings of Melbourne. Amongst these are the town halls of South Melbourne, Prahran, Richmond, Collingwood, and South Yarra. Amongst the most populous suburbs are Collingwood, 32,191 inhabitants; Richmond, 34,097; Prahran, 36,500; South Melbourne, 38,000; Fitzroy, 29,719; Williamstown, 13,449; St Kilda, 19,703; Brighton, 9534; Kew, 8781; Hawthorne, 20,000; Brunswick, 22,759; Essendon, 15,200; Footscray, 16,880; North Melbourne, 17,886; Port Melbourne, 11,039; Flemington and Kensington, 10,501. As a port Melbourne takes the first place as regards tonnage—though of course this is discounted by the fact that imports and exports in through liners are registered in Melbourne and swell the Melbourne tonnage, though the terminal port is Sydney. The tonnage entered and cleared in various periods was in 1881, 2,144,949 tons; in 1891, 4,362,138; and in 1899, 4,947,118 tons. The yearly movement of tonnage at Melbourne and Sydney far exceeds that of any of the ports of any other British possession, Hong-Kong and Singapore excepted. Melbourne is a great manufacturing centre, and both city and suburbs have their distinctive industries. Within the metropolitan district there were, during 1898, 1375 manufactories employing 40,021 hands, 27,694 of whom were males and 12,327 females. Details are only furnished in respect of the following industries:—

Nature of Manufactory.	No.	Average Number of Hands employed.
Tanneries, fellmongeries, and wool-washing establishments	33	972
Bacon and ham curing establishments	7	87
Butter and cheese factories, and creameries	10	167
Flour-mills	10	258
Breweries	12	680
Tobacco, cigar, and snuff manufactories	13	764
Boot factories	78	3618
Brickyards and potteries	15	652
Soap and candle works	10	360
Electric light works	7	137
Gas and coke works	7	521
Stone quarries	19	118

Melbourne cemetery is situated to the north of the city, near Princes Park, and has been used as a burial-ground since 1853. Owing to the growth of the suburban population, which has prevented the extension of this cemetery, a large necropolis has been set apart at Frankston, on the eastern shore of Hobson's Bay, at some distance from the city. Melbourne has some good monuments and statues, amongst which may be named the statue of Queen Victoria in the Parliament Houses vestibule; the statue to Sir Redmond Barry, outside the Public Library; the statue to Bourke and Wills, explorers, which was formerly at the top of Collins Street, but was removed to Spring Street to make room for the cable tram; the Gordon statue in Spring Street, which is a replica of the Gordon monument in Trafalgar Square, London; and a statue to Daniel O'Connell outside St Patrick's Cathedral. The large markets, erected at a cost of £80,000, stand in Bourke Street, and a brick market is situated in Flinders Street. There were formerly two railway stations—the main station at Spencer Street and the Hobson's Bay Railway station, as it was then called. Since then the Hobson's Bay Company have handed over their lines to the Government, and the whole system is now managed by the railway commissioners. The Hobson's Bay line is now connected with the Spencer Street line. The Spencer Street station is not an ornate structure, being built of wood principally, but an imposing building is in contemplation to take its place. There are in Melbourne, among its numerous state schools, about thirty whose size and proportions entitle them to rank with the architectural ornaments of the city. They have each accommodation for from 200 to 2000 scholars. There are many good private schools besides. The principal defences are placed at Port Phillip Heads, and consist of batteries at Queenscliff, Point Nepean, Swan Island, Point Franklin, and the shoals in mid-channel. There is also an obsolete monitor, the *Cerberus,* which lies in Hobson's Bay. But as the state of Victoria participates in the subsidy to the Australian Imperial Defence Squadron, less reliance is now placed on the *Cerberus,* and the fleet pays several visits annually to Port Phillip. There is a large graving-dock at Williamstown, the length of which is 450 feet, and which cost £341,578. The mean temperature is 57·3°, corresponding with that of Washington in the United States, and of Madrid, Lisbon, and Messina. The mean temperature is 6° less than that of Sydney and 7° less than that of Adelaide—the result of a long series of observations being: spring, 57°; summer, 65·3°; autumn, 58·7°; winter, 49·2°. The highest recorded temperature in the shade was 117·7°, and the lowest 27°. The average rainfall over a long series of years was 25·58 inches.

(J. D. F.)

Melcombe Regis. See WEYMOUTH.

Meleda, formerly MELITA (Slavonic, *Mljet*), the most southern of the larger Adriatic islands of the Austrian province of Dalmatia. It is of volcanic origin, with numerous chasms and gorges, of which the longest, the Babinopolje, connects the north and south of the island. Porto Palazzo, the principal harbour, on the north, is a port of call for tourist steamers, and contains the ruins of an ancient palace. Population, 1617.

Melegnano, formerly MARIGNANO, a town of the province of Milan, Lombardy, Italy, 11 miles south-east of Milan by the railway to Piacenza. It has manufactures of linen, silk, clothing, and bricks, and rice-husking. It was a stronghold of Milan in her great struggle against Lodi, and is famous for the victory of Francis I. of France over the Swiss in 1515, and for the battle between the French and Austrians in 1859. Population, about 6000.

Melilla, a Spanish fortified station and penal settlement on the north coast of Morocco, to the south of Cape Tres Forcas, with a population of 5432 in 1887 and 10,201 in 1897. The civil population is not important, but there is a strong garrison to protect the place against its turbulent neighbours, the lawless Arab Riff tribes, and to keep in order the large number of convicts. The town is on a peninsula connected with the mainland and outer lines of fortifications by a rocky isthmus. There is a lighthouse on the north of the town. The Vega of Melilla extends to the south and west of the outer defences, and is watered by the Oro river, whose course has been altered behind Mount San Lorenzo to prevent this stream from flowing into the little harbour, which is only accessible to very small vessels; the roadstead outside is safe and has deep water a mile to the east of the fortress. The Moorish custom-house is on the Spanish border beyond the fort of Santa Isabel, and is the only authorized centre of trade on the Riff coast between Tetuan and the Algerian frontier. Spain has always had much trouble with the Riff tribes around Melilla, and when they besieged the town in 1893, 25,000 men had to be despatched against them.

Méline, Felix Jules (1838- ——), French statesman, was born at Remiremont, in the department of the Vosges, on 20th May 1838. After studying law in Paris, he practised in the Court of Appeal, and took no part in politics till the fall of the Empire. The moderate

Republican opinions which he had always held now obtained for him a post in the mayoralty of the 1st arrondissement, which in March 1871 elected him a member of the Commune. He declined, however, to sit. He had been an unsuccessful candidate for the representation of his native department, the Vosges, in the National Assembly at the general election of February 1871, but was returned at a bye-election in October of the following year. He voted consistently in support of Thiers, and in 1876 was returned for the arrondissement of Remiremont. As member of the Conseil Général of the Vosges, and founder of the Épinal journal, *Le Mémorial des Vosges*, he acquired a local influence, which, added to his gift of brilliant and incisive oratory, brought him the appointment of under-secretary for justice in the Jules Simon ministry (December 1876 to May 1877). In the Republican Chamber, returned by the elections of 1877, he remained consistently moderate, and was among those who voted against the proposal for a general amnesty. Sitting for an agricultural constituency, he now came forward as the champion of the agricultural interest, and began a campaign, conducted with signal skill, knowledge, and pertinacity, in favour of a strongly protectionist policy. His first opportunity of enunciating these views with effect came with his selection in 1880 to be one of the reporters and subsequently president of the commission on the customs tariff. In February 1883 he became Minister of Agriculture in the second Ferry cabinet, and held this post till the fall of the ministry in April 1885. It was a period of severe distress both in industry and agriculture. He carried a law to protect the French beet-sugar industry from German competition, and introduced a measure raising the duties on the importation of cereals and cattle. He also founded the order of agricultural merit. In April 1888 the presidency of the Chamber became vacant on the acceptance of the premiership by Floquet. The voting for M. Méline and M. Clémenceau was equal, and by virtue of the rule giving precedence to the senior candidate M. Méline was declared elected. His tenure of the post coincided with the height of the Boulangist agitation. The debates in the Chamber were marked by an unprecedented violence, with which he proved unable to cope. It was felt that he did not wield the authority of his predecessor, Floquet, by whom he was replaced in the new Chamber of 1889. A staunch Republican, he was one of the most prominent opponents of Boulanger, and on the fall of the Floquet cabinet in February 1889 was entrusted with the formation of a new ministry, but was forced to abandon the attempt. As president of the commission on the tariff, he succeeded during the session of 1891 in inducing first the commission and then the Chamber to replace the existing system of commercial treaties by a uniform tariff of a strongly protective character, especially on articles of agricultural produce. On the fall of the Ribot ministry in March 1893, and again on the fall of the Dupuy ministry in November, he was summoned by the President, but was unable to effect a working combination. In the same year he was elected to succeed Jules Ferry as president of the Conseil Général of the Vosges. In December 1894 he again stood for the presidency of the Chamber, but was defeated by the Radical candidate, M. Brisson. On the resignation of the Bourgeois cabinet, M. Méline formed a new administration (30th April 1896), in which he himself took the portfolio of agriculture. The most urgent question that confronted him was the conflict between the Chamber and the Senate, which had caused the downfall of his Radical predecessor. M. Méline's declaration stated that while the Chamber of Deputies, as elected by direct universal suffrage, had a preponderating influence on politics, it was impossible to legislate and govern without the co-operation of the Senate. This declaration, fiercely attacked by the Radicals, was carried by the help of the Right, on whom the Méline ministry found itself more and more dependent. Another pressing question was that of financial reform. M. Méline abandoned the unpopular Radical project of a tax on the French *rente*, and proposed an income-tax designed to redress the balance of taxation in favour of real property, and thus to foster the greatest of French interests—agriculture. But the opposition prevented the Government from making any substantial progress with its financial measures either in this or in the following session. The Méline ministry, however, derived fresh strength from the success of its foreign policy. The premier played a prominent part in the splendid reception accorded to the Tsar in October 1896, and during the return visit of President Faure in August 1897 reaped the credit of the most brilliant achievement of French diplomacy under the Third Republic—the public proclamation of the alliance between France and Russia. The remainder of his term of office was overshadowed by the Dreyfus case. M. Méline maintained that the verdict of the court-martial could not be revised by the Government; he prosecuted M. Zola for his attack on that tribunal, and in the debates raised by M. Zola's condemnation declared that the matter was *chose jugée*, and that there was no longer a Dreyfus case or a Zola case. The Chamber ordered by 471 votes to 40 that this speech should be posted up throughout France. His protectionist policy was severely tried by the high price of wheat in the spring of 1898. He was at last forced to decree a temporary suspension of the duty. Immediately after this the general election took place. Though the balance of parties remained nominally unchanged, the new Chamber at once proved itself hostile to M. Méline's policy of alliance with the Right. On 14th June, after passing a vote of approval in the declarations of the Government, it demanded that the latter should rely on an exclusively Republican majority. M. Méline thereupon resigned. He stood as the candidate of the Right at the Presidential election of February 1899, but received only 279 votes, against 483 cast for M. Loubet. He was afterwards the most prominent opponent of the Waldeck-Rousseau cabinet, attacking especially the policy of conciliating the Socialists by the inclusion of a Socialist, M. Millerand, as minister of commerce.

Melitopol, a district town of Russia, government of Taurida, 151 miles by rail north-east of Simpheropol, on the Molochnaya river. Till 1841 it was a small village (Novo-Alexandrovskaya), but has grown owing to its important fairs. It has two gymnasia, for boys and girls. Population (1897), 15,120.

Melrose, a police burgh of Roxburghshire, Scotland, on the river Tweed, 37¼ miles south-east by south of Edinburgh by rail. There is a market cross of date 1642, a public hall, and an institute containing library and recreation rooms. A hydropathic establishment is adjacent, and two miles west stands Abbotsford, the mansion built by Sir Walter Scott. Population (1881), 1550; (1901), 2195. The parish formerly contained part of the burgh of Galashiels, but that part was transferred to the parish of Galashiels in 1891.

Melrose, a city of Middlesex county, Massachusetts, U.S.A., on a branch of the Boston and Maine railroad, in the eastern part of the state, 7 miles north of Boston, of which it is a suburb. Its area of 6 square miles is broken and hilly, and the street plan is irregular. It has extensive and varied manufactures, with (in 1900) a capital of $3,296,048, products valued at $3,945,580, and 1428 hands. Population (1890), 8519; (1900), 12,962, of whom 2924 were foreign-born and 130 were negroes.

Melton Mowbray, market town and parish in the Melton parliamentary division of Leicestershire, England, on the river Wreake, 14 miles north-east of Leicester by rail. St. Mary's peal of ten bells is played by a carillon machine. The Colles Memorial Church Institute was erected in 1890, and a new cemetery of six acres opened in 1893. Three blast furnaces have been erected in the neighbouring parish of Asfordby for the smelting of the abundant supply of iron ore in the district. Population (1891), 6392; (1901), 7454.

Melville, Herman (1819–1891), American author, was born in New York City on the 1st of August 1819. He shipped as a cabin-boy at the age of eighteen, thus being enabled to make his first visit to England, and at twenty-two sailed for a long whaling cruise in the Pacific. After a year and a half of this experience he deserted his ship at the Marquesas Islands, on account of the cruelty of the captain; was captured by cannibals on the island of Nukahiva, and detained, without hardship, four months; was rescued by the crew of an Australian vessel, which he joined, and two years later reached New York. Thereafter, with the exception of a passenger voyage around the world in 1860, Melville remained in the United States, devoting himself to literature—though for a considerable period (1866–85) he held a post in the New York custom-house—and being perhaps Hawthorne's most intimate friend among the literary men of America. His writings are numerous, and of varying merit; his verse, patriotic and other, is quite forgotten; and his works of fiction and of travel are of irregular execution. Nevertheless, few authors have been enabled so freely to introduce romantic personal experiences into their books: in his first work, *Typee: A Peep at Polynesian Life, or Four Months' Residence in a Valley of the Marquesas* (1846), he described his escape from the cannibals; while in *Omoo, a Narrative of Adventures in the South Seas* (1847), *White Jacket, or The World in a Man-of-War* (1850), and especially *Moby Dick, or The Whale* (1851), he portrayed seafaring life and character with vigour and originality, and from a personal knowledge equal to that of Cooper, Marryat, or Clark Russell. The experiences of sailor-life in forecastle or on deck, in storm and in sunshine, in pursuit of the whale or in danger of capture by savages, as narrated by Melville in his chief works, have never ceased to interest a limited yet loyal public of readers in America and England. But these stirring records of adventure were accompanied by other tales so turgid, eccentric, opinionative, and loosely written as to seem the work of another author. Melville was the product of a period in American literature when the fiction written by writers below Irving, Poe, and Hawthorne was measured by humble artistic standards. He died in New York on the 28th of September 1891. (C. F. R.)

Memel, a seaport town of Prussia, province of East Prussia, near the northern extremity of the Kurisches Haff, 91 miles by rail north by east of Königsberg *viâ* Tilsit. It is the centre of the timber-exporting trade, and one of the chief seaports for the products of Lithuania. There is an average depth of 22 feet on the bar. The total value of the exports increased from £1,082,150 in 1893 to £1,484,550 in 1899, about 65 per cent. of this total being for timber. The other exports are chemicals and artificial manure, flax, linseed, and cereals. The imports, principally timber, increased from £1,236,500 in 1893 to £1,712,800 in 1899. The port was cleared in 1898 by 748 vessels of 267,360 tons. Several fresh industries have been started, *e.g.*, cellulose factories, chemical works, iron-foundries, and shipbuilding yards. The town is adorned by a bronze statue of the Emperor William I. (1896). Population (1885), 18,748; (1900), 20,174.

Memphis, a city of Tennessee, U.S.A., capital of Shelby county, and the first city in population in the state. It is situated on the east bank of the Mississippi, in the south-western part of the state, at an elevation (at the depôt of the Louisville and Nashville railroad) of 227 feet. The city is divided into twenty-two wards, and no fewer than ten railways centre in it. These, with the river, which is navigable for large vessels at all stages of water, make it one of the most important centres of internal commerce. It is connected with West Memphis, on the opposite side of the river, by a steel cantilever bridge. Memphis has large and rapidly increasing manufacturing interests. In 1900 it had 658 manufacturing establishments, with a total capital of $11,179,024. They employed 8428 hands, and the products were valued at $17,848,530. Among these products were lumber and timber, with a value of $3,051,181; cotton-seed oil and cake, $2,271,313; and foundry and machine-shop products, $1,078,713. Among its educational institutions is the Christian Brothers' College, a Roman Catholic institution, founded in 1871, which in 1898 had 13 instructors and 179 students. The assessed valuation of real and personal property in 1900, on a basis of about 60 per cent. of the full value, was $38,211,544, and the net debt was $3,041,966. The tax rate ranged from $29.70 per $1000 in some of the wards to $36.20 in others. Memphis was rechartered as a city with its limits extended in 1891. The population in 1890, including the population of the area added when the city was rechartered the following year, was 64,495. In 1900 the population was 102,320, of whom 5110 were foreign-born and 49,910 were negroes. The death-rate in 1900 was 25·1, about one-third higher among the coloured than among the white.

Menabrea, Luigi Federico, Marquis of Valdora (1809–1896), Italian general and statesman, was born at Chambéry on 4th September 1809. After studying at the Turin Military Academy, he was in 1848 sent on a political mission to the duchies of Modena and Parma. Elected deputy, he opposed Cavour's ecclesiastical policy and recommended reconciliation between Church and State. During the war of 1859 he gained the title of marquis by his defence of Valdora, and acquired further distinction during the siege of Peschiera. In 1860 he conducted the siege of Gaeta and was appointed senator. Entering the Ricasoli Cabinet of 1861 as Minister of Public Works, he retained his portfolio until 1864 in the succeeding Farini and Minghetti Cabinets. After the war of 1866 he was chosen as Italian plenipotentiary for the negotiation of the treaty of Prague and for the transfer of Venetia to Italy. In October 1867 he succeeded Rattazzi in the premiership, and was called upon to deal with the difficult situation created by the Garibaldian invasion of the Papal States and by the catastrophe of Mentana. During his term of office the famous grist tax Bill was passed and the tobacco monopoly instituted. After his fall in December 1869 his successor, Lanza, in order to remove him from his influential position as aide-de-camp to the king, sent him to London as ambassador, where he remained until in 1882 he replaced General Cialdini at the Paris Embassy. Ten years later he definitively withdrew from public life, and died at Saint Capin on 24th May 1896. (H. W. S.)

Menado. See Celebes.

Me Nam, or Menam (signifying literally the "mother water" or "main river"), the "Nile" of Siam, as Turpin calls it, and the chief highway of the interior, on whose yearly rise and fall depends the whole of the rice crop of Lower Siam. Rising in the Lao, or Siamese Shan, state of Nan in 19° 35′ N. and 101° 24′ E., at a height of 1400 feet upon the shoulders of the mountain mass of Doi Luang, it is first known as the Nam Ngob after a village of that name. As the Nam Nan, still a mere mountain stream, it flows southwards through the state so named between high forested ranges, and, notwithstanding the frequent rapids along its course, the natives use it in their dug-outs for the transport of hill produce. From Utaradit, where it leaves the hills of the Lao country, it flows southwards through the great plain of Lower Siam, and is navigable for flat-bottomed native craft of considerable capacity. It is here known as the Nam, or Me Nam Pichai. Below Pichai the river flows through lonely tracts of forest and swamp country, the latter providing vast overflow basins for the yearly floods. Thousands of tons of fish are caught and cured here during the fall of the river after the rains. Below Pitsunalok the waters of the Me Nam Yom, the historic river of Siam, upon which two of its ancient capitals, Sawankalok and Sukotai, were situated, meander by more than one tortuous clayey channel to the main river, and combine to form the Nam Po. At Paknam Po the main western tributary comes in, the shallow, capricious Me Ping, the river of Raheng and Chieng Mai, bringing with it the waters of the Me Wang. As the chief duty-station for teak, which is floated in large quantities down all the upper branches of the river (see under Chieng Mai), and as a place of transhipment for boats, Paknam Po is an important and growing town. From this point southwards the river winds by many channels through the richest and most densely-populated portion of Siam. About Chainat the Tachin branches off, forming the main western branch of the Me Nam, and falling into the gulf at a point about 24 miles west of the bar of the main or Bangkok river. At Ayuthia, another of the ancient capitals of Siam, the Nam Sak flows in from the north-east, an important stream affording communication with the rich tobacco district of Pechabun, and draining the western slopes of the Korat escarpment. (See Siam.)

Authorities.—*Foreign Office Trade Reports for Bangkok and Chieng Mai Districts.*—Crawford. *Journal of an Embassy to Siam.*—Holt Hallett. *A Thousand Miles on an Elephant.*—Prince Henri d'Orléans. *Around Tonkin and Siam.*—Grindrod, Mrs. *Siam.*—H. Warrington Smyth. *Notes on a Journey on the Upper Me Kong* and *Five Years in Siam.*

Menasha, a city of Winnebago county, Wisconsin, U.S.A., on the Fox river, at the foot of Lake Winnebago, in the eastern part of the state. It is on the Chicago and North-western, the Chicago, Milwaukee and St Paul, and the Wisconsin Central railways. Population (1890), 4581; (1900), 5589, of whom 1535 were foreign-born.

Mende, chief town of department Lozère, France, 252 miles south-south-east of Paris, picturesquely situated on the Lot, at an altitude of 2420 feet, and at the foot of the Mimat cliff, which rises 1000 feet above the town. The cathedral of St Peter was founded in the 14th century by Urban V., a native of the district, but the two towers, respectively 280 and 210 feet high, were added by François de la Rovère in the early part of the 16th century. Partly destroyed by the Protestants in 1580, it was rebuilt in the 17th century, and in 1874 a statue of Pope Urban V. was erected in front. A Renaissance tower of the ancient citadel now serves as the belfry of the church of the Penitents, and a 14th-century bridge crosses the Lot. The town is a convenient centre for visitors to the gorges of the Tarn. Local institutions are a communal college, library of 12,000 volumes, hospital, and consultative chamber of agriculture. An important industry is the manufacture of serges and shalloons, known as Mende stuffs, exported to Spain, Italy, and Germany. Mende grew up around the Hermitage of St Privat, partly excavated in the side of the Mimat cliff, to which the bishop retreated after the destruction of the town of Javols, and where he was subsequently slain by the Vandals, who had pursued him thither, about 408. In the 14th century the new town became the civil, as it had previously been the ecclesiastical, capital of the Gevandan district. Population (1881), 4994; (1901), 7319.

Mendeléeff, Dmitri Ivanovitch (1834–——), Russian chemist, the youngest of a family of seventeen, was born at Tobolsk, Siberia, on 7th February (N.S.) 1834. After attending the gymnasium of his native place, he went to study natural science at St Petersburg, where he graduated in chemistry in 1856, subsequently becoming *privat-docent.* In 1859 he went to Heidelberg, where he started a laboratory of his own, but returning to St Petersburg in 1861, he became professor of chemistry in the Technological Institute there, and three years later succeeded to the same chair in the university. Mendeléeff's original work covers a wide range, from questions in applied chemistry, such as the origin of petroleum deposits and the application of nitro-compounds to the manufacture of smokeless powders, to the most general problems of chemical and physical theory. His name is best known for his work on the Periodic Law. He was not the first to take up this subject, for before him various chemists had traced numerical sequences among the atomic weights of some of the elements and noted connexions between them and the properties of the different substances, but it was left to him to give a full expression to the generalization, and to treat it not merely as a system of classifying the elements according to certain observed facts, but as a "law of nature" which could be relied upon to predict new facts and to disclose errors in what were supposed to be old facts. Thus in 1871 he was led by certain gaps in his tables to assert the existence of three new elements so far unknown to the chemist, and to assign them definite properties. These three he called ekaboron, ekaaluminium, and ekasilicon; and his prophecy was completely vindicated within fifteen years by the discovery of gallium by de Boisbaudran in 1871, scandium by Nilson in 1879, and germanium by Winkler in 1886. Again, in several cases he ventured to question the correctness of the "accepted atomic weights," on the ground that they did not correspond with the Periodic Law, and here also he was justified by subsequent investigation. Since his early work the periodic arrangement of the elements has engaged the attention of many chemical thinkers, and numerous variations in it and in the modes of stating it have been proposed. So far, however, no formulation has been suggested which commands universal acceptance as final, and the task still remains not only of finding a solution of certain anomalies, real or apparent, but of explaining the cause and inner meaning of the periodicities that have already been observed. Another branch of chemical theory to which Mendeléeff attaches great importance and has devoted much study is the question of such "indefinite" compounds as solutions, which he looks upon as homogeneous liquid systems of unstable dissociating compounds of the solvent with the substance dissolved, holding the opinion that they are merely an instance of ordinary definite or atomic compounds, subject to Dalton's laws. In another department of physical chemistry he has investigated the expansion of liquids with heat, and devised a formula for its expression similar to Gay-Lussac's law of the uniformity of the expansion of gases, while so far back as 1861 he anticipated Andrews's conception of the critical temperature of gases by defining the absolute boiling-point of a substance as the temperature at which cohesion and heat of vaporization become equal to zero and the liquid changes to vapour, irrespective of the pressure and volume. Mendeléeff has written largely on chemical topics, his most widely-known book probably being the *Principles of Chemistry*, which was written in 1868–70, and has gone through many subsequent editions in various languages. For his work on the Periodic Law he was awarded in 1882, at the same time as L. Meyer, the Davy medal of the Royal Society.

Mendoza, a province in the west of the Argentine Republic, bounded on the N. by San Juan, on the E. by San Luis, on the S. by the territories of Pampa and Neuquen, and on the W. by Chile. The official area at the census of 1895 was 56,502 square miles. The population in 1869 was 65,413, and in 1895 it was 116,136. Mendoza is divided into sixteen departments. In 1895 there were 7308 farms, and 28,244 acres planted in cereals. The capital, MENDOZA, with a population in 1895 of 28,302, is 636 miles from Buenos Aires by rail, and has a national college, agricultural school, normal school, and other public institutes.

Menelek II. (SAHALA MARIEM), EMPEROR OF ABYSSINIA (1844——), son of Haëli Melicoth, king of Shoa, was born in 1844, and claimed to be a direct descendant of Solomon by the Queen of Sheba. On the death of his father in 1856 he was kept a prisoner at Gondar by Kassai, the governor, who had seized the throne under the title of Theodore III. But having succeeded in effecting his escape, he was acknowledged king of Shoa, and at once attacked the usurper. These campaigns were unsuccessful, and he turned his arms to the west, east, and south, and annexed much territory to his kingdom, still, however, maintaining his divine right to the crown of Ethiopia. After the death of Theodore in 1868 he continued to struggle against his successor, the Emperor Johannes. Being again unsuccessful, he resolved to await a more propitious occasion; so, acknowledging the supremacy of Johannes, he married his daughter to the emperor's son, the Râs Area; he was thereupon declared heir to the empire, and on his side acknowledged the Râs Area as his successor. Shortly afterwards the Râs Area died, and the Emperor Johannes was killed in a war against the Dervishes at the battle of Matama, 10th March 1889. The succession now lay between the late emperor's natural son, the Râs Mangasha, and Menelek, but the latter was elected by a large majority on 4th November, and consecrated shortly afterwards. His clemency to Mangasha, whom he compelled to submit and then made viceroy of Tigré, was ill repaid by a long series of revolts. In 1889 Menelek signed the treaty of Uccialli, but finding that its ambiguity placed his empire under Italian domination, he denounced it; and after defeating the Italians at Amb-Alaghi, he compelled them to capitulate at Adowa in February 1896, and a treaty was signed recognizing the absolute independence of Abyssinia. His French sympathies were shown in a reported official offer of treasure towards payment of the indemnity at the close of the Franco-Prussian war, and in February 1897 he concluded a commercial treaty with France in very favourable terms. The British mission under Sir Rennell Rodd in the following year was, however, cordially received, and Menelek agreed to a settlement of the Somali boundaries, to keep open to British commerce the caravan route between Zeila and Harrar, and to prevent the transit of munitions of war to the Mahdists, whom he proclaimed enemies of Abyssinia. (See also ABYSSINIA.)

Mengtze, a district city in the south-east of the province of Yunnan, China. It was selected by the French convention of 1886 as the seat of the overland trade between Tongking and Yunnan, and opened two years later. It is situated on an elevated plateau 4580 feet above sea-level. The country round is fertile and well cultivated, and the place must have been one of considerable wealth before the Taiping rebellion, as the ruins of many fine temples attest. Population, about 12,000. A very considerable overland trade has sprung up since the opening of Mengtze. In 1898 the value of the trade was £596,748, in 1899, £854,252, and in 1900, £832,860, 54·8 per cent. of this being imports and 45·2 per cent. exports. Of the import trade Hong Kong supplied 96 per cent. and of the export trade 80 per cent., Tongking claiming the remainder. Tin (79·5 per cent.) and opium (17·7 per cent.) are the principal exports, and textiles (67 per cent.), mostly cottons, and tobacco (9·3 per cent.) are the chief of the imports. On the Tongking side this trade follows the Red river route as far as Manhao, which is distant from Mengtze about 40 miles, though the navigation of the river is attended by considerable difficulties. From Manhao the transit is by land, and is performed by coolies or pack animals. Concessions have been obtained by the French Government to build a line of railway from Tongking frontier at the town of Laokai *viâ* Mengtze to Yunnanfu.

Menominee, a city of Michigan, U.S.A., capital of Menominee county, on Lake Michigan, at the mouth of Menominee river, in the southern part of the Upper Peninsula, at an altitude of 595 feet. It has three railways, the Chicago and North-western, the Chicago, Milwaukee and St Paul, and the Wisconsin and Michigan. It is an important shipping point for lumber and iron ore, and has many saw and planing mills. Population (1890), 10,630; (1900), 12,818, of whom 4186 were foreign-born. The death-rate in 1900 was 14.

Menomonie, a city of Wisconsin, U.S.A., capital of Dunn county, on the Red Cedar river, in the western part of the state, at an altitude of 807 feet. It is on the Chicago, Milwaukee and St Paul, and the Chicago, St Paul, Minneapolis and Omaha railways. It has lumber and flour mills, and is an important shipping point for grain and lumber. Population (1890), 5491; (1900), 5655, of whom 1772 were foreign-born.

Menorca. See BALEARIC ISLANDS.

Mentone (Italian, *Mentone*), town, arrondissement of Nice, department of Alpes-Maritimes, France, 19 miles east-north-east of Nice by rail. The church of St Michel in the old town has been rebuilt in great part since the earthquake of 1887. A monument was erected in 1895 to commemorate the union of Mentone with France. There is a proposal to convert the Corci Valley into public gardens. In the eastern bay is the harbour, constructed in 1890. It has a depth of 24 feet, and is sheltered by a jetty 400 yards long; but although accessible to large vessels, it is frequented chiefly by those engaged in coasting trade. The distillation of various essences is an important industry, to feed which the double violet and a particular species of orange are cultivated. The culture of the vine, for some time abandoned, has been again introduced, and yields a wine of fair quality. About 1½ miles east of the town the bridge of St Louis crosses the torrent which separates France from Italy. Population (1881), 6737; (1891), 8232; (1901), 14,913.

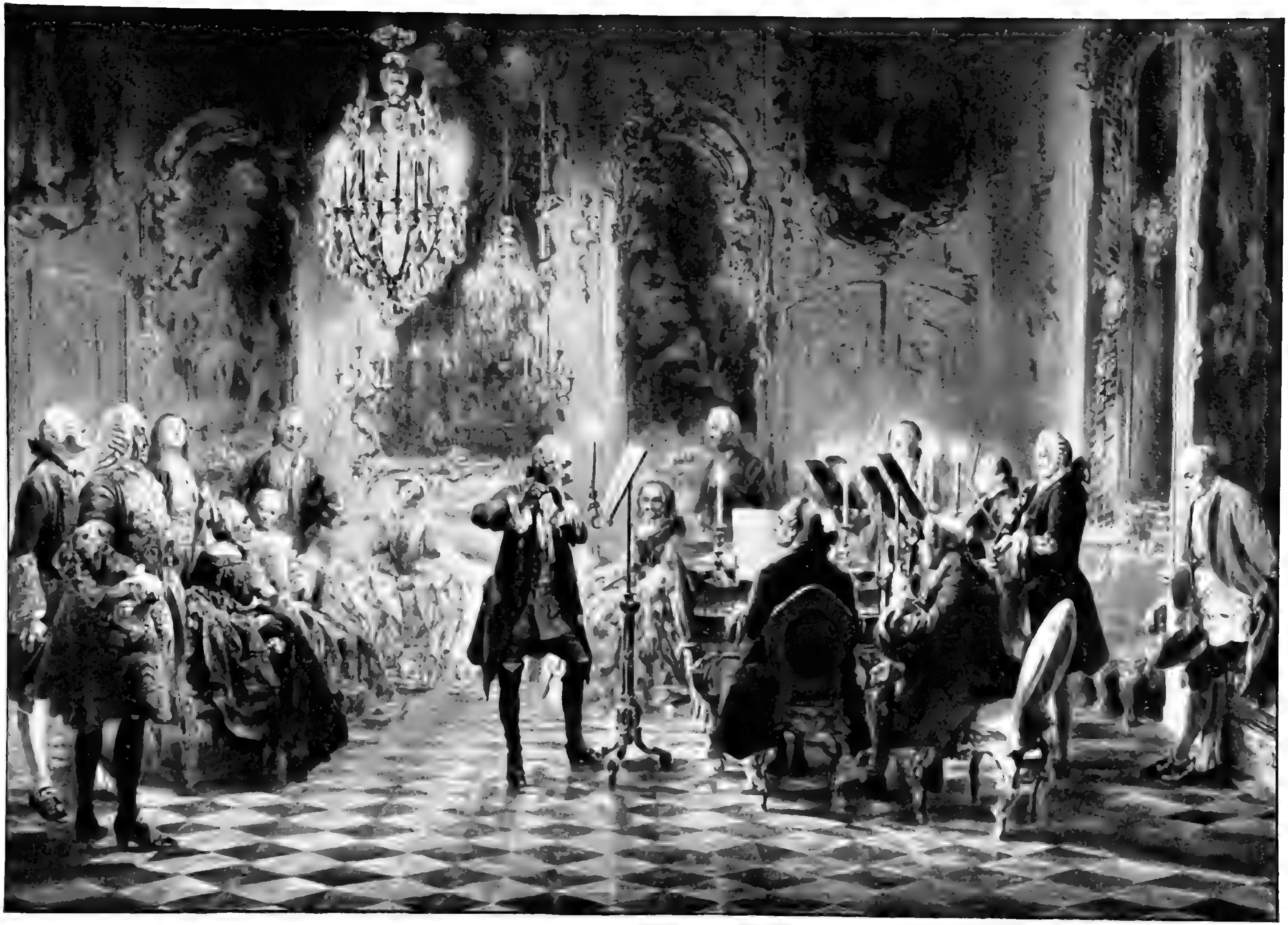
Menzel, Adolph Friedrich Erdmann von (1815-——), German artist, was born at Breslau on 8th December 1815. His father was at the head of a school for girls, and intended to educate his son as a professor; but he would not thwart his taste for art. Left an orphan in 1832, Menzel found himself called upon to maintain his family. In 1833 Sachse of Berlin published his first work, an album of pen-and-ink drawings reproduced on stone, to illustrate Goethe's little poem, "Künstler's Erdenwallen." He executed lithographs in the same manner to illustrate *Denkwürdigkeiten aus der brandenburgisch-preussischen Geschichte*, pp. 834–36; "The Five Senses" and "The Prayer," as well as diplomas for various corporations and societies. From 1839 to 1842 he produced 400 drawings, reviving at the same time the technique of engraving on wood, to illustrate the *Geschichte Friedrichs des Grossen* ("History of Frederick the Great") by Franz Kugler. He subsequently brought out *Friedrichs des Grossen Armee in ihrer Uniformirung* ("The Uniforms of the Army under Frederick the Great"), *Soldaten Friedrichs des Grossen* ("The Soldiers of Frederick the Great") and finally, by order of the Emperor Frederick William II., he illustrated the works of Frederick the Great, *Illustrationen zu den Werken Friedrichs des Grossen.* By these works Menzel has established his claim to be considered one of the first, if not actually the first, of all the illustrators, of his day in his own line. Meanwhile Menzel had set himself to study unaided the art of painting, and he soon produced a great number and variety of pictures, always showing keen observation and honest workmanship—subjects dealing with the life and achievements of Frederick the Great ("A Concert," see Plate) and scenes of everyday modern life, such as "In the Tuileries," "The Ball Supper," and "At Confession." Among the most important of these works are "The Forge" and "The Market-place at Verona." Invited to paint "The Coronation of William I. at Koenigsberg," he produced an exact representation of the ceremony without regard to the traditions of official painting. In a curious study of Menzel (*Gaz. des Beaux Arts,* Paris, 1880) M. Duranty writes, "Though in excellent health, Menzel has a morbid love of truth." Menzel's example has been an encouragement to multitudes of his fellow-artists; and more than one who would have been no more than a pleasing painter of incident has, by his influence, been transformed into an attentive observer of the facts of nature. Among these disciples are F. Skarbina, Max Liebermann, and G. Kühl. Menzel is one of the most interesting and most genuinely original personalities among the artists of the 19th century.

See LUDWIG PIETSCH. *A. Menzel.*—"A. Menzel," *Knackfuss Collection*, No. 7.

Menzelinsk, a district town of Russia, government of Ufa, 181 miles north-west of the town of Ufa, and 10 miles from the left bank of the Kama. Its fair is one of the most important in the southern Ural region, goods, chiefly cattle, hides, furs, grain, tea, manufactured articles, crockery, &c., being sold to the annual value of £400,000 to £500,000. Population (1897), 7542.

Meran, a favourite health resort and the capital of a district in South Tirol, Austria. The population in 1890 was 7176, or, with the adjoining communes of Obermais and Untermais, 13,201; and in 1900, 9284, and with adjoining communes, 17,951. It is Catholic, and chiefly German. The public buildings now include a Protestant church. The annual number of visitors and patients is about 10,000.

Mercantile, or Commercial, Agencies, in America, are organizations designed to collect, record, and distribute to regular clients information relative to the standing of commercial firms. In Great Britain and some European countries trade protective societies, composed of merchants and tradesmen, are formed for the promotion of trade, and members exchange information regarding the standing of business houses. These societies had their origin in the associations formed in the middle of the 19th century for the purpose of disseminating information regarding bankruptcies, assignments, and bills of sale. The mercantile agency in the United States is a much more comprehensive organization and covers a wider field. It came into existence after the great financial disaster of 1837, when all commerce was prostrate. Trade in the United States had become scattered over a wide territory. Communication was slow and the town merchant was without adequate information as to the standing of many business men seeking credit. Such information as could be gathered was collected individually by correspondence and in other ways. Some large houses, whose business justified the expense, employed travelling agents to report on debtors and collect moneys due. At best the information obtained was very meagre and by no means trustworthy. Undoubtedly the severity of the collapse of 1837 was due in part to the insufficiency of this information. New York merchants, who had suffered so severely, determined to organize a headquarters where reports regarding the standing of customers could be exchanged. Lewis Tappan, a man well known in business circles at that time, undertook the work. This led to the establishment of the Mercantile Agency in New York in 1841, the first organization of its kind. The system has been wonderfully developed and extended since. It now includes the whole North American continent. The territory has been completely divided into districts with more than 150 branch offices. Branches are also established in all the leading capitals of the world. Hundreds of reporters, correspondents, and clerks are employed constantly in gathering and recording information relative to the formation of firms and corporations, of persons identified with such firms and corporations or engaged themselves in mercantile pursuits; their financial resources; their past business training and present business relations, and other facts having a direct bearing on their standing and credit. This information is not wholly *ex parte;* where circumstances warrant it, reliance is placed on statements made by parties concerned, and the making of such statements is encouraged. Financial responsibility is not the whole question to be determined by the grantor of credit, but the capacity of the grantee to transact business, his opportunities and the competition he is compelled to meet. Credit is an essential to commerce conducted on enormously broad lines, and those lines are constantly extending. The granting of credit is as much a problem in the mercantile world to-day as it was when mercantile agencies were first known. Improvement in means of communication by post and with the aid of the electric current, and the perfection of the art of printing, have made possible immense strides in mercantile agency business. Instead of curtailing the usefulness of the system, they have been the means of expanding enormously trade possibilities, thereby increasing in greater ratio the necessity for quick and accurate sources of information. Agency records are subject to constant revision, and through the improved methods of communication are constantly at the service of clients at distant points. A rating book is issued quarterly, in which the names of a million and a half separate and distinct mercantile firms are given, classified by states, cities, and towns, and arranged alphabetically, with a key showing estimated capital and credit rating, explanatory classification symbols, state maps showing routes, and



"A CONCERT OF FREDERICK THE GREAT." By ADOLPH MENZEL.

(By permission of the Berlin Photographic Co.)

much information of value to mercantile firms. Weekly correction sheets are issued. There are two large agencies in the United States—the Mercantile Agency, R. G. Dun and Co., established 1841, and the Bradstreet Company. There are a number of small agencies, but in the main they are confined to single trades.

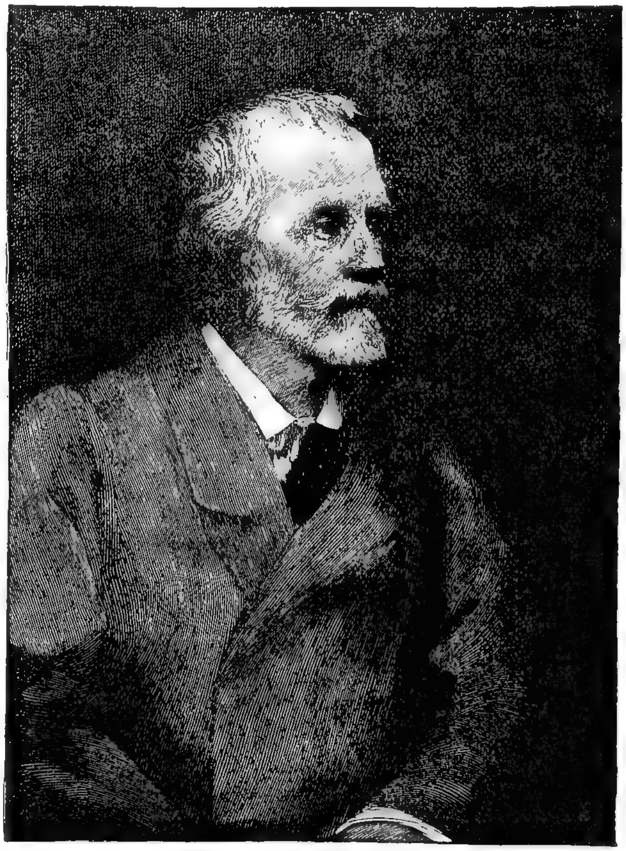
Mercury.—The world's production of mercury for 1899 was 3775 metric tons, of which Spain produced 1357, the United States 993, Austria 536, Russia 360, Mexico 324, and Italy 205 metric tons. The American product comes almost entirely from California. Mercury is known to occur in South America, China, Japan, Australia, New Zealand, the East and West Indies, and Iceland. Mercury occurs in formations of all ages from the Archæan to the Quaternary, and it has been found in both sedimentary and eruptive rocks of the most varied character, *e.g.*, conglomerates, sandstones, shales, limestones, quartzites, slates, serpentines, crystalline schists, and eruptive rocks from the most acid to the most basic. It appears that nearly all known deposits occur along lines of continental uplift, where active shearing of the formations has occurred. Large deposits are seldom found in eruptive rocks, but generally near such formations or near active or extinct hot springs. The deposits are of many types, simple fissure veins being less usual than compound, recticulated, or linked veins. Segregations and impregnations are very common. The form of the deposit seems to depend chiefly on the physical properties and structure of the enclosing rocks and the nature of the fissure systems that result from their disturbance. The principal ore is cinnabar, though metacinnabarite and native mercury are often abundant; the selenide, chloride, and iodide are rare. Of the associated heavy minerals, pyrite (or marcasite) is almost universal, and chalcopyrite, tetrahedrite, blende, and realgar are frequent. Many deposits contain traces of gold and silver, and some deposits, as the Mercur in Utah, are more valuable for their gold than their mercury content. The usual gangue-forming minerals are quartz, dolomite, calcite, barite, fluorspar, and various zeolites. Some form of bituminous matter is one of the most universal and intimate associates of cinnabar. Formerly quicksilver deposits were supposed to be formed by sublimation, but a careful study of the California occurrences convinced the writer as early as 1875 that this was unlikely, and that deposition from hot alkaline sulphide solutions was more probable. By treating the black mercuric sulphide with such solutions, hot and under pressure, he succeeded in producing artificial cinnabar and metacinnabarite. He also showed that the mineral water at the New Almaden mines, when charged with sulphydric acid and heated under pressure, was capable of effecting the same change, and that this method of production agreed better with all the facts than the sublimation theory. (See "Genesis of Cinnabar Desposits," *Am. Jour. Science*, vol. xvii. p. 453.) The investigations of Dr G. F. Becker on the "Quicksilver Deposits of the Pacific" (*U.S. Geol. Survey*, Mon. xiii. 1888) established the correctness of these views beyond doubt.

With the exception of the massive deposits of Almaden in Spain and a few of those in California and Idria, cinnabar occurs in forms so disseminated as to make its mining very expensive. Rude hand-sorting of the ores is usually practised. Wet concentration has not been successful, because it necessitates ore crushing and extensive slime losses of the brittle cinnabar. As a rule low-grade ores can be roasted directly with less loss and expense. At Almaden in Spain the ores average from 5 to 7 per cent., but in other parts of the world much poorer ores have to be treated. In California, in spite of the high cost of labour, improved furnaces enable ores containing not more than one-half per cent. to be mined and roasted at a profit. Distillation with lime in retorts, being applicable to rich ores only, is no longer used. The first improvement was the roasting of the coarse ores in discontinuous furnaces; these were first made continuous at Idria in Austria. The most successful of these continuous furnaces was a modification of Count Rumford's continuous lime-kiln. This furnace was introduced at New Almaden by Mr J. B. Randol, the author of many improvements in the metallurgy of mercury. The success of the continuous coarse-ore furnace at New Almaden led Mr Randol to attempt the continuous treatment of fine ores also, and the Huettner and Scott continuous fine-ore furnace, which was the result of these experiments, solved the problem completely. It contains several vertical shafts in which the descending ore is retarded at will by inclined shelving, which causes it to be exposed to the flames as long as may be necessary to roast it thoroughly. The time of treatment is determined by the rapidity with which the roasted ore is withdrawn at the bottom. Several similar furnaces are in use, as the Knox and Osborne, the Livermore, and the Cormak-Spirek. The fumes from the roasting furnaces are received in masonry chambers, usually provided with water-cooled pipes; from these it passes through earthenware pipes, and finally through others of wood and glass. Not all the yield is in liquid mercury; much of it is entangled in masses of soot that cover the condenser walls, and this is only recovered after much labour. The conditions for effective condensation are:—(1) The furnace gases should be well oxidized, to avoid the production of an excess of soot. Gas firing would meet this requirement better than the use of wood or coal. (2) The volume of permanent gases passing through the furnace should be reduced to a minimum consistently with complete oxidation. (3) The cross-section of the condensers should be sufficient to reduce the velocity of the escaping gases, and the surface large enough for cooling and for the adhesion of condensed mercury. The latter requirement is best provided for by hanging wooden aprons in the path of the cooled gases. (4) The temperature of the escaping gases should not exceed 15° to 20° C., but cooling below this temperature would not give any adequate return for the expense. Cooling by water is quicker, but more expensive than by air. Water sprays, acting directly on the fumes, have not given good results, on account of the difficulty of recovering flowered quicksilver from the water. (5) The use of an artificial inward draught is absolutely necessary to control the operation of the furnaces and condensers and to avoid the salivation of the workmen. (6) The condenser should be easily and quickly cleaned during the operation of the furnace. (7) Both furnaces and condensers should have inclined iron plates in their foundations to prevent the infiltration of mercury. (8) There is a great need of some substance for the construction of quicksilver condensers which shall be strong enough to be made thin, be a good conductor of heat, and resistant to abrasion and the alternate action of heat and cold. It should also resist the action of mercury and warm dilute sulphuric acid, and be not too expensive. Quicksilver is best removed from the "soot," not by pressure, but by the opposite treatment. A machine in use for this purpose at New Almaden, devised by Col. von Leicht, consists of an iron bowl, perforated at the bottom, in which revolves a vertical shaft carrying a propeller blade which tosses the soot (mixed with wood ashes and a little coal oil) into the air, so that the entangled mercury is free to run out through the bottom of the bowl. The residue from which no more mercury can be extracted mechanically is returned to the roasting furnace. The losses of treatment are:—(1) Furnace loss, which is easily reduced to nothing, and (2) condenser loss, which can never be zero. The latter consists of mercury lost as vapour and as mist, and its minimum amount is determined not by the richness of the ore but by the volume of escaping gases, their velocity and temperature. The percentage of loss will be higher with a poor than a rich ore. On a 3 per cent. ore the losses need not exceed 3 or 4 per cent. ore content. On a 1 per cent. ore they will run from 5 to 10 per cent. But in poorly arranged plants under bad management they may easily be doubled or even trebled. The Huettner and Scott fine-ore furnace costs with condensers in California about $30,000, and roasts from 30 to 45 tons of ore (from 2½ inches to dust) in 24 hours at a cost of from $1 to $0.62 per ton.

For details see "Mines and Works of Almaden in Spain," by M. Kuss, translated from *Ann. des Mines* by S. B. Christy. San Francisco, 1879; and "Imperial Quicksilver Works, Idria in Krain [Carniola]," translated by S. B. Christy. San Francisco, 1884. Also the following from the *Trans. Am. Ins. Min. Eng.*:—T. Egleston. "Mercury in North California," vol. iii. p. 273.—S. B. Christy. "Quicksilver Reduction and Condensation at New Almaden," vols. xiii. p. 574, xiv. p. 206.—V. Spirek. "Quicksilver Industry of Italy," *Mineral Industry*, vol. vi. p. 568. The geological occurrence of cinnabar is elaborately treated in the work of Dr Becker already cited.

(S. B. C.)

Meredith, George (1828– ——), British novelist and poet, of mixed Irish and Welsh descent, was born in Hampshire on the 12th of February 1828. At an early age he was sent to school in Germany, where he remained until he was fifteen. During these impressionable years he imbibed a good deal of the German spirit; and German influence, especially through the media of poetry and music, can often be traced in the cast of his thought and sentiment, as well as in the formation of his literary style. Upon his return to England he started, at his guardian's desire, upon the study of law, for which, however, he felt very little inclination, and he soon abandoned it for the more congenial sphere of literature. At the age of twenty-one he began to contribute poetry to the magazines. His early career was not without the difficulties commonly incident to the literary calling. He was engaged for some years in journalism, editing an Eastern Counties paper, for which he wrote numerous political notes and articles. During the Austro-Italian war of 1866 he acted as special correspondent of the *Morning Post*, and, although he saw little actual fighting, he enjoyed, particularly at Venice, opportunities for a study of the Italian people which he afterwards turned to account in his novels, and especially in *Vittoria*. Towards the close of 1867, when his friend Mr John Morley paid a visit to America, Mr Meredith undertook in his absence the conduct of the *Fortnightly Review*. For many years he acted as literary adviser to the publishing firm of Chapman and Hall, in which capacity he left a reputation for being not only eminently wise in his selection of the books to be published, but both critical and encouraging to authors of promise whose works he found himself obliged to reject. Among the writers with whom he came in contact in this way were Lord Lytton ("Owen Meredith"), Mr Thomas Hardy, and Mr George Gissing, all of whom have expressed their grateful sense of his wise assistance. He was, indeed, one of the last of the old school of "readers." Mr Meredith married twice, his first wife being a daughter of Thomas Love Peacock. She died after twelve years of married life, broken by separation. On his second marriage Mr Meredith settled at Box Hill, Surrey, close to the old inn in which Keats wrote part of *Endymion*. His second wife died 17th September 1885.



George Meredith.

(From a photograph by Frederick Hollyer of the painting by G. F. Watts.)

Mr Meredith's first appearance in print was in the character of a poet, and his first published poem may be found in *Chambers's Journal* for 7th July 1849. Two years later he put forth a small volume of *Poems* (1851), which, if it did not attract a large public, was at least fortunate in eliciting the praise of two judges whose opinion was of the first importance to a beginner. Tennyson was at once struck by the individual flavour of the verse, and declared of one poem, "Love in the Valley," that he could not get the lines out of his head. Charles Kingsley's eulogy was at once more public and more particular. In *Fraser's Magazine* he subjected the volume to careful consideration, praising it for richness and quaintness of tone that reminded him of Herrick, for completeness and coherence in each separate poem, and for the animating sweetness and health of the general atmosphere. At the same time he censured the laxity of rhythm, the occasional lack of polish, and the tendency, always characteristic of Mr Meredith's poetry, to overload the description with objective details to the confusion of the principal effect. No doubt as a result of Kingsley's introduction, two poems by Mr Meredith appeared in *Fraser's Magazine* shortly afterwards; but with the exception of these, and a sonnet in the *Leader*, he did not publish anything for the next five years. In the meanwhile he was busy upon a work which was to give him a triumphant introduction to the world of letters. It was early in 1856 that the *Shaving of Shagpat* made its appearance, and, despite the fact that the hour was particularly rich in literary production, it was at once recognized as a work of singular imagination, richness, and romance. George Eliot was one of the first to acclaim its excellence, and Dante Gabriel Rossetti was among its enthusiastic eulogists. Its success was not, perhaps, popular, but it was at least genuine, and the book remains one of the most fascinating in the language. Modelled upon the *Arabian Nights*, it catches with wonderful ardour the magical atmosphere of Orientalism; through its city of "yellow domes and black cypresses, silver fountains and marble pillars," the reader wanders with all the circumstance of imaginative actuality. Mr Meredith, in casting about for a new field, was less fortunate in inspiration. It occurred to him to turn his familiarity with the life and legendary tradition of the Rhinelander into a sort of imitation of the grotesquerie of the German romanticists, and in the following year, 1857, he put forth *Farina, a Legend of Cologne*, which sought to transfer to English sympathies the spirit of German romance in the same way that *Shagpat* had handled Oriental fairy-lore. The result was less successful. The plot of *Farina* lacks fibre, its motive is insufficient, and the diverse elements of humour, serious narrative, and romance scarcely stand in proportion to one another. If, however, *Farina* lost him a little ground, the *Ordeal of Richard Feverel*, which followed in 1859, transferred Mr Meredith at once to a new sphere and to the altitude of complete success. With this novel Mr Meredith deserted the realm of fancy for that of the philosophical and psychological study of human nature, and *Richard Feverel* was the first, as it is perhaps the favourite, of those wonderful studies of motive and action which placed him at the head of contemporary novelists. The theme of this fine study is the question of a boy's education. It depicts the abortive attempt of a proud and opinionated father, hide-bound by theory and precept, to bring up his son to a perfect state of manhood through a "system" which controls all his early circumstances and represses many of the natural and wholesome instincts and impulses of adolescence. The love scenes in *Richard Feverel* are specially fresh and full of vitality, and marked a revolution in the English treatment of clean and manly passion. In the following year Mr Meredith contributed to *Once a Week*, and in 1861 published as a book the second of his novels of modern life, *Evan Harrington*, which contains a richly humorous—occasionally almost farcical—plot, with some magnificent studies of character. A year later he produced his finest volume of poems, entitled *Modern Love, and Poems of the English Roadside, with Poems and Ballads.* A memorable attack upon the dramatic poem which gives the volume its title appeared in the *Spectator*, based upon the view that the poet had elected to treat a deep subject—psychical unfaithfulness—without himself possessing any sufficient conviction upon its issues. To this Mr Swinburne, with one of his characteristically generous impulses, replied (*Spectator*, 7th June 1862) in a spirit of fervent eulogy, pointing out that it is the part of poetry not so much to argue a thesis as to state a case, and that the subject had been treated in *Modern Love* with all the lucidity demanded by poetic convention. Some of the individual "sonnets" (of sixteen lines) into which *Modern Love* is divided are certainly worthy of being ranked with the most subtle and most intense poetic work of the 19th century.

Returning to fiction, Mr Meredith next published *Emilia in England* (1864), afterwards renamed *Sandra Belloni.* His powerful story, *Rhoda Fleming* (1865), followed soon afterwards. *Vittoria*, published in the *Fortnightly Review* in 1866, and in book form in 1867, is a sequel to *Emilia in England.* Four years later appeared *The Adventures of Harry Richmond*, in the pages of *Cornhill* (1870–71). Its successor was *Beauchamp's Career* (*Fortnightly Review*, 1874–75), the novel which Mr Meredith has privately described as his own favourite. Its hero's character is supposed to have been founded upon that of the late Admiral Maxse, Mr Meredith's brother-in-law. "The House on the Beach" and "The Case of General Opie and Lady Camper" (*New Quarterly Magazine*, 1877) were slight but glittering exercises in comedy; the next important novel was *The Egoist* (1879). In an interesting series of lectures which Mr Meredith delivered at the London Institution in 1877 his main thesis was that a man without a sense of comedy is dead to the finer issues of the spirit, and the conception of Sir Willoughby Patterne, the central figure of *The Egoist*, is an embodiment of this idea in the flesh. *The Tragic Comedians* (1880), the next of Mr Meredith's long novels, combines the spirits of comedy and tragedy in the story of the life of Ferdinand Lassalle, the German Socialist. The appearance of *Diana of the Crossways* (1885) marks an epoch in Mr Meredith's career, since it was the first of his stories to strike the general public. Its heroine was popularly identified with Sheridan's granddaughter, Mrs Norton, and the use apparently made of the well-known story of that lady's communication to *The Times* of the Cabinet secret of Peel's conversion to Free Trade had the effect of producing explicit evidence from Lord Dufferin and others that this story was untrue. However that might be, its popular acceptance gave additional interest to the novel.

Meanwhile further instalments of poems—*Poems and Lyrics of the Joy of Earth* (1883)—had struck anew the full, rich note of natural realism which is Mr Meredith's chief poetic characteristic. "The Woods of Westermain," in particular, has a sense of the mysterious communion of man with nature unapproached by any English poets save Wordsworth and Shelley. *Ballads and Poems of Tragic Life* (1887) and *A Reading of Earth* (1888) gave further evidence of the wealth of thought and vigour of expression which Mr Meredith brought to the making of verse. To "the general," no doubt, Mr Meredith's verse is prohibitive, or nearly so—for, after all, he has written "Martin's Puzzle," "The Old Chartist," and "Juggling Jerry." His readers, of the verse even more than of the prose, must be prepared to meet him on a common intellectual footing. But when once that is granted, the music and magic of such poems as "Seed-time," "Hard Weather," "The Thrush in February," "The South-Wester," "The Lark Ascending," "Love in the Valley," "Melampus," "A Faith on Trial," are very real, amid all their occasional obscurities of diction.

Mr Meredith had, however, now completed his sixtieth year, and the angles of his individuality began to grow sharper, while the difficulties of his style, which had never been easy, became accentuated. The increase in mannerism was marked in *One of Our Conquerors* (1891) and in the poem of "The Empty Purse," (1892). Nor did either *Lord Ormont and His Aminta* (1894) or *The Amazing Marriage* (1895) reach the high level of the earlier novels, though in the latter he seemed to catch an afterglow of genius. But by this time Mr Meredith's fame was assured, and the greatness of the work of his prime fully acknowledged. He was chosen to succeed Tennyson as President of the Authors' Society; on his seventieth birthday (1898) he was presented with a congratulatory address by thirty of the most prominent men of letters of the day; and in various other ways his position as the greatest living English writer had come to be popularly recognized. The critics discussed him; and new editions of his books (both prose and verse), for which there had long been but scanty demand, were called for. One of the results was that Mr Meredith, with very doubtful wisdom, recast some of his earlier novels; and in the sumptuous "authorized edition" of 1897 (published by Constable) very large alterations are made in some of them. In fact, a reader who compares the first and last editions either of *Richard Feverel* or *Evan Harrington* will notice changes little short of revolutionary. It is no doubt competent to an author himself to revise his earlier published work even to the extent to which Mr Meredith in the 1897 edition revised these novels; but certainly it is not necessary to accept his judgment when this involves the excision in old age of some of the most virile passages of books that were written in the full glow and vigour of his prime; and one of the duties of future editors will be to restore *Richard Feverel* and *Evan Harrington* to their earliest versions. In 1898 appeared his *Odes in Contribution to the Song of French History*, consisting of one ode ("France, December 1870") reprinted from *Ballads and Poems* (1871), and three others previously unpublished; a fine example of his lofty thought, and magnificent—if often difficult—and individual diction. In 1901 another volume of verse, *A Reading of Life*, appeared.

Mr Meredith's literary quality must always be considered in the light of the Celtic side of his temperament and the peculiarities of his mental equipment. His nature is intuitive rather than ratiocinative; his mental processes are abrupt and far-reaching; and the suppression of connecting associations frequently gives his language, as it gave Browning's, the air of an impenetrably nebulous obscurity. It is this "anfractuosity," to use a word of Dr Johnson's, that leaves much of his poetry, despite the intellect that illumines it and the beauty that lends it colour for readers who will take the trouble to put themselves at the writer's point of view, with a dimness and a blurred outline beyond even the intricacies of his prose. But, when once his manner has been properly understood, it is seen to be inseparable from his method of intellection, and to add to the narrative of description both vividness of delineation and intensity of realization. The essential respect in which Mr Meredith's method of describing action and emotion in narrative differs from that of convention is that, while the ordinary method is to relate what happens from the point of view of the onlooker, Mr Meredith describes it from the point of emotion of the actor; and his influence in this direction has largely modified the art of fiction. Herein lies the secret of the peculiar brilliancy of his style, derived from his combination of the narrator with the creator, or—in its strict sense—the seer. The reader, by the transference of the interest from the audience to the stage, is transported into the very soul of the character, and made to feel as he feels and act as he acts. Moreover, Mr Meredith's instinct for psychology is so intimate, and his sense of motive and action so true, that the interaction of character and character directly dominates the sequence of events depicted in his imaginary world, and discloses the moral idea or criticism of life, instead of the preconceived "moral" being merely illustrated by the plot. In building up the minds, actions, creeds, and tragedies or comedies of his imaginary personalities amid the selected circumstances, and inspiring them with the identical motives and educational influences of life itself, Mr Meredith has spent an elaboration and profundity of thought and an originality and vigour of analysis upon his novels which in explicitness go far beyond what had previously been attempted in fiction, and which give to his works a philosophical value of no ordinary kind. Simplicity can scarcely be expected of his language, for the interplay of ideas is in itself original and complex, and their interpretation is necessarily original and complex too. But when Mr Meredith is at his best, he is only involved with the involution of his subject; the aphorisms that decorate his style are simple when the idea they convey is simple, elaborate only in its elaboration. Pregnant, vividly graphic, capable of infinite shades and gradations, his style is a much finer and subtler instrument than at first appears, and must be judged finally by what it conveys to the mind, and not by its superficial sound upon the conventional ear. It owes something to Jean Paul Richter; something, too, to Carlyle, with whose methods of narrative and indebtedness to the apparatus of German metaphysics it has a good deal in common. To the novelist Richardson, too, a careful reader will find that Meredith, both in manner and matter (notably in *The Egoist* and in *Richard Feverel*), owes a good deal; in "Mrs Grandison" in *Richard Feverel* he recalls "Sir Charles Grandison" by name; and nobody can doubt that Sir Willoughby Patterne, both in idea and often in expression, was modelled on Richardson's creation. But what is most characteristic in Mr Meredith remains individual. Like all the great masters, he has his own tone of voice, his own fashion of expressing an idea. Feeling, perception, reflection, judgment, have equal shares in determining his architectonic relation to a problem or a situation. He rings changes on the changing emotions of humanity, but every chime rings true. It is beyond our scope here to enter into details concerning the philosophy which represents Mr Meredith's "criticism of life." Broadly speaking, it is a belief in the rightness and wholesomeness of Nature, when Nature—"Sacred Reality"—is lovingly and faithfully and trustfully sought and known by the pure use of reason. Man must be "obedient to Nature, not her slave." Mystical as this philosophy occasionally becomes, it is in the main inspiring, clean, austere, and practical; and it is always dominated by the categorical imperative of self-knowledge and the striving after honesty of purpose and thought. A strong vein of political Radicalism runs through Mr Meredith's philosophy. It is, however, a Radicalism allied to that of the French sages rather than to the current developments of British party politics. Mr Meredith has always been strongly French in his sympathies, and his appreciation of French character at its best and at its worst is finely shown in his Napoleon odes. In the main his politics may be summed up as a striving after liberty for reason and conscience and the constant progress of humanity —

> The cry of the conscience of life;
> *Keep the young generations in hail,*
> *And bequeath them no tumbled house.*

It is part of Mr Meredith's creed—and this must be remembered in considering his diction—that verbal expression is itself a test of right thought and action. Hence is derived his passion for verbal analysis. Hence also his impulse towards and vindication of poetry—meaning still "the best words in the best order"; and hence his own dictum, otherwise perhaps hard to undiscerning minds, that Song itself is the test by which truth may be tried. The passage occurs in "The Empty Purse"—itself a careful though mannered exposition of Mr Meredith's general views on life:—

> Ask of thyself: This furious Yea
> Of a speech I thump to repeat,
> In the case I would have prevail,
> For seed of a nourishing wheat,
> *Is it accepted of Song?*
> Does it sound to the mind through the ear,
> Right sober, pure sane? has it disciplined feet?
> Thou wilt find it a test severe;
> Unerring whatever the theme.
> Rings it for Reason a melody clear,
> We have bidden old Chaos retreat,
> We have called on Creation to hear;
> All forces that make us are one full stream.

Undoubtedly, as a poet, Meredith is generally ranked far less high than as a novelist. But he can only be understood and appreciated properly by those who realize that not prose (in the ordinary sense) but poetry is to him the highest form of expression, and that only in it can he fully deliver his message as a writer who aspires to contribute something more to the common stock of ideas than can be embodied dramatically in prose fiction.

A carefully compiled bibliography by John Lane is included in *George Meredith: Some Characteristics*. By R. Le Gallienne, 1890. (Lane.) (H. Ch.; A. Wa.)

Mergui, the southernmost district of Lower Burma, in the Tenasserim division, bounded on the W. by the Bay of Bengal and on the E. by Siam. It had in 1876 a population of 51,846, 73,748 in 1891, and 88,667 in 1901, showing an increase of 20·23 per cent. and giving a density of 9 inhabitants to the square mile. The area is 9789 square miles, and it had in 1898–99, 360 villages paying a revenue of Rs.2,98,671. Of the population in 1891, 63,296 were Buddhist and Jains, 5288 Mahommedans, 857 Hindus, 1891 aborigines, mostly Selungs, and 2416 Christians, 2191 of whom were natives. Of the total area of 6,264,960 acres, only 81,785 acres were cultivated in 1898–99: 3,503,259 were not available for cultivation, and 2,482,299 acres apart from fallow were cultivable. The rainfall in 1898–99 taken at Mergui was 150·71 inches. Mergui town had in 1891 a population of 10,137. There is a considerable coasting trade with other Burmese ports and with the Straits Settlements, but the town does not greatly increase in size. The coal on the Tenasserim river still remains unworked, but a renewed effort is being made to work the Maliwun tin mines by European methods. There were 192,000 acres of forests in the Mergui district in 1889–90.

Merida, a town of Spain, in the province of Badajoz, 30 miles east of Badajoz by rail. The population was

10,886 in 1897. There is an active trade in the agricultural products of the surrounding districts, and such local industries as manufactures of leather, linen goods, soap, and hats have developed. Several improvements have, fortunately, not greatly interfered so far with the priceless treasures of Roman and mediæval antiquities.

Meriden, a city and town of New Haven county, Connecticut, U.S.A., on the New York, New Haven, and Hartford railroad, south-west of the centre of the state, at an altitude of 133 feet. The plan of the city, which is included within the town, is irregular; it is divided into five wards, and the waterworks, which supply water by gravity, are owned by the city. In 1900 its manufacturing establishments had a capital of $16,699,004, employed an average number of 7531 wage-earners, and had a product valued at $13,485,640. Of this, plated and Britannia ware had a value of $4,129,896; hardware, $1,619,149; and cutlery and edge tools, $408,493. Population of the town (1890), 25,423; (1900), 28,695; of the city (1890), 21,652; (1900), 24,296, of whom 7215 were foreign born and 207 were negroes. The death-rate of the city in 1900 was 14·3.

Meridian, a city of Mississippi, U.S.A., capital of Lauderdale county, on the Mobile and Ohio, the Queen and Crescent and the Southern railways, in the eastern part of the state, at an altitude of 344 feet. It is in a region in great part devoted to the production of cotton, of which staple Meridian is a collecting and shipping point of much importance. It is the seat of Eastern Mississippi Female College, a Methodist Episcopal institution, founded in 1869. In 1899 it had 28 instructors and 307 students. Population (1890), 10,624; (1900), 14,050, of whom 235 were foreign-born and 5787 were negroes.

Merioneth, a maritime county of North Wales, is bounded on the N. by Carnarvon and Denbigh, on the E. by Denbigh, on the S.E. by Montgomery, on the S. by Cardigan, and on the W. by Cardigan Bay.

Area and Population.—The area of the ancient county, as given in the census returns of 1901, was 427,810 acres, or 668 square miles, with a population in 1881 of 51,967, in 1891 of 49,212, and in 1901 of 49,130, the number of persons per square mile being 73, and of acres to a person 8·7. In 1895 the area of the administrative county was diminished by the transference of the part of the parish of Beddgelert in Merioneth to Carnarvon. In 1891 its population was 48,859, and in 1901, 48,774. The area of the registration county is 525,802 acres, with a population in 1891 of 64,726. Between 1881 and 1891 the population decreased 5·15 per cent., and between 1891 and 1901, 0·2 per cent. The excess of births over deaths between 1881 and 1891 was 7092, but there was a decrease in the resident population of 3511. The following table gives the numbers of marriages, births, and deaths, with the number and percentage of illegitimate births, for 1880, 1890, and 1898 :—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				Number.	Per Cent.
1880	407	2161	1423	137	6·4
1890	365	1723	1213	131	7·6
1898	506	1842	1188	139	7·5

In 1891 there were in the county 102 natives of Scotland, 85 natives of Ireland, and 65 foreigners, while 3621 persons could speak English, 45,856 Welsh, and 12,023 English and Welsh.

Constitution and Government.—The county returns one member to Parliament. It has neither parliamentary nor municipal borough, but the following are urban districts: Bala (1544), Barmouth (2213), Dolgelley (2437), Festiniog (11,435), Mallwyd (890), and Towyn (3744). The county is in the North Wales circuit, and assizes are held at Dolgelley. It is partly in the diocese of Bangor and partly in that of St Asaph, and contains 37 ecclesiastical parishes and districts, and parts of 4 others.

Education.—The total number of elementary schools on 31st August 1899 was 77, of which 50 were board and 27 voluntary schools, the latter including 26 National Church of England schools and 1 "British and other." The average attendance at board schools was 5808, and at voluntary schools 1580. the total school board receipts for the year ended 29th September 1899 were over £24,212. The income under the Agricultural Rates Act was over £1234.

Agriculture.—Rather more than a third of the total area is under cultivation, and of this more than two-thirds is in permanent pasture, while corn crops occupy an eleventh and green crops less than a fortieth. Oats are the principal corn crop, occupying more than three-fifths of that acreage, while the small acreage under green crops is usually nearly equally divided between potatoes and turnips. There is a specially large proportion of cows among the cattle kept. The following table gives the main divisions of the cultivated area at intervals from 1880 :—

Year.	Total Area under Cultivation.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	152,623	16,868	4033	15,067	116,221	434
1885	157,098	17,004	3954	11,225	124,879	36
1890	161,315	16,317	4072	12,160	128,616	150
1895	154,038	14,937	3768	13,897	121,341	95
1900	152,929	13,963	3611	18,698	116,559	98

The following table gives particulars regarding the principal live stock for the same years :—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or in Calf.	Sheep.	Pigs.
1880	6137	38,493	14,827	413,473	8,468
1885	5453	39,500	14,937	399,743	9,059
1890	4998	38,281	14,549	412,878	10,049
1895	5266	38,002	13,998	376,853	9,561
1900	5219	39,518	14,276	433,727	8,137

Industries and Trade.—Manufactures are insignificant, only about 800 persons being employed in factories and workshops. The total number of persons employed in connexion with mines and quarries in 1898 was 6062; 35 tons of gold ore valued at £7 were mined in 1885, 13,264 tons valued at £16,584 in 1895, 703½ tons valued at £1158 in 1898; 155,634 tons of slate valued at £435,438 were dug in 1885, 135,457 tons valued at £456,865 in 1895, and 151,279 tons valued at over £500,000 in 1899. In 1899 sandstone was raised to the amount of 21,856 tons, igneous rocks of 12,808 tons, and slate of 160,565 tons. Fisheries are unimportant.

AUTHORITIES.—RAMSAY. *The Geological Structure of Merionethshire and Carnarvonshire.* London, 1858.—BREESE. *Kalendars of Gwynedd.* London, 1873.—KILNER. *Four Welsh Counties.* London, 1891.—Guides to North Wales. (T. F. H.)

Merivale, Charles (1808–1893), English historian and dean of Ely, born 8th March 1808, was the second son of John Herman Merivale, a Chancery barrister, and Louisa Heath Drury, daughter of Dr Drury, headmaster of Harrow. Another son was Herman Merivale, formerly permanent Under-Secretary of State for the Colonies (1848), and India (1860). Charles Merivale was at Harrow School (1818 to 1824) under Dr Butler. His chief friends were Charles Wordsworth, afterwards bishop of St Andrews, and Richard Chenevix Trench, afterwards archbishop of Dublin. In 1824 he was offered a writership in the Indian Civil Service, and went for a short time to Haileybury College, where he was distinguished for proficiency in Oriental languages. But he eventually decided against an Indian career, and went up to St John's College, Cambridge, in 1826. Among other distinctions he came out as fourth classic in 1830, and in 1833 was elected fellow of St John's. He was a member of the Apostles' Club, his fellow-members including Tennyson, A. H. Hallam, Monckton Milnes, W. H. Thompson, Trench, and Spedding. He was fond of athletic exercises, had played for Harrow against Eton in 1824, and in 1829 rowed in the first inter-University boat-race, when Oxford won. In 1833 he was ordained, and undertook college and university work successfully, acquiring some fame as a preacher. In 1848 he took the college living of Lawford, near Manningtree, in Essex; he married, in 1850, Judith Mary Sophia, youngest daughter of George Frere. In 1863 he was appointed chaplain to the Speaker of the House of Commons, declined the professorship of modern history at Cambridge in 1869, but in the same year accepted from Mr Gladstone the deanery of Ely, and until his death on 27th December 1893 devoted himself to the best interests of the cathedral. He received many honorary academical distinctions. His principal work was *A History of the Romans under the Empire*, in seven volumes, which came out between 1850 and 1862; but he wrote several smaller historical works, chiefly of an educational character, and published sermons, lectures, and Latin verses. His history did much to popularize the study of Roman history during the Empire, and was the first readable book on the subject that covered the ground satisfactorily. Merivale as a historian cannot be compared with Gibbon for virility, but he takes an eminently common-sense and appreciative view. The chief defect of the book, inevitable at the time it was composed, is that, drawing the materials from contemporary memoirs rather than from inscriptions, he relies on literary gossip rather than on the evidence of fact that inscriptions alone can supply. His judgment of character is mainly ethical, and not sufficiently relative to circumstances. The style is easy and flowing, but has a rotundity now unfashionable, and adapted to gliding skilfully over difficulties imperfectly apprehended. The Dean was an elegant scholar, and his rendering of the *Hyperion* of Keats into Latin verse (1862) has received high praise. A typical instance of the *mens sana in corpore sano*, his geniality was seasoned by an acute, almost caustic sense of humour, and it may be questioned whether he would have been more severe to fanaticism or listlessness. He had none of the faults or affectations of the pedant, and was eminently a practical man, with an accurate memory and a good head for business. His vigorous enjoyment of life, his shrewd interest in men and affairs, continued unabated to the last. (A. C. BE.)

Merrill, a city of Wisconsin, U.S.A., capital of Lincoln county, on the Wisconsin river and the Chicago, Milwaukee, and St Paul railway, north of the centre of the state, at an altitude of 1263 feet. In 1900 the city contained 69 manufacturing establishments, with a total capital of $3,520,126, products valued at $4,150,272, and 1694 wage-earners. It is in a heavily-timbered region, and its manufactures consist in great part of lumber. Population (1890), 6809; (1900), 8537, of whom 2399 were foreign-born.

Merrimac River, a stream of New Hampshire and Massachusetts, U.S.A., rising in the White Mountains of New Hampshire and flowing south into Massachusetts, and thence north-east to its mouth at Newburyport. Its length is 110 miles, and it drains an area of 4864 square miles. Its course is through a glaciated region, in consequence of which it is interrupted by many rapids and falls, which have been extensively utilized as sources of water power in the manufacture of cotton and woollen goods, notably at Lawrence and Lowell, Massachusetts, and at Nashua and Manchester, New Hampshire. This stream probably drives more spindles than any other river in the world.

Merritt, Wesley (1836-——), American soldier, was born in New York City on the 16th of June 1836, and after graduating at West Point in 1860, was assigned to dragoon service. During the Civil War he gained renown as a cavalry officer, serving in successive Virginia campaigns, under Stoneman and Sheridan. He was made a major-general of volunteers on 1st April 1865, and was promoted gradually from lieutenant-colonel of regulars to major-general. He served in Indian campaigns, as superintendent at West Point, and in command of military departments. He was assigned in May 1898 to the command of the United States forces that were sent to the Philippines, after Admiral Dewey's victory, and made first military governor of the islands. He was retired from service, June 1900.

Merscheid, a town of Prussia, in the Rhine province, now known as OHLIGS.

Merseburg, a town of Prussia, province of Saxony, on the left bank of the Saale, 9 miles by rail south of Halle. The cathedral was thoroughly restored in 1883-86. A new meeting-hall of the provincial estates was built in 1895. The castle, built in 1483-1561, but restored in the 17th century, now serves Government purposes. A bronze statue of the Emperor Frederick III. (1894), and another of the Emperor William I. (1897), adorn the town. Population (1885), 16,828; (1900), 19,119.

Mersina, a town of recent foundation, on the south coast of Asia Minor, in the vilâyet of Adana, and the port (an open roadstead) of Tarsus and Adana, with which it is connected by railway and road. The population of 12,500 is half Moslem, half Christian. The average annual exports in 1896-1900 were valued at £639,830 (1900, £821,243), the imports at £332,639 (1900, £269,121). The town is the seat of British and other consuls.

Merthyr Tydfil, a parliamentary borough and market town of Glamorganshire, Wales, on the river Taff, 24 miles by the Taff Vale railway north-north-west of Cardiff, with which it is also connected by canal. The iron ore here treated is mainly imported from Spain. At Merthyr Vale is one of the largest collieries in South Wales. A theatre has been erected, seating 1800 persons and lighted by electricity. A Roman Catholic church (1894) and a town hall (1898) have been erected; and the General Hospital, built in 1887, was enlarged in 1897. Population (1891), 59,004; (1901), 69,227.

Merv, formerly a large and flourishing town in the east of the oasis of the same name, in western Asia, now in ruins. NEW MERV was founded in the first quarter of the 19th century, more to the west of the oasis, and is now a district town of Russia, in the Transcaspian province, and on the Transcaspian railway, 510 miles from Uzun-ada station on the Caspian Sea, and 381 miles from Samarkand. It stands on both banks of the Murghab, at an altitude of about 820 feet above the Caspian, the Russian fort being situated on the right bank of the river. It is a well-built town, with (1897) 8729 inhabitants, Russians, Armenians, Turkomans, Persians, and Jews. It has a Greek and an Armenian church, and a synagogue, a Russian and two Mussulman schools, a hospital, and a meteorological observatory. Its trade returns are considerable. Corn, raw cotton (two factories), hides, wool, nuts, and dried fruit are exported. The climate is extremely dry and continental; there is often no rain from June till October, and the total rainfall is but 5 inches; the average yearly temperature is 60° Fahr. The Merv oasis was taken possession of by Russia in 1884.

Meshed, properly MASH-HAD (the place of martyrdom), capital of the great Persian province of Khorassan, situated in 36° 17′ N. and 59° 36′ E., at an elevation of 3180 feet. Its population is about 70,000 fixed and 10,000 floating, the latter consisting of pilgrims to the shrine of Imam Riza. Without the pilgrims, who come to visit it to the number of over 100,000 yearly, Meshed would be but a poor place; but lying on the eastern confines of Persia, close to Afghanistan, Russian Central Asia, and Transcaspia, at the point where a number of trade routes converge, it is very important politically, and the Russian and British Governments have maintained consulates-general there since 1889. Meshed had formerly a great transit trade to Central Asia: of European manufactures, mostly Manchester goods, which came by way of Trebizond, Tabriz, and Tehran; and of Indian goods and produce, mostly muslins, Indian and green teas, which came by way of Bander Abbási. With the opening of the Russian railway from the Caspian to Merv, Bokhara, and Samarkand in the 'eighties, Russian manufacturers were enabled to compete in Central Asia with their western rivals, and the value of European manufactures passing Meshed in transit was much reduced. In 1894 the Russian custom-house enforced new regulations by which a heavy duty is levied on Anglo-Indian manufactures and produce, excepting pepper, ginger, and drugs, imported into Russian Asia by way of Persia; and the importation of green teas is altogether prohibited except by way of Batum, Baku, Uzun-ada, and the Transcaspian railway. Since then the transit trade is practically *nil.* The present trade of Meshed is estimated at: exports, £120,000; imports, £210,000. In 1890 General Maclean, the British consul-general, reported that there were 650 silk, 40 carpet, and 320 shawl looms at work; in 1898 Colonel Temple mentioned 250 silk and 200 carpet looms. The Imperial Bank of Persia opened a branch at Meshed in 1891. (A. H.-S.)

Mesolonghi. See MISSOLONGHI.

Mesopotamia.—Since 1885 the Porte has been gradually extending its authority over the nomads in Mesopotamia. When Sheikh Fáris, the paramount sheikh of the northern Shammar Arabs, made his submission he was appointed Pasha, and maintained order within the limits of his authority. Some of the smaller tribes, on the outskirts of the desert, have been settled in villages; in several localities the Sultan owns large private estates, upon which there are model farms; small military posts have been established to protect the agricultural colonies from Arab raids; and in 1892 a special school was opened at Constantinople for the sons of influential Kúrd and Arab sheikhs. There has been a great extension of cultivation in the Euphrates valley: the rich lands south of Jebel Sinjar are cultivated, and villages have been built on them; Rakka has been occupied by colonists from Aleppo; and the Circassians of Rás el-ʿAin have planted colonies as far south as Jebel Abdul-aziz. In 1892 the most influential chiefs of the Yezidis were treacherously murdered at Mosul by Omar Pasha, and an attempt was made to exterminate the sect. This was checked by an appeal to Constantinople through the European consuls at Mosul. Throughout the country there has been a great increase of German influence, especially since the extension of the Anatolian railway to Diarbekr, Mosul, and Baghdad was projected.

See SACHAU. *Reise in Syrien und Mesopotamien.* Leipzig, 1883; *Am Euphrat und Tigris.* 1899.—PARRY. *Six Months in a Syrian Monastery.* 1895.—VON OPPENHEIM. *Vom Mittelmeer zum Persischen Golf.* Berlin, 1900. (C. W. W.)

Messina, a city of Italy in the north-east corner of the island of Sicily, with an excellent harbour opening upon the strait of the same name. Owing to its excellent position, Messina has gradually recovered its importance, and now, with a population of 156,552, is the second city of Sicily. Its harbour, strongly fortified, is visited by most of the vessels which pass through the Mediterranean to the Suez Canal eastward bound. In consequence it has become an important trade centre with a large number of wealthy commercial houses. Some industries have been established and show signs of flourishing. Agriculture, however, is the principal occupation of the district, although the province of Messina is one of the poorest of the island. Excellent silk is produced, Messina being in this respect ahead of the rest of Sicily. Except the cathedral, begun by the Normans and enlarged and embellished by Angevins and by the Spaniards, Messina has few ancient monuments, earthquakes having time after time ruined the most important edifices. By the Casati Law on higher instruction in Italy, the University of Messina was in 1860 given second-class status and its faculties restricted to law and medicine. It underwent a period of decadence from 1860 to 1885. In the latter year a Consorzio Universitario, in which the municipality, the provincial authorities, and the Chamber of Commerce were represented, provided funds for the extension of the University, and obtained from Parliament a law conferring upon it first-class status, with the addition of faculties of philosophy and letters, and of natural science and mathematics. In 1899 the University possessed 41 official and 31 free chairs. Its students, who in 1890 numbered only 302, had in 1900 increased to 672, a development due chiefly to the reputation of the various professors. In 1896, 6370 vessels of 3,257,403 tons entered and cleared the port, unloading and loading 379,623 tons of goods; in 1898, 7478 vessels of 3,392,756 tons, unloading and loading 391,201 tons of goods, entered and cleared.

Meta. See ORINOCO.

Metabolic Diseases. See PATHOLOGY.

Metallography.—The examination of metals and alloys by the aid of the microscope has assumed much importance in comparatively recent years, and it might at first be considered to be a natural development of the use of the microscope in determining the constitution of rocks, a study to which the name petrography has been given. It would appear, however, that it is an extension of the study of the structure of meteoric irons. There can be no question that in the main it was originated by Dr Sorby, who in 1864 gave the British Association an account of his work. His later papers will be referred to in the bibliography. Following the work of Sorby came that of Professor Martens of Charlottenburg, presenting many features of originality. Although much of his work dealt with the examination of opaque bodies and the application of the method to the various products of the metallurgy of iron, he studied also the general laws of fractures, fissures, blow-holes, and crystallization in metals. M. Osmond, who was one of the earliest to recognize the importance of micrography, has made certain branches of the work peculiarly his own, and has obtained results in connexion with iron and steel which are of the highest interest. A list of the more important papers by these and other workers will be found in the appended bibliography.

Preparation of the Specimen.—Experience alone can enable the operator to determine what portion of a mass of metal or alloy will afford a trustworthy sample of the whole. In studying a series of binary alloys it has been found advantageous in certain cases to obtain one section which will show in a general way the variation in structure from one end of the series to the other. This has been effected by pouring the lighter constituent carefully on the surface of the heavier constituent, and allowing solidification to take place. A section through the culot so obtained will show a gradation in structure from pure metal on one side to pure metal on the other. A thin slice of metal is usually cut by means of a hack-saw, and for this purpose saws driven by mechanism are frequently used. The thickness of the piece should not be less than ¼ inch, and in order that it may be firmly held between the fingers it should not be less than 1 inch square. The preliminary stages of polishing are effected by emery paper placed on plate glass, or preferably on wooden discs capable of being revolved at a high rate of speed. The finest grade of emery paper that can be obtained is used towards the end of the operation. Before use the finer papers should be rubbed with a hard steel surface to remove any coarse particles. The completion of the operation of polishing is effected in various ways, according to the nature of the specimen. It is generally effected on wet cloth or parchment covered with a small amount of carefully washed jeweller's rouge. Various mechanical appliances are employed to minimize the labour and time required for the polishing. These usually consist of a series of interchangeable revolving discs, each of which is covered with emery paper, cloth, or parchment, according to the particular stage of polishing for which it is required. In the case of brittle alloys and of alloys having a very soft constituent, which during polishing tends to spread over and obliterate the harder constituents, polishing is in many cases altogether avoided by casting the alloy on the surface of glass or mica. In this way, with a little care, a perfect surface is obtained, and it is only necessary to develop the structure by suitable etching. In adopting this method, however, instances have occurred in which the removal of the cast surface has shown a structure differing considerably from the original.

Polishing in Bas-Relief.—If the polishing be completed with fine rouge on a sheet of wet parchment, placed upon a comparatively soft base such as a piece of deal, certain soft constituents of an alloy may often be eroded in such a manner as to leave the hardest portions in relief. For the later stages of polishing Le Chatelier recommends the use of alumina obtained by the calcination of ammonium alum; and for the final polish of soft metals, chromium oxide.

Development of the Structure by Reagents.—Usually the constituents of an alloy do not possess a characteristic or distinctive tint, and polishing is supplemented by reagents which serve to reveal the constituents by the varying degree to which they are acted upon. Osmond divides these into three classes—acids, halogens, and salts. As regards acids, water containing from 2 to 10 per cent. of hydrochromic acid is useful. It is made by mixing 10 grams of potassium bichromate with 10 grams of sulphuric acid in 100 grams of water. The use of nitric acid requires much experience. It is frequently employed in the examination of steels, and the writer prefers to use a 1 per cent. solution in alcohol, although many workers use concentrated acid, and effect the etching by allowing a stream of water to dilute the film of acid left on the surface of the specimen after dipping it. Of the halogens, iodine is the most useful. A solution in alcohol is applied, so that a single drop covers half a square inch of surface. The specimen is then washed with alcohol, and dried with a piece of fine linen or chamois leather. Tincture of iodine also affords a means of identifying lead in certain alloys by the formation of a yellow iodide of lead, while the vapour of iodine has in certain cases been used to tint the constituents. Thin coloured films may often be produced by the oxidation of the specimen when heated in air. This, as a means of developing the structure, in the case of the copper alloys is specially useful. Tinted crystals may thus be distinguished from the investing layer caused by the presence of a minute quantity of another constituent. The temper colours produced by heating iron or steel in air are well known. Carbide of iron is less oxidizable than the iron with which it is intimately associated, and it assumes a brown tint, while the iron has reached the blue stage. These coloured films may be fixed by covering with thin films of gelatine.

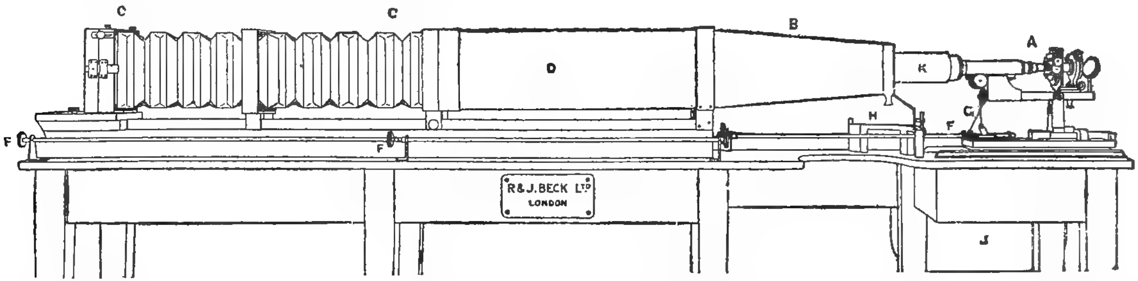


Fig. 1.—Micrographic Apparatus.

In some cases the alloy may be attacked electrolytically by exposing it for a few minutes to a weak electric current in a bath of very dilute sulphuric acid. Certain organic bodies give very satisfactory results. The Japanese, for instance, produce very remarkable effects by simple reagents of which an infusion of certain forms of grass is a not unimportant constituent. In the case of iron and steel a freshly-prepared infusion of liquorice root has been found to be most useful for colouring certain constituents of steel. M. Osmond, who was the first to use this reagent, insisted that it should be freshly prepared and always used under identical conditions as regards age and concentration. His method of applying it was to rub the specimen on parchment moistened with it, but he has subsequently modified this "polish attack" by substituting a 2 per cent. solution of ammonium nitrate for the liquorice infusion. In each case a small quantity of freshly-precipitated calcium sulphate is used on the parchment to assist the polishing.

Appliances used in Micrography.—The method of using the microscope in connexion with a camera for photographic purposes will now be considered. Every micrographer has his own views as to the form of an installation to be adopted, and it will therefore be well to give an illustration of a definite apparatus (Fig. 1) which has been found to give satisfactory results. It consists of a microscope A with a firm base placed in a horizontal position. The microscope can be connected by a tube B with the expanded camera CC, at the end of which is the usual frame to receive the photographic plate. A practised observer can focus on a plate of clear glass by the aid of a subsidiary low-power microscope lens. If a semi-transparent plate is employed it should be as fine as possible. The surface of the table is cut in such a way near H that the observer who is seated may conveniently examine the object on the stage of the microscope, the portion B turning aside for this purpose. The subsequent focussing is effected by a rod, FFF, and gearing attached to the fine adjustment of the microscope, GA; flap J when raised forms the support of the lamp used for illumination. As an illuminant an arc light has many advantages, as the exposure of the plate used will seldom exceed 10 seconds. An incandescent lamp or a gas

METALLOGRAPHY.

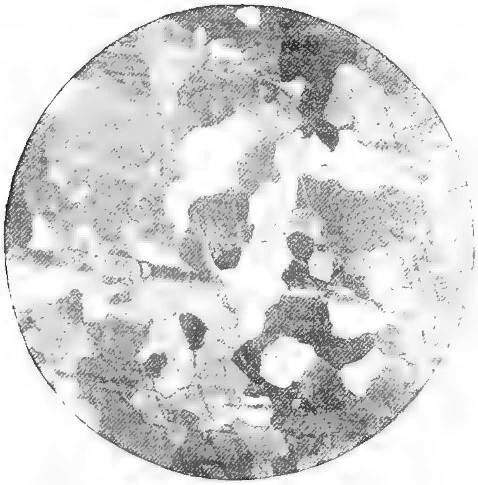


Fig. 1.—Gold containing 5 per cent. of copper, etched by nitro-hydrochloric acid. Shows crystalline grains Mag 25 diams.

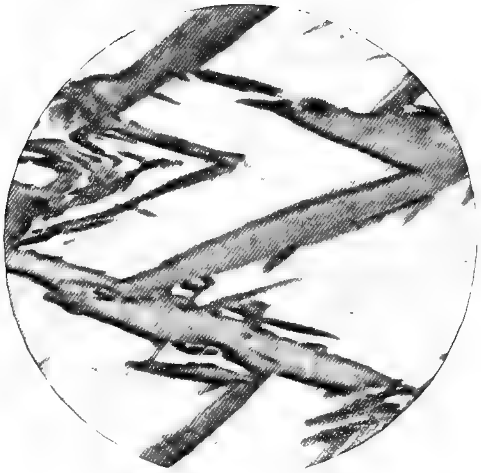


Fig. 2.—Steel containing 1·2 per cent. of carbon quenched in iced brine from a temperature of 1000° C. Mag. 1000 diams.

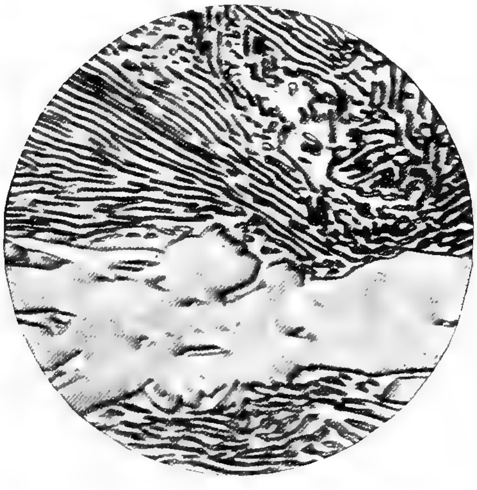


Fig. 3.—Steel containing 1·2 per cent. of carbon slowly cooled from 900° C. Shows pearlite and cementite. Mag. 1000 diams.

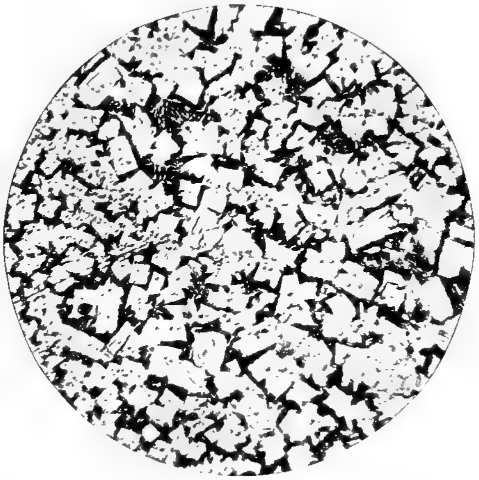


Fig. 4.—Lead-antimony alloy cast on mica and etched. 75 per cent. Pb, 25 per cent. Sb. Mag. 140 diams.

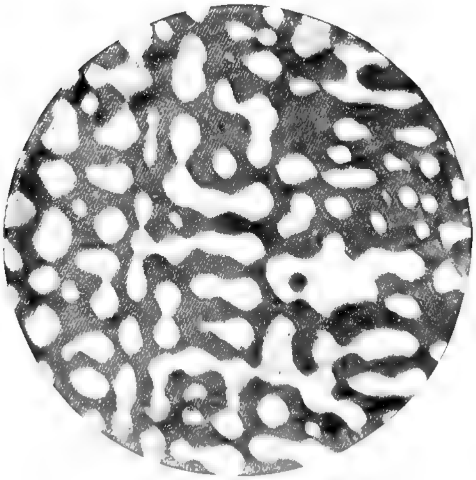


Fig. 5.—Gold-lead alloy lightly etched with 1 per cent. nitric acid. 50 per cent. Pb, 50 per cent. Au. Mag. 140 diams.

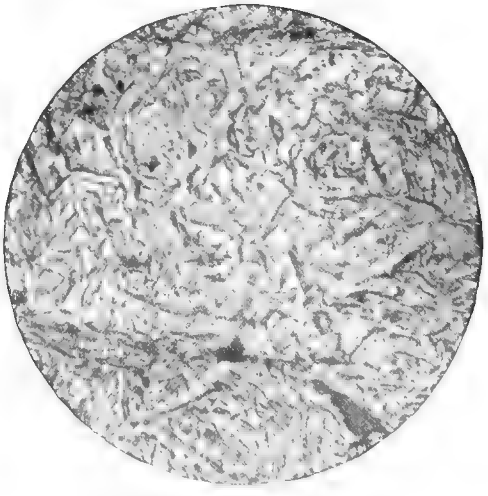


Fig. 6.—Steel containing 0·8 per cent. carbon quenched in water from a temperature of 1000° C. Shows the martensitic structure. Mag. 1000 diams.

lamp with a mantle will give good results, but with much longer exposure. Actual illumination is best effected by a Beck vertical illuminator or a Zeiss prism. It is necessary that the lens used for concentrating the light on the illuminator should be an achromatic one, as colour effects cause trouble in photographing the objects. For lower powers the Lieberkuhn parabolic illuminator is useful. Certain groups of alloys show better under oblique illumination, which may be effected by the aid of a good condensing lens, the angle of incidence being limited by the distance of the object from the objective in the case of high magnification. As regards objectives, the most useful are the Zeiss 2 mm., 4 mm., and 24 mm.; two other useful objectives for low powers being 35 mm. and 70 mm., both of which are projecting objectives. A projecting eye-piece, preferably of low power, should be employed with all but the two latter objectives. The immersion lens, the Zeiss 2 mm., is used with specially thickened cedar oil, and if the distance from the objective to the plate is 7 feet, magnifications of over 2000 diameters can easily be obtained (see Plate). As regards sensitized plates, excellent results have been obtained with Lumière plates sensitive to yellow and green. The various brands of "process" plates are very serviceable where the contrasts on the specimen are not great.

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Metal Work, Art.—The term "art metal work" is applied to those works in metal in which beauty of form or decorative effect is the first consideration, irrespective of whether the object is intended for use or is merely ornamental; and it embraces any article from a Birmingham brass bedstead to works of the highest artistic merit. The term, as definitely distinguishing one branch of metal-working from another, has scarcely been in use for more than half a century, and is objected to by many on the ground that no such prefix was required in the best periods of art, and that allied crafts continue to do without it to the present day. Indeed, as long as metal-working remained a handicraft—in other words, until the introduction of steam machinery—every article, however humble its purpose, seems to have been endowed with some traditional beauty of form. The ceaseless changes in taste and fashion attendant upon progressive civilization, the proclivities of rulers, foreign alliances, facilities for travel, and the opening up of new areas to trade, had led to the evolution of a long series of distinct styles, developed without apparent effort by successive generations of craftsmen. The robust, florid, and distinctly Roman rendering of the classic, which followed the refined and attenuated treatment associated with the architecture of the brothers Adam, who died in 1792 and 1794, is the last development in England which can be regarded as a national style. The massively moulded ormolu stair balustrade of Northumberland House, now at 49 Prince's Gate; the candelabra at Windsor and Buckingham Palaces, produced in Birmingham by the firm of Messenger; the cast-iron railings with javelin heads and lictors' fasces, the tripods, Corinthian column. standard lamps and candelabra, boat-shaped oil lamps and tent-shaped lustres with classic mountings, are examples of the metal work of a style which, outside the eccentric Brighton Pavilion and excursions into Gothic and Elizabethan, was universally accepted in the United Kingdom from the days of the Regency until after the accession of Victoria. Except perhaps the silversmiths, no one was conscious of being engaged in "art metal-working," yet the average is neither vulgar nor in bad taste, and the larger works are both dignified and suited to their architectural surroundings.

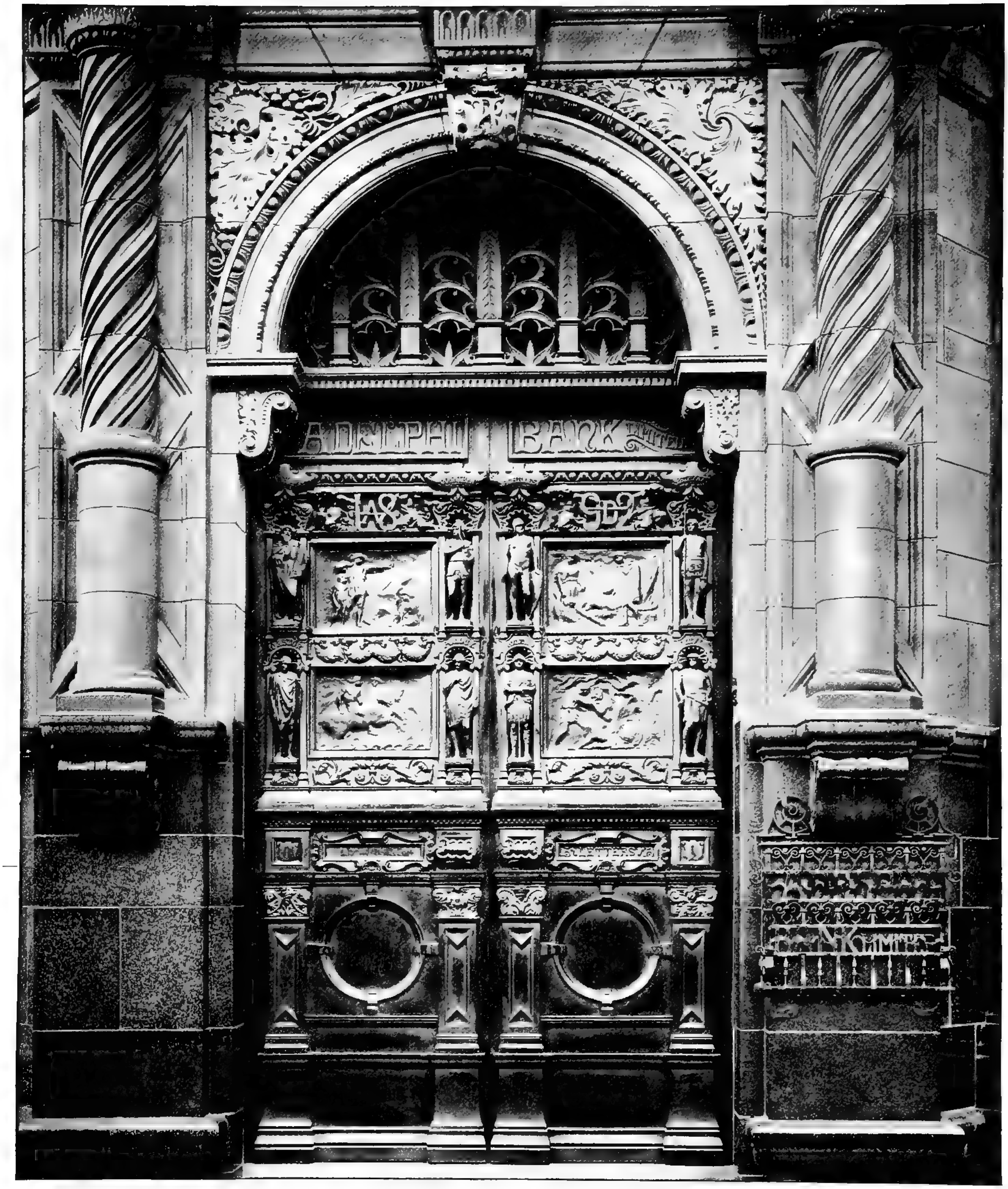
The introduction of gas as an illuminant, about 1816, at once induced a large demand and a novel description of metal fitting; and with this the craft fell under the control of a new commercial class, imbued with expansive notions of free trade, eager to supply the markets of the world, intent on breaking with past traditions, and utilizing steam power, electro-deposition, and every mechanical and scientific invention tending to economize metal or labour. Such were the conditions of metal-working, especially as carried on in the great centres of Birmingham and Sheffield, at this time. But when all artistic perception in Great Britain appeared lost in general admiration of the triumphs of machinery and the expansion of trade, a new influence in art matters, that of the Prince Consort, began to make itself felt. The Great Exhibition, state-aided schools of design, the South Kensington Museum, and the establishment of a Science and Art Department under Government, are among the results of the important art revival which he inaugurated. He is credited with having himself designed candelabra and other objects in metal, and he directly encouraged the production of the sumptuous treatise on metal work by Digby Wyatt, which laid the foundations of the revival. To this work, and that of Owen Jones, can be traced the origin of the eclecticism which has laid all past styles of art under contribution. The Gothic revival, pursued simultaneously but quite independently, also helped in a general way the recognition of art, without very directly affecting the movement. It did, however, lead to a profound study of one of the bygone phases of the art of Great Britain, and was especially valuable in teaching how to work within definite limitations, but without slavish copying; it also emancipated a considerable body of craftsmen from the tyranny of manufacturers whose sole idea was that machine work should supercede handicraft. Its greatest efforts were the metal chancel screens designed by Sir G. G. Scott, that for Hereford Cathedral having been exhibited in 1862. The effect produced by these, though purporting to be strictly Early English in character, could hardly on the whole have been conceived by the designers and workers of that period. It does not appear that the influence either of Owen Jones or Digby Wyatt on metal-working extended beyond bringing the variety and beauty of past styles to the direct notice of designers. They did not actually themselves produce designs affecting the development of the metal crafts. Neither can the London silversmiths, though they employed the best talent available, particularly in the decade following the Great Exhibition of 1851, be credited with directing or even much influencing the art metal revival, especially of later years. They were rivalled by Elkington of Birmingham, who secured the permanent assistance of at least one fine artist, Morel Ladeuil, the producer of the Elcho Challenge Shield. Perhaps the first actual designer to make a lasting impression on the crafts was Thomas Jeckyll, some of whose work, including gates for Sandringham, was exhibited in 1862. Infinitely greater as a designer was Alfred Stevens, whose influence on English craftsmen might be regarded as almost comparable to that of Michelangelo on that of his Italian contemporaries. Stevens's designs certainly directly raised the standard of production in several metal-working firms by whom he was employed; whilst in the Wellington Memorial in St Paul's Cathedral, and in Dorchester House, his work is seen unfettered by commercial considerations. Omitting many whose occasional designs have had little influence on the development of the metal crafts, we come to Alfred Gilbert, whose influence for a time has been scarcely less than that of Stevens himself. Monumental works, like his statue of Queen Victoria at Winchester and his work at Windsor, may be handed down as his greatest achievements, but judged as art metal work, his smaller productions, such as the centre-piece presented by the army and navy to Queen Victoria on her Jubilee, have been more important.

The charming bronze statuettes of Onslow Ford, the most representative of which are in the Tate Gallery; the work of George Frampton, as seen in the Mitchell Memorial; and the beautiful bas-reliefs of W. Stirling Lee, examples of which are illustrated in the bronze gates of the Adelphi Bank at Liverpool (see Plate), have all contributed, especially when applied to architectural decoration, to a high standard of excellence. Painters also have frequently designed and modelled for metal work, like Lord Leighton, who produced bronze statuettes of most refined character; and Sir L. Alma-Tadema, who designed the grilles for his studio and entrance hall; but none have devoted themselves so conspicuously to it as Professor von Herkomer, who, whether working in gold and enamel, iron, or his favourite alloy, pewter, infuses a freshness into his designs and novelty into his methods which display an unusual mastery over materials.

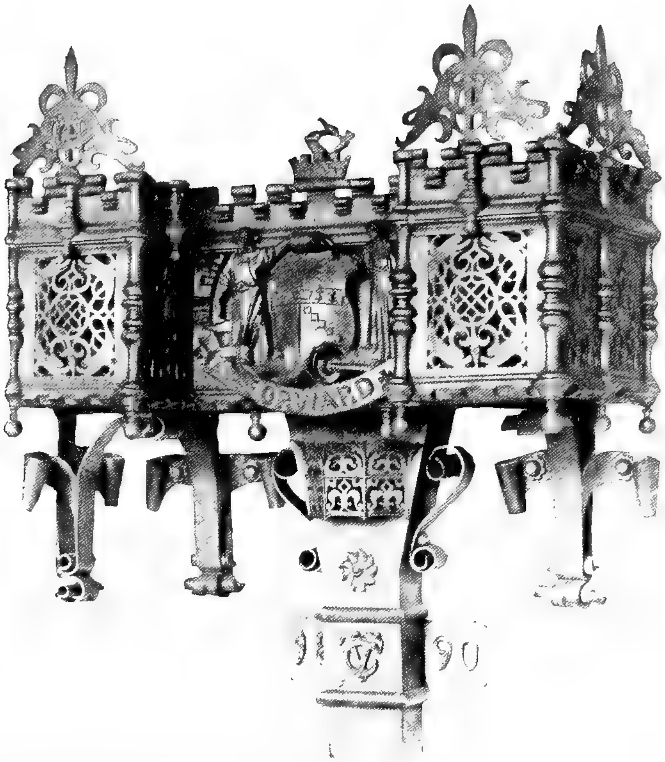
The gift of reproducing effects of nature or art by brush or chisel is not, however, accompanied necessarily by power to design, as many have discovered; but a noteworthy exponent of the dual faculty is G. C. Haité, whose designs are widely applied.

It is chiefly to architecture that metal work owes its permanent, steady, and comprehensive artistic improvement. Good architecture creates good craftsmen, and together they have ever stood and fallen. The buildings of Norman Shaw and Ernest George demanded quiet and harmonious metal work; and the custom of these architects of superintending and designing every detail, even for interiors, created the supply. Such men educate those they employ, and apt pupils gather round them. The work of every worthy architect raises the standard of the crafts; but beyond others Messrs Ashbee, Lethaby, and Wilson have taken an active personal interest in schools of metal work. The technical schools, maintained or subsidized by corporate bodies, have also been of immense service in creating a class of intelligent, capable, and self-respecting craftsmen, whose wages, proportioned to their skill, enable them to regard their work not merely as irksome toil, but as worthy occupation abounding in interest. Home industries, carried on far from the recognized centres, such as the metal working round Keswick, executed during hours of enforced idleness by field labourers and railway porters, educate the passer-by as well as the worker. This admirable school, founded in 1884 by Canon and Mrs Rawnsley, to provide recreation as well as remunerative work, was in 1901 attended by about fifty men during the winter, in addition to employing a permanent staff of twelve.

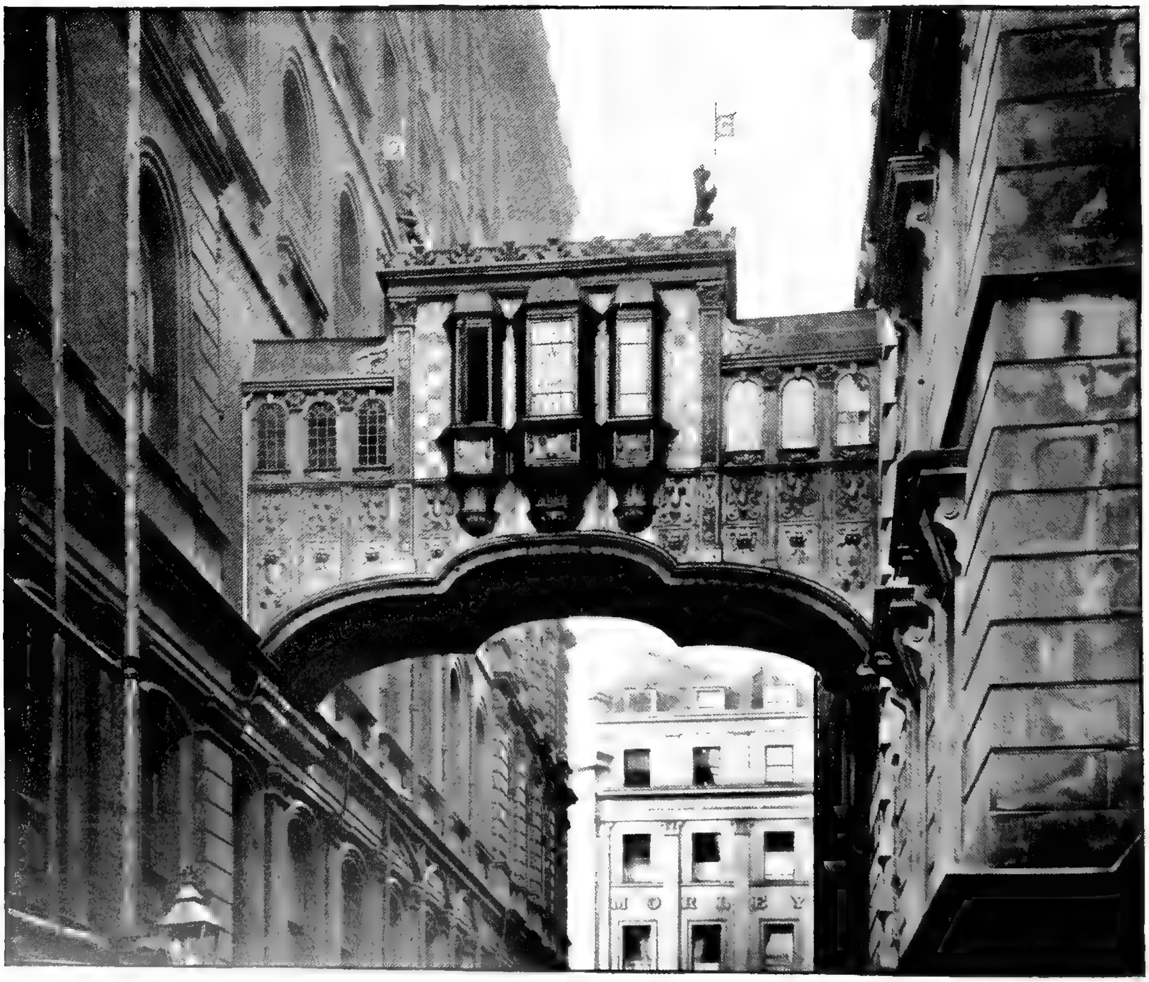
Architects and artists who design for the principal decorating firms are to-day as conversant with the Renaissance and succeeding styles of France and Italy as mediæval revivalists were familiar with the Gothic styles with which they made us so well acquainted. Metal work more or less based upon every kind of past style, and appropriate to the most varied architectural and decorative surroundings, is produced in vast quantities, and in some cases so skilful are the workers that modern forgeries and reproductions are almost beyond the power of experts to detect. This large class of designers and craftsmen, to whom a thorough knowledge of the history of design is a necessity, may be distinguished as conventional, following and developing traditional lines. The new art school, on the contrary, breaks wholly with tradition, unless unconsciously influenced by the Japanese, and awards the highest place to originality in design. It is not to be expected that an art revival following on, and in possession of, all the results of a period of unprecedented activity in scientific research should proceed as leisurely or with the same restraint as heretofore; but unfettered activity, and the general encouragement almost ostentatiously to abandon the traditions of art, have no exact parallel in the past, and may yet prove a danger. It is perhaps the very rapidity of the movement, so characteristic of the age, that is likely to retard its progress and to fail to carry with it the wealthy clients and the decorators they employ, or perhaps even to increase the disposition, already apparent, to cling to the safe ground of reproductions of the styles of the 17th and 18th centuries. The multiplication of art periodicals, lectures, books, photographs, meetings of societies and guilds, museums, schools of arts and crafts, polytechnics, scholarships, facilities for travel, exhibitions, even those of the Royal Academy, to which objects of applied art are now admitted, not only encourages many persons to become workers and designers in the applied arts, but exposes everything to the attentions of the plagiarist, who travesties the freshest idea before it has well left the hands of its originator. Thus the inspirations of genius, appropriated by those who imperfectly appreciate their subtle beauty and quality, become hackneyed and lose their charm and interest. The keen desire to be unconventional in applied art has spread from Great Britain and the United States to Germany, Austria, and other countries, and is, in fact, everywhere apparent, but without concerted lines, well-defined first principles, or limitations. Individuals may follow Rossetti, or Burne-Jones, or William Morris, or any other brilliant masters at home or abroad, but neither artists nor public are agreed as to any particular school being best worth development. It seems agreed in a general way that the completed work in metal is to be wholly the conception and, as far as possible, the actual handiwork of the designer: casting by the *cire-perdue* process, left practically untouched from the mould, and embossing, being the two most favoured processes. The female figure is largely made use of in every class of unconventional design, and rich and harmonious colours are sought, the glitter of metal being invariably subdued by deadening its lustre, or by patinas and oxides. Gilding, stains and lacquers, electro-plating, chasing, "matting," frosting, burnishing, mechanically produced mouldings and enrichments, and the other processes esteemed in the 19th century, are disused and avoided. New contrasts are formed by the



Cast Bronze Gates, Adelphi Bank, Liverpool. Designed by W. D. Caröe, the figures by Stirling Lee, executed by Starkie Gardner and Co.



RAIN-WATER HEAD, IN LEAD, FOR THE VICTORIA LAW COURTS, BIRMINGHAM. Designed by ASTON WEBB and INGRES BELL, and executed by DENT AND HELLIER.



COVERED BRIDGE OF IRON, SHEATHED IN CAST LEAD, GRAND HOTEL, LONDON. Designed by WILLIAM WOODWARD, and executed by STARKIE GARDNER AND Co.

juxtaposition of differently toned metals; or these with an inlay of haliotis shell, introduced by Alfred Gilbert; or of coloured wax, favoured by Onslow Ford; or enamelling, perfected by Professor von Herkomer; or stained ivory, pearls, or semi-precious stones. The quality of the surface left by the skilled artist or artisan is more regarded than symmetry of design, or even than correct modelling. Frequently only the important parts in a design are carefully finished and the rest merely sketched, the mode of working, whether by modelling tools or hammer, being always left apparent.

The newer kinds of art metal work have, until recently, reached the purchaser direct from the producer's workshop, but they may now also be seen in the shops of silversmiths, jewellers, and general dealers, who are thus helping to transfer production from large commercial manufactories to smaller ateliers under artistic control. The production of the larger household accessories, such as bedsteads, fenders, gas and electric fittings, clocks, &c., has hardly as yet come under the influence of the art movement. The services rendered by Mr W. A. S. Benson of Chiswick, who by his practical and elegant designs commenced about 1886 to revolutionize the production of sheet-brass and copper utensils, cannot be passed over in this connexion. The average ecclesiastical metal work has upon the whole rather receded than progressed in merit, except when it is specially designed by architects and executed under their supervision. Though the demand for good domestic wrought-iron work has enormously increased, adaptations from the beautiful work of the 17th and 18th centuries have been found so suited to the architectural surroundings amidst which they are placed, that entirely new departures have hitherto been relatively uncommon. Of such the gates for Sandringham, by Jeckyll; for Crewe Hall, by Charles Barry; and for the Victoria and Albert Museum, by Gamble, are the earliest and best known. Of the vast number designed upon traditional lines may be cited those for Lambton Castle, Welbeck, Eaton Hall, Twickenham, Clieveden, and the Astor Estate Office on the Victoria Embankment. Cast iron, brought to perfection by the Coalbrookdale Company about 1860, but now little esteemed, owing to the poverty of design which so often counterfeits smith's work, presents great opportunities to founders possessing taste or willing to submit to artistic control. A very large field is also opening for cast-lead work, whether associated with architecture, as in the leaden covered-way over Northumberland Street, in London (see Plate), and the fine rain-water heads of the Birmingham Law Courts (see Plate), or with the revival of the use of metal statuary and vases in gardens. The subdued colour and soft contours of pewter render it once more a favoured material, peculiarly adapted to the methods of the art revival, and perhaps destined to supersede electro-plate for household purposes. In silver work the proportion of new art designs exhibited by dealers and others is still relatively small; but jewellers, except when setting pure brilliants and pearls, are becoming more inclined to make their jewels of finely modelled gold and enamel enriched with precious and semi-precious stones, than of gems merely held together by wholly subordinate settings.

On the continent of Europe, France was undoubtedly the first to recognize the merits of its bygone designers and craftsmen, and even antecedent to the Exhibition of 1851, when art in Great Britain was practically dormant, it was possible to obtain in Paris reproductions of the finest ormolu work of the 18th century faithfully rendering the characteristics of the originals. At the same time a most active production of modern designs was proceeding, stimulated by rewards, with the result that the supply of clocks, lamps, candelabra, statuettes, and other ornaments in bronze and zinc to the rest of Europe became practically a monopoly of Paris for nearly half a century. In all connected with their own homes the French adhere to their traditions far more than other nations, and the attempt at originality in the introduction of metal work into the scheme of decoration of a room is almost unknown. In the domain of bronze and imitation bronze statuary the originality of the French is absolutely unrivalled. And not only in bronze, but in Paris jewellery, enamels, silver, pewter, and iron work an excessively cultured refinement is apparent, beside which other productions, even the most finished, appear imperfectly developed and crude. The French artist attains his ideal, and it is difficult to imagine, from his standpoint, that the metal-work of the present can be surpassed. The best English metal-worker, on the contrary, is probably not often quite satisfied with the results he attains, perhaps because in Great Britain the pursuit of art has for centuries been fitful and individual, while in France art traditions have been continuously developed and maintained, and are hereditary. The British temperament may cause French art to be regarded by many as exotic and over-developed, but the fact remains that their metal-work is approached in power and technique by a very few of the best British artists. The metal-work of Belgium is based at present entirely on that of France, without attaining the same standard, unless designed for ecclesiastical uses. In Holland these crafts have not progressed. Italian metal-workers are now mainly employed in reproduction, but traditions linger, either of the goldsmith or blacksmith, in some remote parts, while the sporadic appearance of craftsmen of a high order is evidence that the ancient artistic spirit is not wholly extinct. Similarly, the surprising damascening by Messrs Zuluaga of Madrid in the monument to General Prim, and that of Alvarez of Toledo, give hope that the Spanish craftsman only needs to be properly directed. German and Austrian workers had for years shown more energy than originality, but they have recently embraced the newest English developments and carried them to extremes of exaggeration. For really fresh and progressive indigenous art we may perhaps have, in the near future, to turn to America and to Russia, where, having little artistic past to refer to, designers and craftsmen display unequalled individuality and force. It is from the Far East, however, that the most serious rivalry may be anticipated. The metal-work of China and Japan, so pleasantly naïve and inexpensive, though becoming undesirably modified as to design through contact with European buyers, is losing none of its matchless technique, which indeed in Japan is still being developed. In any history of the art revival the influence of such firms as Barbedienne and Christofle in Paris and Tiffany in New York cannot be ignored. The example and success of the latter probably did much to stimulate workers in England. Their aim, however, has been consistently to surpass existing standards in beauty and originality, without departing from recognized canons of art. The "new art" of Great Britain, so earnestly and actively promulgated, has no doubt a fine future, but its immediate expansion is checked and limited by the pronounced partiality of the wealthy classes for antiques and reproductions. On this account, immense sums are still spent in Paris and elsewhere abroad upon metal work destined for British and American houses, while the money available to be spent on works of art flows mainly into the pockets of the dealers in bric-à-brac. This patronage can be intercepted, and a settled preference for modern British art induced, not by ignoring the beauty and magnificently decorative effects of the works that are preferred, but by careful study of the works of the past, with a view to equalling or surpassing them in the qualities which render them so attractive. (J. S. G.)

METAPHYSICS.

§ 1. Metaphysics the Science of Being.

SIDE by side with psychology, the science of mind, and with logic, the science of reasoning, metaphysics is tending gradually to reassert its ancient Aristotelian position as the science of being in general. Not long ago, in England at all events, metaphysics was merged in psychology. But with the decline of dogmatic belief and the spread of religious doubt about the creation and government of the world; as the special sciences also grow more general, and the natural sciences become more speculative about matter and force, evolution and teleology; men begin to wonder again, like the Greeks, about the nature and origin of things, and half unconsciously discover that they are metaphysicians. Nor must we expect any great difference between the old and the new methods of dealing with these problems, when the causes have been similar: the decay of polytheism in Greek religion and his own discoveries in natural science were the motives which impelled Aristotle to metaphysical questions. There is, however, a certain difference in the way of approaching things. Aristotle emphasized being as being, without always sufficiently asking whether the things whose existence he asserted are really knowable. We, on the contrary, mainly through the influence of Descartes, rather ask what are the things we know, and therefore, some more and some less, come to connect ontology with epistemology, the science of being with the science of knowing, and in consequence come to treat metaphysics in relation to psychology and logic, from which epistemology is an offshoot. To this pressing question then—What is the world as we know it?—three kinds of definite answers are returned: those of materialism, idealism, and realism, according to the emphasis laid by metaphysicians on body, or mind, or on both. Metaphysical materialism is the view that everything known is body or matter; but while according to ancient materialists soul is only another body, according to modern materialists mind without soul is only an attribute or function of body. Metaphysical idealism is the view that everything known is mind, or some mental state or other, which some idealists suppose to require a substantial soul, others not; while all agree that body has no different being apart from mind. Metaphysical realism is the intermediate view that everything known is either body or soul, neither of which alone exhausts the universe of being. Aristotle, the founder of metaphysics as a distinct science, was also the founder of metaphysical realism, and still remains its main authority. His view was that all things are substances, in the sense of distinct individuals, each of which has a being of its own different from any other, whereas an attribute has only the being of its substance (*Met.* Z 1–3; *Post. An.* I 4); that bodies in nature are obviously natural substances, and as obviously not the only kind of substance; and that there is supernatural substance, *e.g.*, God, who is an eternal, perfect, living being, thinking, but without matter, and therefore not a body. At the present day realism is despised on the ground that its differentiation of body and soul, natural and supernatural, ignores the unity of being. Indeed, in order to oppose this unity of being to the realistic duality, both materialists and idealists nowadays arrogate to themselves the title of monists, and call realists dualists by way of disparagement. But we cannot classify metaphysics by the antithesis of monism and dualism without making confusion worse confounded. Not to mention that it has led to another variety, calling itself pluralism, it confuses materialism and idealism. Extremes meet; and those who believe only in body, and those who believe only in mind, have an equal right to the equivocal term "monist." Moreover, there is no real opposition between monism and dualism, for there can very well be one kind of being, without being all body or all soul; and as a matter of fact, Aristotelian realism is both a monism of substance and a dualism of body and soul. It is in any case unfair to decide questions by disparaging terms, and to argue as if the whole choice were between materialistic or idealistic monism, leaving realism out of court. In this case it would also hide the truth of things, which requires two different kinds of substance, body and soul. The strength of materialism consists in recognizing nature without explaining it away, its weakness in its utter inability to explain consciousness either in its nature or in its origin. On the other hand, it is the virtue of idealism to emphasize the fact of consciousness, but its vice to exaggerate it, with the consequence of resorting to every kind of paradox to deny the obvious and get rid of bodies. There are in reality two species of substances, or entirely distinct things, those which are impenetrably resisting, and those which are conscious substances; and it is impossible to reduce bodies and souls to one another, because resistance is incompatible with the attributes of spirit, and consciousness inexplicable by the attributes of body. So far true metaphysics is a dualism of body and soul. But this very dualism is also monism: both bodies and souls are substances, as Aristotle said; and we can go farther than Aristotle. Men are apt to dwell too much on the coexistence and too little on the inclusiveness of substances. The fact is that many substances are often in one; *e.g.*, many bodies in the one body, and both body and soul in the one substance, of man. What is true of the microcosm is true of the macrocosm. There are many bodies in one earth; and there is no reason for stopping this inclusiveness short of one bodily universe, or for refusing to believe that with the omnipresent spiritual substance of God it forms one substantial universe, like a gorgeous palace containing many rooms and inhabitants, all under one master. So far true metaphysics is a monism of substance, in the sense both that all things are substances and that all substances, however different, are members of one substance, the whole universe of body and spirit. In this case metaphysics generally will have to recognize three monisms, a materialistic monism of body, an idealistic monism of soul, and a realistic monism of substance, which is also a dualism of substances. But a term so equivocal, leading to an antithesis so misleading as that between monism and dualism, can never represent the real difference between metaphysical schools. We shall return, then, to the clearer and more authoritative division, and proceed to discuss materialism, idealism, and realism in their order. Idealism will receive most attention, because it is the dominant philosophy of modern thought, which tries to dethrone Aristotle as Jupiter dethroned Saturn. But perchance *redeunt Saturnia regna.*

§ 2. Recent Materialism.

(1) *Materialism Proper.*—Materialism in its modern sense is the view that all we know is body, of which mind is an attribute or function. Several causes, beginning towards the end of the 18th century, gradually led up to the materialism which flourished in the middle of the 19th century in the writings of Moleschott, Vogt, and

Büchner. The first cause was the rapid progress of natural science. The chemistry of Lavoisier, and especially his discovery of the nature of combustion, from which followed that of respiration, gave fresh evidence to the old principle of the indestructibility of matter by bodily forces, and to the application of chemical laws to biology. The zoology of Lamarck, although his views were unpopular and condemned by the authority of Cuvier, yet weakened the old hypothesis of the immutability of species, and started the theory of evolution in the form of the hereditary transmission of modifications produced in organisms by use and adaptation to the environment. The astronomy of Laplace suggested the hypothesis that the regular motions of the bodies comprising the solar system might be explained by supposing that the atmosphere of the sun originally extended beyond the orbits of all the planets and had gradually contracted. The geology of Lyell continued, as it were, the evolution of the solar system by accumulating facts inclining him to believe that the forces now operating are similar to those which worked out geological revolutions, or that we may dispense with catastrophes, and regard ancient and present fluctuations of the organic and inorganic world as belonging to one series of events. These advances in natural science, which pointed to a unity and gradual evolution in nature, were accompanied by a growth in commerce, manufactures, and industrialism which tended to absorb men's minds in material interests; and it was the same kind of spirit which showed itself in the revolutionary upheaval of 1848, and in the materialistic publications which immediately followed, while these publications have reacted on the industrial socialism of our own time. Meanwhile, philosophic forces to counteract materialism were weak. Realism was at a low ebb. Idealism was receding for the moment. Hegelianism, which had for a time been converted into a kind of orthodox basis of State-education in Germany, had made itself unpopular. Its confusion of God, nature, and man had also led to differences within the school itself. Out of the Hegelians of the "left" arose not only David Strauss (1808–1874), but also Ludwig Feuerbach (1804–1872), who became the immediate forerunner of the materialists. Feuerbach's point against Hegel—not God, but man—made him a philosopher of humanity, like Comte, rather than a materialist. But he enunciated propositions which could not but lead to materialism, such as, "The body is part of my being; nay, the body is its totality, is my Ego," and "Man is what he eats," and "Man by himself is but man; man with man, the unity of 'I' and 'thou,' is God." These causes, then, scientific, industrial, and philosophical, led to the domination of materialism in the middle of the 19th century in Germany, or rather to its revival; for in its main position, that matter and motion are everything and eternal, it was a repetition of the materialism of the 18th century in France. Carl Vogt (1817–1895) was an instance of this revival. When in 1854 the physiologist Rudolf Wagner declared that an individual permanent *Seelensubstanz* is required, if not by physiology yet by morals, if not by science yet by faith, Vogt replied by turning the saying of the French physician Cabanis, "The brain is determined to thought as the stomach is to digestion, or the liver to the secretion of bile," into the offensive form, "Thought stands in the same relation to the brain as the bile to the liver or the urine to the kidneys." But recent materialism was not mere repetition. J. Moleschott (1822–1893) made a diligent use of the science of his day in his *Kreislauf des Lebens* (1852). Starting from Lavoisier's discoveries, he held that life is metabolism, a perpetual circulation of matter from the inorganic to the organic world, and back again. He urged this metabolism against the hypothesis of vital force as then held by Liebig, but descending from antiquity in various forms. Aristotle had imputed to all living beings a soul, but to plants only in the sense of a vegetative, not a sensitive, activity. Stahl (1666–1734) changed Aristotle's vegetative into a sensitive soul, which he imputed to all living beings, and supposed that it is an incorporeal substance governing the body and its forces, as well as performing mental operations. Since Stahl's time the psychical side of his views has usually been either abandoned or modified, but in Moleschott's time many scientific men still accepted some sort of vital principle, not exactly soul, yet over and above bodily forces in organisms. Moleschott, like Lotze, had the merit of resisting the whole hypothesis of a vital principle, and in later editions of his work he supported his case by Berthelot's discoveries in artificially producing from the chemical elements organic substances. But he went farther. On the basis of Lavoisier's discovery that respiration is combustion, he argued that the heat so produced is the only force developed in the organism, and that matter therefore rules man. His saying, "Without phosphorus no thought," does not mean much; but he went on to the conclusion that thought is a movement of the matter of the brain. Finally, he put the whole materialistic view of the world into the following form: Without matter no force, without force no matter. L. Büchner (1824–1899) himself said that he owed to Moleschott the first impulse to composing his important work *Kraft und Stoff* (1855), which has run through many editions and become a kind of text of materialism. He borrowed from Moleschott the hypothesis that matter and force are inseparable. At the same time his originality consisted in his use of the theory of evolution. He applied Lyell's evolution of the earth's crust to the evolution of life upon it. In later editions, after the publication of the *Origin of Species* in 1859, he regarded Darwinism as the chief support of materialism, and asserted that the struggle for life and natural selection have abolished final causes. As in the sequel it became more and more patent that natural selection gives no account of the origin of variations, as proofs of the direct action of the environment on the species became more plentiful, so that Darwin himself in 1876 confessed that he had not attached sufficient weight to food, climate, &c., and as in consequence Lamarck's views revived in a neo-Lamarckian school, Büchner accepted the new theory, that Lamarckian adaptation to the environment hereditarily transmitted produces the variations which are the materials of Darwinian natural selection. His general inference was that, not God, but evolution of matter, is the cause of the order of the world; that life is a combination of matter which in favourable circumstances is spontaneously generated; that there is no vital principle, because all forces, non-vital and vital, are movements; that movement and evolution proceed from life to consciousness; that it is foolish for man to believe that the earth was made for him, in the face of the difficulties he encounters in inhabiting it; that there is no God, no final cause, no immortality, no freedom, no substance of the soul; and that mind, like light or heat, electricity or magnetism, or any other physical fact, is a movement of matter. Sometimes he spoke of mind as an effect of matter; but, though his expressions may be careless, nothing is to be made of the difference, for he called it movement and effect indifferently in the same context. His definitely expressed view was that psychical activity is "nothing but a radiation through the cells of the grey substance of the brain of a motion set up by external stimuli."

Belonging to a slightly later time than the materialists hitherto mentioned, E. Haeckel has lately published a book which may be taken to represent materialism as it stands, *Die Welträthsel*, or, as it appears in the translation by J. M'Cabe, *The Riddle of the Universe.* The point of this book is the identification of substance with body. Starting like his predecessors with the indestructibility of matter, Haeckel makes more than they do of the conservation of energy, and merges the persistence of matter and energy in one universal law of substance, which, on the ground that body is subject to eternal transformation, is also the universal law of evolution. One of the first to popularize Darwin in Germany, he regards Darwinism, like Büchner, as a supplement of Lamarckism. His strong point, however, consists not in establishing either selection, or adaptation, or any other process, but in inferring the fact of evolution of some sort from the consideration of three evidences: comparative anatomy, showing the long-known graduated series of organisms; palæontology, showing their similar geological succession in a historical series; and embryology, showing the similar development of the organism from the impregnated ovum, expressed in the biogenetic law, "Ontogenesis is a brief and rapid recapitulation of phylogenesis." On the strength of this concilience of arguments for evolution in the organic world, he carries back the process in the whole world, until he comes to a cosmology, which reminds one of the rash hypotheses of the Presocratics. He supposes that all organisms have developed from the simple cell, and that this has its origin by spontaneous generation, to explain which he propounds the "carbon-theory," that protoplasm comes from inorganic carbonates. He not only agrees with Laplace and Lyell about the evolution of the solar system, but also supposes that the affinities, pointed out by Lothar Meyer and Mendeléeff, between groups of chemical elements prove an evolution of these elements from a primitive matter (prothyl) consisting of homogeneous atoms. These, however, are not ultimate enough for him; he thinks that everything, ponderable and imponderable or ether, is evolved from a primitive substance, which condenses first into centres of condensation (pyknatoms), and then into masses, which when they exceed the mean consistency become ponderables, and when they fall below it become imponderables. Here he stops: according to him, substance is eternal and eternally subject to the law of substance; and God is the eternal force or energy of substance. What then is the origin of mind or soul? Haeckel answers that it has no origin, because sensation is an inherent property of all substance. He supposes that *æsthesis* and *tropesis*, as rudimentary sensation and will, are the very causes of condensation; that they belong to *pyknatoms*, to ponderables and imponderables, to chemical atoms and molecules. Hence, when he returns to organisms, it does not surprise us that he assigns to ova and spermatozoa cell-souls, to the impregnated ovum germ-soul, to plants tissue-souls, to animals nerve-souls; or that he regards man's body and soul as born together in the impregnated ovum, and gradually evolved from the bodies and souls of lower animals. It appears to his imagination that the affinity of two atoms of hydrogen to one of oxygen, the attraction of the spermatozoon to the ovum, and the elective affinity of a pair of lovers, are all alike due to sensation and will. But has he solved the problems of mind? When he applies sensation and will to nature, and through plants to the lowest animals, he considers their sensation and will to be rudimentary and unconscious. Consciousness, according to his own admission, is not found even in all animals, although it is present not only in the highest vertebrates—men, mammals, birds—but also in ants, spiders, the higher crabs and molluscs. He holds indeed that, in accordance with the law of substance, consciousness must be evolved from unconsciousness with the development of sense organs and a central nervous organ. At the same time he admits, first, that to mark the barrier between unconscious and conscious is difficult; secondly, that is it impossible to trace the first beginning of consciousness in the lower animals; and, thirdly, that "however certain we are of the fact of this natural evolution of consciousness, we are, unfortunately, not yet in a position to enter more deeply into the question" (*Riddle of the Universe*, 191). Thus in presence of the problem which is the crux of materialism, the origin of consciousness, he first propounds a gratuitous hypothesis that everything has mind, and then gives up the origin of conscious mind after all. He is certain, however, that the law of substance somehow proves that conscious soul is a mere function of brain, that soul is a function of all substances, and that God is the force or energy, or soul or spirit, of Nature. He, in fact, returns to ancient hylozoism, which has tended to revive from time to time in the history of thought. As Empedocles confused physical attraction and repulsion of bodily elements with the love and hatred of conscious beings, so Telesio and Campanella believed in the "sense of things," Bruno, an ardent admirer of the Presocratics, believed in animated *minima*, and Leibnitz after him endowed monads with perception and appetition. Maupertuis converted the percipient monads of Leibnitz into percipient atoms. Haeckel is the inheritor of these animistic views, and especially of the first and the last. He believes that mind and soul are inherent attributes of all bodies. Curiously enough, he supposes that by making mind a universal attribute of matter he has made his philosophy not materialism, but monism. It is really both: monistic, because it reduces substance to one kind; materialistic, because it identifies that one kind of substance with body or matter, and reduces mind to an attribute of matter. It makes no difference to attribute mind to all matter, so long as it is attributed as an attribute. It is at least as materialistic to say that unconscious mind is an attribute of Nature as to say that conscious mind is an attribute of brain; and this is the position of Haeckel. Materialists seem to dread the word "materialism." Büchner also entreats us "to abandon the word 'materialism,' to which (it is not clear why) a certain scientific odium attaches, and substitute 'monism' for it" (*Last Words on Materialism*, 273). His reason, however, is different: it is that a philosophy, not of matter as such, but of the unity of force and matter, is not materialism. But if a philosophy makes force an attribute of matter only, as his does, it will recognize nothing but matter possessing force, and will therefore be materialism as well as monism, and in short materialistic monism. The point is that neither Büchner nor Haeckel could on their assumptions recognize any force but force of body, or any mind but mind of body, or any distinct thing or substance except body. This is materialism.

(2) *Materialistic Tendencies.*—Besides these direct instances of materialism, there are philosophers to whom the scientific tendencies of the age have given a materialistic tendency. In Germany, for example, Eugen Dühring is a realist, whose intention is to prove against Kant a knowledge of the thing in itself by attributing time, space, and categories generally to the real world. But, under the influence of Trendelenburg's attempt to reconcile thought and being by assigning motion to both, his *Wirklichkeitsphilosophie*, in a similar effort after a unity of being, lands him in the contention that matter is absolute being, the support of all reality underlying all bodily and mental states. So R. Avenarius was no materialist, but only an empiricist anxious to reclaim man's natural view of the world from philosophic incrustations; yet when his *Empiriokriticismus* ends in

nothing but environment, nervous system, and statements dependent on them, without soul, though within experience, he comes near to materialism, as Wundt has remarked. In France, again, positivism is not materialism, but rather the refusal to frame a metaphysical theory. Comte, in his law of the three stages, tells us that man first gets over theology, then over metaphysics, and finally rests in positivism. Yet in getting over theology he ceases to believe in God, and in getting over metaphysics he ceases to believe in soul. As Paul Janet truly remarked, positivism contains an unconscious metaphysics in rejecting final causes and an immaterial soul. So E. Littré (1801–1881), Comte's disciple, said that soul signifies "considered anatomically the *ensemble* of functions of the brain, and considered physiologically the *ensemble* of functions of encephalic sensibility." He also took Mill to task for recognizing the possibility of a supernatural principle of the world. Now, when in surrendering theology and metaphysics we have also to surrender God and the soul, we are not free from materialism. Positivism, however, shelters itself behind the vague word "phenomena." Lastly, in England we have not only an influence of positivism, but also, what is more important, the synthetic philosophy of Herbert Spencer. The point of this philosophy is not materialism, but realism. The author himself says that it is transfigured realism—which is realism in asserting objective existence as separate from subjective existence, but anti-realism in denying that objective existence is to be known. In his *Principles of Psychology* he twice quotes his point that "what we are conscious of as properties of matter, even down to its weight and resistance, are but subjective affections produced by objective agencies which are unknown and unknowable." This then is his transfigured realism, which, as far as what is known goes, is idealism, but as far as what exists goes, realism—of a sort. His *First Principles*, that is, his book on metaphysics, is founded on this same point, that what we know is phenomena produced by an unknown noumenal power. He himself identifies phenomenon, appearance, effect, or impression produced on consciousness through any of the senses. He divides phenomena into impressions and ideas, vivid and faint, object and subject, non-ego and ego, outer and inner, physical and psychical, matter and spirit; all of which are expressions of the same antithesis among phenomena. He holds that all the time, space, motion, matter known to us are phenomena; and that force, the ultimate of ultimates, is, as known to us, a phenomenon, "an affection of consciousness." If so, then all we know is these phenomena, affections of consciousness, subjective affections, but produced by an unknown power. So far as this main point of transfigured realism is steadily maintained, it is a compound of idealism and realism, but not materialism. But it is not maintained, on the side either of phenomena or of noumena; and hence its tendency to materialism.

In the first place, the term "phenomenon" is ambiguous, sometimes meaning a conscious affection, and sometimes any fact whatever. Spencer sets himself to find the laws of all phenomena. He finds that throughout the universe there is an unceasing redistribution of matter and motion, and that this redistribution constitutes evolution when there is a predominant integration of matter and dissipation of motion, and constitutes dissolution where there is a predominant absorption of motion and disintegration of matter. He supposes that evolution is primarily integration, from the incoherent to the coherent, exemplified in the solar nebula evolving into the solar system; secondly differentiation, from the more homogeneous to the more heterogeneous, exemplified by the solar system evolving into different bodies; thirdly determination, from the indefinite to the definite, exemplified by the solar system with different bodies evolving into an order. He supposes that this evolution does not remain cosmic, but becomes organic. In accordance with Lamarck's hypothesis, he supposes an evolution of organisms by hereditary adaptation to the environment (which he considers necessary to natural selection), and even the possibility of an evolution of life, which, according to him, is the continuous adjustment of internal to external relations. Next, he supposes that mind obeys the same law of evolution, and exemplifies integration by generalization, differentiation by the development of the five senses, and determination by the development of the order of consciousness. He holds that we pass without break from the phenomena of bodily life to the phenomena of mental life; that consciousness arises in the course of the living being's adaptation to its environment, and that there is a continuous evolution from reflex action through instinct and memory up to reason, an evolution of social institutions, and an evolution of conscience out of fear. He throws out the brilliant suggestion that the experience of the race is in a sense inherited by the individual; which is true in the sense that animal organisms become hereditarily better adapted to perform mental operations, though no proof that any elements of knowledge become *a priori*. Now, although in his enthusiasm for universal evolution Spencer does not perceive it, he has clearly changed the meaning of the term "phenomenon" from subjective affection of consciousness to any fact of nature, in regarding all this evolution, cosmic, organic, mental, social, and ethical, as an evolution of phenomena. The greater part of the process is a change in the facts of nature before consciousness; and in all that part, at all events, the phenomena evolved must mean physical facts which are not conscious affections, but, as they develop, are causes which gradually produce life and consciousness. Moreover, evolution is defined universally as an "integration of matter and dissipation of motion," and yet mental, social, and moral developments are also called evolution, so that, in accordance with the definition, they are also integrations of matter and dissipations of motion. It is true that the author did not see that he was passing from transfigured realism into materialism. He thinks that he is always speaking of phenomena in the sense of subjective affections; and in spite of his definition, he half unconsciously changes the meaning of evolution from a change in matter and motion, first into a change in states of consciousness, then to a change in social institutions, and finally into a change in moral motives. He also admits himself that mental evolution exemplifies integration of matter and dissipation of motion only indirectly. But here he becomes hopelessly inconsistent, because he had already said, in defining it, that, "*evolution is an integration of matter and concomitant dissipation of motion*" (*First Principles*, § 145). However, with all the author's disclaimers, the general effect left on the reader's mind is that throughout the universe there is an unceasing change of matter and motion, that evolution is always such a change, that it begins with phenomena in the sense of physical facts, gradually issues in life and consciousness, and ends with phenomena in the sense of subjective affections of consciousness.

In the second place, having declared the noumenal power, which causes phenomena, or conscious affections, to be unknowable, and having left anybody who pleased to make it a god and an object of religion, he proceeds to describe it as if it were known force, and known in two respects as persistent and as resistent force. He supposes that the law of evolution is deducible from the law of persistent force, and includes in force what is now called energy. Then having discussed force as something thoroughly material, and laying special emphasis on resistance, he tells us that "the force of which we assert persistence is that Absolute Force of which we are indefinitely conscious as the necessary correlate of the force we know" (*First Principles*, § 62). Similarly, both in *First Principles* and in the *Principles of Psychology*, he assigns to us, in addition to our definite consciousness of our subjective affections, an indefinite consciousness of something out of consciousness, of something which resists, of objective existence. Thus it turns out that the objective agency, the noumenal power, the absolute force, declared unknown and unknowable, is known after all to exist, persist, resist, and cause our subjective affections or phenomena, yet not to think or to will. Such a noumenon looks very like body or matter. Lastly, when a theory of the world supposes a noumenal power, a resistent and persistent force, which results in an evolution, defined as an integration of matter and a dissipation of motion, which having resulted in inorganic nature and organic nature, further results without break in consciousness, reason, society, and morals, then such a theory will be construed as materialistically as that of Haeckel by the reader, whatever the intention of the author.

It may be urged in reply that the synthetic philosophy could be made consistent by transferring the knowable resistance and persistence of the unknowable noumenon to knowable phenomena on the one hand, and on the other hand by maintaining that all phenomena from the original nebula to the rise of consciousness are only "impressions produced on consciousness through any of the senses," after all. But in that case what will become of Spencer's theory of evolution? It will have asserted the evolution of man and his consciousness out of the phenomena of his consciousness. The truth is that his theory of evolution can be carried through the whole process from inorganic, through organic, to mental and moral facts, without a break, only by giving the synthetic philosophy a materialistic interpretation, and by adhering consistently to Spencer's own materialistic definition of evolution; otherwise there will be a break at least between life and mind, where there will be something more than matter and motion to be redistributed. If everything knowable is an example of evolution, and evolution is by definition a transformation of matter and motion, then everything knowable is an example of a transformation of matter and motion. As an exponent of universal evolution Haeckel is more consistent than Spencer. Huxley (1825–1895) developed views very like those of Spencer, and similarly materialistic without being materialism, because inconsistent. He regarded everything known as evolved from matter, and reduced consciousness to a mere collateral product (or "epiphenomenon") of cerebral operations without any power of influencing them. Matter, according to him, impresses the afferent nervous system, this the brain, this the efferent nervous system, while consciousness remains a mere spectator. "In man, as in brutes," said he, "there is no proof that any state of consciousness is the cause of change in the nature of the matter of the organism"; so that "we are conscious automata." But, in spite of these materialistic tendencies, he followed Hume in reducing matter and everything knowable to phenomena of consciousness; and, supposing that nothing is knowable beyond phenomena, concluded that we can neither affirm nor deny that anything exists beyond, but ought to take up an attitude which the ancient sceptics called Aphasia, but he dubbed by the new name of Agnosticism. Thus Huxley first reduced consciousness to a product of matter, and then matter to a phenomenon of consciousness. By combining materialism with idealism he made consciousness a product of itself. Tyndall (1820–1893), again, came still nearer to materialism, and yet avoided it. In his Belfast address (1874), while admitting that matter as understood by Democritus is insufficient, because atoms without sensation cannot be imagined to produce sensation, he contended, nevertheless, that matter properly understood is "the promise and potency of all terrestrial life." In thus endowing all matter with sensation like Haeckel he was not avoiding materialism. But in the very same address, as well as on other occasions, he did not identify mind with matter, but regarded them as concomitant.

All these materialistic tendencies seem to have one explanation. They emanate from scientific writers who rightly try to rise from science to metaphysics, but, as Bacon says, build a universal philosophy on a few experiments. The study of evolution, without considering how many conditions are required for "the integration of matter and the dissipation of motion" to begin, and the undoubted discoveries which have resulted from the study of inorganic and organic evolution, have led men to expect too much from this one law of nature. This tendency especially prevails in the uncertain science of biology, which is so far off the general principles of natural philosophy that its votaries are often ignorant of the real nature of body as matter and force. The close dependency of all mental operations on brain also tempts them to the conclusion that brain is not only an organ, but the whole organ of conscious mind. We may see traces of this tendency in the writings of H. Maudsley, in his lecture, for example, on *Lessons of Materialism* (1879). It appears also that Darwin, having extended his theory of evolution as far as the rational and moral nature of man, in the *Descent of Man*, ended in his *Autobiography* by declaring his attitude to first and final causes to be that of an agnostic. Not that he was a materialist, and shortly before his death, in a conversation with Büchner, he maintained his agnosticism against his opponent's atheism. Still, his agnosticism meant that, though he did not assert that there is no God, he did assert that we cannot know whether there is or there is not. To the evolutionary biologist brain is apt to appear to be the crowning object of knowledge. On the other hand, those scientific men, such as Herschel, Maxwell, and Stokes, who approach nature from mathematics and mechanics, and therefore from the universal laws of motion, have the opposite tendency, because they perceive that nature is not its own explanation. In order to exert force, or at all events that force of reciprocal pressure which we best understand, and on which, in impact, the third law of motion was founded, there are always at least two bodies, enduring, triply extended, mobile, each inert, mutually impenetrable or resistent, different yet similar; and in order to have produced any effect but equilibrium, some bodies must at some time have differed either in mass or in velocity, otherwise forces would only have neutralized one another. Why do bodies exist, with all these conditions, so similar yet different—that is, in so harmonious an order? Natural science has no answer: natural theology has an answer. This essence of bodies, this resemblance in difference, this prevailing order of nature, is the deepest proof of God; and it cannot be the result of evolution, because it is the condition of natural force, and therefore of natural evolution. A second argument for God is the prevailing goodness or adaptation of nature to the ends of conscious beings, which might conceivably be explained by Lamarckian evolution, but has not yet been so explained, and if it were, would not be inconsistent with a divine design in evolution. Further, the very existence of conscious beings is the best proof of the distinct or substantial being of the soul, existing in man with body, in God as pure spirit. It seems hopeless to expect that natural science, even with the aid of evolution, can explain by mere body the origin and nature of this fact of consciousness. If so, materialism is not the whole truth of metaphysics.

§ 3. The Rise of Metaphysical Idealism.

(1) *Descartes to Leibnitz.*—Metaphysical arises from psychological idealism, and always retains more or less of an epistemological character. Psychological idealism assumes without proof that we perceive nothing but mental objects, and metaphysical idealism draws the logical but hypothetical conclusion that all we can know from these mental objects of sense is mental objects of knowledge. But at first this logical conclusion was not drawn. Descartes, the founder of psychological idealism, having proceeded from the conscious fact, *cogito ergo sum*, to the *non-sequitur* that I am a soul, and all a soul can perceive is its ideas, nevertheless went on to the further illogical conclusion that from these mental ideas I can (by the grace of God) infer things which are extended substances or bodies, as well as thinking substances or souls. He was a psychological idealist and a metaphysical realist. This illogicality could not last. Even the Cartesian school, as it came more and more to feel the difficulty of explaining the interaction of body and mind, and, indeed, any efficient causation whatever, gradually tended to the hypothesis that the real cause is God, who, on the occasion of changes in body, causes corresponding changes in mind, and *vice versâ*. This occasionalism is not idealism, but its emphasis on the will of God gave it an idealistic tendency. Thereupon Spinoza advanced a pantheism which supposed that bodies and souls are not, as Descartes thought, different substances, but merely attributes—the one the extension and the other the thought of one substance, Nature or God. Taking the Aristotelian theory that a substance is a thing in itself, not in Aristotle's sense of any individual existing differently from anything else, but in the novel meaning of something existing alone, he concluded, logically enough from this mere misunderstanding, that there can be only one substance, and that, as no finite body or soul can exist alone, everything finite is merely a mode of one of the attributes of the one infinite substance which alone can exist by itself. Spinozism, however, though it tramples down the barrier between body and soul, is not yet metaphysical idealism, because it does not reduce extension to thought, but only says that the same substance is at once extended and thinking—a position more akin to materialism. At the same time Spinoza maintained a parallelism between extension and thinking so close as to say that the order of ideas is the same as the order of things, so that any mode of extension and the idea of it are the same thing expressed in two ways, under the attribute of extension and under the attribute of thought. (See H. H. Joachim's *Study of the Ethics of Spinoza*, 1901, p. 72.) It remained, however, for Schelling to convert this parallelism into identity by identifying motion with the intelligence of God, and so to transform the pantheism of Spinoza into pantheistic idealism. Leibnitz, again, having become equally dissatisfied with Cartesianism, Spinozism, and the Epicurean realism of Gassendi, whom he had first followed in analysing nature into atoms and vacuum, in the latter part of his life came still nearer than Spinoza to metaphysical idealism in his monadology, or half-Pythagorean, half-Brunistic analysis of bodies into monads, or units, or simple substances, indivisible and unextended, but endowed with perception and appetite. He gradually fell under the dominion of two false assumptions. On the one hand, essentially a mathematician, he supposed that unity is indivisibility, whereas everything known to be one is merely undivided or individual, and that there must be simple because there are compound substances, although composition only requires simpler or relatively simple elements. On the other hand, under the influence of the mechanics of his day, which had hardly distinguished between inertia, or the inability of a body to change itself, and resistance, or the ability of bodies to oppose one another, he concluded that, as inertia is passive, so is resistance, and refused to recognize that in collision the mutual resistance of moving bodies is a force, or active power, of changing their movements in opposite directions. From these two arbitrary hypotheses about corporeal motion, that it requires indivisibly simple elements, and that it offers only passive resistance, he concluded that behind bodies there must be units, or monads, which would be at once substantial, simple, indivisible, and active. He further supposed that the monads are "incorporeal automata," not interacting like bodies, but each perceiving what was passing in the other, and acting in consequence by appetite, or self-acting. Such mentally endowed substances might be called souls; but, as he distinguished between perception and apperception or consciousness, and considered that perceptions are often unconscious, he preferred to divide monads into unconscious entelechies of inorganic bodies, sentient souls of animals, and rational souls, or spirits, of men; while he further concluded that all these are derivative monads created by God, the monad of monads. All derivative monads, he allowed, are accompanied by bodies, which, however, are composed of other monads dominated by a central monad. Further, he explained the old Cartesian difficulty of the relation of body and mind by transforming the Spinozistic parallelism of extension and thought into a parallelism between the motions of bodies and the perceptions of their monads; motions always proceeding from motions, and perceptions from perceptions; bodies acting according to efficient causes, and souls according to final causes by appetition, and as if one influenced the other without actually doing so. Finally, he explained the concomitance of these two series, as well as that between the perceptions of different monads, by supposing a pre-established harmony ordained by the primitive monad, God. Up to this point, then, Leibnitz opened one of the chief avenues to metaphysical idealism, the resolution of the material into the immaterial, the analysis of bodies into mental elements. Like the Pythagoreans, he regarded bodies as composed of units; unlike them, he endowed these units with minds. He followed Bruno's dogma—"Spirto si trova in tutte le cose, e non è minimo corpusculo, che non contegna cotal porzione in sè, che non inanimi" (*Della causa*). His theory of bodies involved an idealistic analysis neither into bodily atoms, nor into mathematical units, but into mentally endowed simple substances. There remained, however, his theory of the nature of bodies; and here he hesitated between two alternatives. According to one alternative, which consistently flowed from the psychological idealism of Descartes, as well as from his own monadism, he suggested that bodies are real phenomena; phenomena, because they are aggregates of monads, which derive their unity only from appearing together to our perceptions; real phenomena well founded, because they result from real monads. In support of this view, he said that bodies are not substances, though *substantiata*; that their apparent motion and resistance are results of the passions of their monads; that their primary matter is nothing but passive power of their monads; that the series of efficient causes between them is merely phenomenal. According to this alternative, then, there is nothing but mental monads and mental phenomena; and Leibnitz is a metaphysical idealist. According to the other alternative, however, he suggested

that at least organic bodies are compound or corporeal substances, which are not phenomena, but something realizing or rather substantializing phenomena; and not mere aggregates of monads, but something substantial beyond their monads, because an organic body, though composed of monads, has a real unity (*unio realis*). From this point of view he believed that the real unity of a body is a *vinculum substantiale*, which gives it its real continuity and is the principle of its actions; that its primary matter is its own principle of resistance; and that it has not only this passive, but also an active, power of its own. He suggested that this theory of the substantial unity of a body might explain transubstantiation, by supposing that, while the monads and phenomena of bread remain, the *vinculum substantiale* of the body of Christ is substituted. He feared also whether we can explain the mystery of the Incarnation, and other things, unless real bonds or unions are added to monads and phenomena. According to this alternative, these organic bodies are compound or corporeal substances, between monads and phenomena; and Leibnitz is a metaphysical realist. He was held to this belief in the substantiality of bodies by his Christianity, by the influence of Aristotle, of scholasticism, and of Cartesianism, as well as by his own mechanics. But the strange thing is that at the very end of his life and at the very same time, in 1714–16, he was writing the idealistic alternative to Remond de Montmort and Dangicourt, and the realistic alternative to Father des Bosses. He must have died in doubt. We cannot, therefore, agree with many recent idealists who regard Leibnitz as one of themselves, though it is true that, when stripped of its realism, his metaphysics easily passed into the metaphysical idealisms of Lotze and of Fechner. It is true, also, that on its idealistic side the philosophy of Leibnitz is the source of many current views of panpsychism, of psychophysical parallelism, as well as of the phenomenalism of bodies, and of the analysis of bodies into mental elements.

(2) *Locke to Hume.*—Meanwhile in England, Locke, though differing from Descartes about the origin of ideas, followed him in the illogical combination of psychological idealism with metaphysical realism. He thought that we perceive nothing but ideas both of primary and of secondary qualities, and yet that somehow we are able to infer that, while our ideas of secondary qualities are not, those of primary qualities are, like the real qualities of external things. Berkeley saw the inconsistency of this position, and, in asserting that all we perceive and all we know is nothing but ideas in "mind, spirit, soul, or myself," has the merit of having made, as Paulsen remarks, "epistemological idealism the basis of metaphysical idealism." According to him, a body such as the sun is my idea, your idea, ideas of other minds, and always an idea of God's mind; and when we have sensible ideas of the sun, what causes them to arise in our different minds is no single physical substance, the sun, but the will of God's spirit. Hume saw that in making all the objects of perception ideas Berkeley had given as little reason for inferring substantial souls as substantial bodies. He therefore concluded that all we know from the data of psychological idealism is impressions or sensations, ideas, and associations of ideas, making us believe without proof in substances and causes, together with "a certain unknown, inexplicable *something* as the cause of our perceptions." We have here, in this sceptical idealism, the source of the characteristically English form of idealism, still to be read in the writings of Mill and Spencer, and still the starting-point of more recent works, such as Pearson's *Grammar of Science* and James's *Principles of Psychology*.

(3) *Kant and Fichte.*—Lastly, in Germany, partly influenced by Leibnitz and partly roused by Hume, Kant elaborated his transcendental or critical idealism, which, if not, as he thought, the prolegomena to all future metaphysics, is still the starting-point of most metaphysical idealists. Kantism consists of four main positions, which it will be well to lay out, as follows:—

(*a*) As to the origin of knowledge, Kant's position is that sense, outer and inner, affected by things in themselves, receives mere sensations or sensible ideas (*Vorstellungen*), as the matter which sense itself places in the *à priori* forms of space and time; that thereupon understanding, by means of the synthetic unity of apperception, "I think"—an act of spontaneity beyond sense, in all consciousness one and the same, and combining all my ideas as mine in one universal consciousness—and under *à priori* categories, or fundamental notions, such as substance and attribute, cause and effect, &c., unites groups of sensations or sensible ideas into objects and events, *e.g.*, a house, one ball moving another; and that, accordingly, perception and experience, requiring both sense and understanding, are partly *à posteriori* and partly *à priori*, and constitute a knowledge of objects which, being sensations combined by synthetic unity under *à priori* forms, are more than mere sensations, but less than things in themselves. This first position is psychological idealism in a new form and supported by new reasons; for, if experience derives its matter from mental sensations and its form from mental synthesis of sensations, it can apprehend nothing but mental objects of sense, which, according to Kant, are sensible ideas having no existence outside our thought, not things in themselves; or *phenomena*, not *noumena*.

(*b*) As to the known world, Kant's position was the logical deduction that from such phenomena of experience all we can know by logical reason is similar phenomena of actual or possible experience; and therefore that the known world, whether bodily or mental, is not a Cartesian world of bodies and souls, nor a Spinozistic world of one substance, nor a Leibnitzian world of monadic substances created by God, but a world of sensations, such as Hume supposed, only combined, not by association, but by synthetic understanding into phenomenal objects of experience, which are phenomenal substances and causes—a world of phenomena, not noumena. This second position is a new form of metaphysical idealism, containing the supposition, which lies at the foundation of later German philosophy, that since understanding shapes the objects out of sensations, and since nature, as we know it, consists of such objects, "understanding, though it does not make, shapes nature," as well as our knowledge. Known nature is a mental construction in part, according to Kant.

(*c*) As to existence, Kant's position is the wholly illogical one that, though all known things are phenomena, there are things in themselves, or noumena; things which are said to cause sensations of outer sense and to receive sensations of inner sense, though they are beyond the category of causality which is defined as one of the notions uniting phenomena; and things which are assumed to exist and have these causal attributes, though declared unknowable by any logical use of reason, because logical reason is limited by the mental matter and form of experience to phenomena; and all this according to Kant himself. This third position is a relic of ancient metaphysical realism; although it must be remembered that Kant does not go to the length of Descartes and Locke, who supposed that from mere ideas we could know bodies and souls, but suggests that beneath the phenomena of outer and inner sense the thing in itself may not be heterogeneous (*ungleichartig*). In this form we shall find the thing in itself revived in our day by A. Riehl.

(*d*) As to the use of reason beyond knowledge, Kant's position is that, in spite of its logical inability to transcend phenomena, reason in its pure, or *à priori* use, contains necessary *à priori* "ideals" (*Ideen*), and practical reason, in order to account for moral responsibility, frames postulates of the existence of things in themselves, or noumena, corresponding to these "ideals"; postulates of a real free-will to practise morality, of a real immortality of soul to perfect it, and of a real God to crown it with happiness. This fourth position is the coping-stone of Kant's metaphysics. It is quite inconsistent with its foundation and structure. Kant first deduced that from the experience of mental phenomena all logical use of reason is limited to mental phenomena, and then maintained that to explain moral responsibility practical reason postulates the existence of real noumena. But what is a postulate of practical reason to explain moral responsibility except a logical use of reason? Nevertheless, in his own mind Kant's whole speculative and practical philosophy was meant to form one system. In the preface to the second edition of the *Kritik* he says that it was necessary to limit speculative reason to a knowledge of phenomena, in order to allow practical reason to proceed from morality to the assumption of God, freedom, and immortality, existing beyond phenomena: "Ich musste also das *Wissen* aufheben, um zum *Glauben* Platz zu machen." He forgot that he had also limited all logical use of reason, and therefore of practical reason, to phenomena, and thereby undermined the rationality not only of knowledge, but also of faith.

Fichte now set himself in the *Wissenschaftslehre* (1794) to make transcendental idealism into a system of metaphysical idealism without Kant's inconsistencies and relics of realism. His point was that there are no things in themselves different from minds or acting on them; that man is no product of things; nor does his thinking arise from passive sensations caused by things; nor is the end of his existence attainable in a world of things; but that he is the absolute free activity constructing his own world, which is only his own determination, his self-imposed limit, and means to his duty which allies him with God. In order to prove this novel conclusion, he started afresh from the Cartesian "I think" in the Kantian form of the synthetic unity of apperception acting by *à priori* categories; but, instead of allowing, with all previous metaphysicians, that the Ego passively receives sensations from something different, whether bodies, or monads, or God, or an unknown thing in itself, and not contenting himself with Kant's view that the Ego, by synthetically combining the matter of sensations with *à priori* forms, partially constructs objects, and therefore Nature as we know it, he boldly asserted that the Ego, in its synthetic unity, entirely constructs things; that its act of spontaneity is not mere synthesis of passive sensations, but construction of sensations into an object within itself; and that therefore understanding makes as well as shapes Nature, as the Ego in thinking constructs both its own knowledge and its own world. This construction, or self-determination, is what Fichte called positing (*setzen*). According to him, the Ego posits first itself (thesis); secondly, the non-Ego, the other, opposite to itself (antithesis); and, thirdly, this non-Ego within itself (synthesis), so that all reality is in consciousness. But, he added, as the Ego is not conscious of this self-determining activity, but forgets itself, the non-Ego seems to be something independent, a foreign limit, a thing in itself, or *per se*. Hence it is the office of the theory of knowledge to show that the Ego posits the thing *per se* as only existing for itself, a *noumenon* in the sense of a product of its own thinking. Further, according to Fichte, on the one hand the Ego posits itself as determined through the non-Ego—no object, no subject; this is the principal fact about theoretical reason; on the other hand, the Ego posits itself as determining the non-Ego—no subject, no object; this is the principal fact about practical reason. Hence he united theoretical and practical reason, which Kant had separated, and both with will, which Kant had distinguished; for he held that the Ego, in positing the non-Ego, posits both its own limit and its own means to the end, duty, by its activity of thinking which requires will. The conclusion of his epistemology is that we start with ourselves positing subjective sensations—*e.g.*, sweet, red—and refer them as accidents to matter in space, which, though mental, is objective, because its production is grounded on a law of all reason. The metaphysics resulting from this epistemology is that the so-called thing in itself is not a cause of our sensations, but a product of one's own thinking, a determination of the Ego, an object, limit, and means to the end of the Ego, a thing known to the Ego which constructs it. Fichte thus transformed the transcendental idealism of Kant by identifying the thing with the object, and by interpreting noumenon, not in Kant's sense of something which speculative reason conceives and practical reason postulates to exist in accordance with the idea, but in the new meaning of a thought, a product of reason. This change led to another. Kant had said that the synthetic unity "I think" is in all consciousness one and the same, meaning that I am always present to all my ideas. Fichte transformed this unity of the conscious self into a unity of all conscious selves, or a common consciousness; and this change enabled him to explain the unity of anything produced by the Ego by contending that it is not the different objects of different thinkers, but the one object of a pure Ego or consciousness common to them all. According to Kant, the objective is valid for all consciousnesses; according to Fichte, it is valid for one consciousness. Here he was for the first time grappling with a fundamental difficulty in metaphysical idealism which is absent from realism, namely, the difficulty of explaining the identity of a thing, *e.g.*, the sun. As long as even the meagre realism of the Kantian thing in itself is maintained, the account of there being one sun is simply that one thing causes different phenomena in different minds. But as soon as the thing in itself is converted into something mental, metaphysical idealists must either say that there are as many suns as minds, or that there is one mind and therefore one sun. The former was the alternative of Berkeley, the latter of Fichte. In fact, Fichte differed from Berkeley, as from Kant, in two respects. In the first place, while Berkeley said that God, and Kant that an unknown thing, is the cause of our sensations, Fichte said that we posit the sensations and the thing, and falsely regard the thing as the cause of sensations, until the theory of knowledge shows that it is only a mental product and a noumenon in this sense. Secondly, while Berkeley supposed that there might be as many suns as ideas, and Kant that an unknown thing causes many appearances of the sun in many minds, Fichte said that there is one mind positing one sun, a single pure Ego positing a single mental object, one and the same in all human persons. Thus the complete metaphysical idealism of Fichte's *Wissenschaftslehre*, formed out of the incomplete metaphysical idealism of Kant's *Kritik*, is the theory on its epistemological side that the Ego posits the non-Ego as a thing in itself, and yet as only a thing existing for it as its own noumenon, and on its metaphysical side that in consequence all reality is the Ego and its own determinations, which are objective, or valid for all, as determinations, not of you or of me, but of the consciousness common to all of us, the pure or absolute Ego. Lastly, Fichte called this system realism, in so far as it posits the thing in itself as another thing;

idealism, in so far as it posits it as a noumenon which is a product of its own thinking; and on the whole real idealism or ideal realism.

God does not seem to find much place in the *Wissenschaftslehre*, where mankind is the absolute and nature mankind's product, and where God neither could be an absolute Ego which posits objects in the non-Ego to infinity without ever completing the process, nor could be even known to exist apart from the moral order which is man's destination. Hence in his *Philosophical Journal* in 1798 Fichte prefaced a sceptical essay of Forberg by an essay of his own, in which he used the famous words, "The living moral order is God; we need no other God, and can comprehend no other." Having, however, in consequence, lost his professorship at Jena, he gradually altered his views, until at length he decided that God is not mere moral order, but also reason and will, yet without consciousness and personality; that not mankind but God is the absolute; that we are only its direct manifestations, free but finite spirits destined by God to posit in ourselves Nature as the material of duty, but blessed when we relapse into the absolute; that Nature, therefore, is the direct manifestation of man, and only the indirect manifestation of God; and, finally, that being is the divine idea or life, which is the reality behind appearances. In this extension of metaphysical idealism he was influenced by his disciple, Schelling. Nevertheless, he refused to go as far as Schelling, and could not bring himself to identify either man or nature with Absolute God. He wanted to believe in the absolute without sacrificing personality and freedom. God determines man, and man determines Nature: this is the final outcome of Fichte's pure idealism.

Fichte completed the process from psychological and epistemological to metaphysical idealism, which it has been necessary to recall from its beginnings in France, England, and Germany, in order to understand present idealism, which derives its original inspiration from the past and immediately from Spinoza and Leibnitz, Berkeley and Hume, Kant and Fichte. The assertion of absolute substance by Spinoza incited Schelling and Hegel. The analysis of bodies into immaterial elements by Leibnitz incited Lotze. The Spinozistic parallelism of extension and thought, and the Leibnitzian parallelism of bodily motion and mental action, incited Schelling and Fechner. Berkeley and Hume produced the English idealism of Mill and Spencer, with their successors, and occasioned the German idealism of Kant. Kant's *à priori* synthesis of sensations into experience lies at the root of all German idealism. But Fichte was the most fertile of all. He carried metaphysical idealism to its height, by not only resolving the bodily into the mental, but also elevating the action of mind into absolute mental construction; not inferring things in themselves beyond, but originating things from within, mind itself. By changing the meaning of "noumenon" from the thing apprehended (νοούμενον) to the thought (νόημα), and in the hypothesis of a common consciousness, he started the view that a thing is not yours or my thought, but a common thought of all mankind, and led to the wider view of Schelling and Hegel that the world is an absolute thought of infinite mind. In making the essence of mind activity and construction, in destroying the separation of theoretical and practical reason, in asserting that mind thinks things as means to ends of the will, he prepared the way for Schopenhauer and other voluntarists. In making the essence of the Absolute not mere reason, but will, action, and life, he anticipated Lotze. In reducing the thing in itself to a thought, he projected the neo-Kantism of Lange and Cohen. In the doctrine—no object, no subject—no subject, no object—that is, in the utter identification of things with objects of subjects, he anticipated not only Schelling and Hegel, but also Schuppe and Wundt with their congeners. In expanding Kant's act of synthesis till it absorbed the inner sense and the innermost soul, he started the modern paradox that soul is not substance, but subject or activity, a paradox which has been gradually handed down from Schelling and Hegel to Fechner, and from Fechner to Paulsen and Wundt. Meanwhile, through holding with Kant that man is not God, but a free spirit, whose destiny it is to use his intelligence as a means to his duty, he is still the resort of many who vindicate man's independence, freedom, conscience, and power of using nature for his moral purposes: such, for example, are Eucken and Münsterberg. Kant and Fichte together became the most potent philosophic influences on European thought in the 19th century, because their emphasis was on man. They made man believe in himself and his mission. They fostered liberty and reform, and even radicalism. They almost avenged man on the astronomers, who had shown that the world is not made for earth, and therefore not for man. Kant half asserted, and Fichte wholly, that nature is man's own construction. The *Kritik* and the *Wissenschaftslehre* belonged to the revolutionary epoch of the "Rights of Man," and produced as great a revolution in thought as the French Revolution did in fact. Instead of the old belief that God made the world for man, philosophers began to fall into the pleasing dream, I am everything, and everything is I—and even I am God.

§ 4. Noumenal Idealism in Germany.

Noumenal idealism is the metaphysics of those who suppose that all known things are indeed mental, but not all are phenomenal in the Kantian sense, because a noumenon is knowable so long as by a noumenon we mean some mental being or other which we somehow can discover beyond phenomena. The noumenal idealists of Germany assumed, like all psychological idealists, the unproved hypothesis that there is no sense of body, but there is a sense of sensations; and they usually accepted Kant's point, that to get from such sensations to knowledge there is a synthesis contributing mental elements beyond the mental data of sense. They saw also the logic of Kant's deduction, that all we can know from such mental data and mental categories must also be mental. This was the starting-point of their metaphysical idealism. But they disagreed with Kant, and agreed with Fichte about things in themselves or noumena, and contended that the mental things we know are not mere phenomena of sense, but noumena, precisely because noumena are as mental as phenomena, and therefore can be known from similar data: this was the central point of their noumenal idealism. They rightly revolted against the inconsistencies of Kant's third and fourth positions about the existence of unknown but postulated things in themselves, hidden from theoretical, but revealed to practical, reason. In a way they returned to the wider opinions of Aristotle, which had come down to Descartes and Locke, that reason in going beyond sense knows more things than phenomena; yet they would not hear of external bodies, or of bodies at all. No realists, they came nearer to Spinozistic pantheism and to Leibnitzian monadism, but only on their idealistic side; for they would not allow that extension and body are different from thinking and mind. In this denial of all bodily substances and all bodily attributes they were anticipated by Berkeley's view that when we get beyond ourselves we find nothing but other minds and ideas. But their real founder was Fichte, on account of his definite reduction of the noumenal to a mental world. This was indeed the very point—the knowability of a noumenal mental world. At the same time it soon appeared that they could not agree among themselves when they came to ask what it is, but in attempting to define it seem to have gone through the whole gamut of mind. Schelling and Hegel thought it was infinite reason; Schopenhauer, unconscious will; Hartmann, unconscious intelligence and will; Lotze, the activity or life of the divine spirit; Fechner, who has been followed by Paulsen, a world of spiritual actualities comprised in the one spiritual actuality, God, in whom we live and move and have our being.

(1) *Schelling and Hegel.*—Of these noumenal idealisms the earliest in time and the nearest to Fichte's philosophy was the panlogism, begun by Schelling (1775–1854), completed by his disciple Hegel (1770–1831), and then modified by the master himself. Starting from Fichte's *Wissenschaftslehre*, Schelling accepted the whole process of mental construction, and the deduction that noumena are knowable products of universal reason, the Absolute Ego. But from the first he was bolder than Fichte, and had no doubt that the Absolute is God. God, as he thought, is universal reason, and Nature a product of universal reason, a direct manifestation, not of man, but of God: *Deus mundus implicitus; mundus Deus explicitus.* While Fichte emphasized man, Schelling emphasized Nature, and made a *Naturphilosophie*, which, extravagant as it was, yet had the merit of rising beyond the narrow relation of Nature to mere man up to the universal relation of Nature to God Himself. This departure from Fichte was due to the pantheism of Spinoza, from whom Schelling derived the identification of God and Nature. But he passed Spinozism through the pure idealism of Fichte, and therefore regarded God, not as one substance partly extended and partly thinking, but as one intelligent subject; and Nature, not as God's extension, but with its extension and all its attributes as nothing but God's intelligence made manifest, beginning unconsciously in the inorganic world, and finally rising to conscious intelligence in man. Hence numerous phrases, such as, "Dead nature is only unripe intelligence," "Matter is slumbering spirit," "The process of Nature is an unconscious poetry," "Nature is the Odyssey of spirit," in which he strove to express his conversion of Spinoza's realistic into his own idealistic pantheism. Thus also the correspondence supposed by Spinoza between thought and extension, and the pre-established harmony supposed by Leibnitz between the perceptions of monads and the movements of bodies (phenomenal or substantial) were transformed into an identity of ideal and real, subjective and objective, in absolute reason. The hypothesis of parallelism became for the first time a hypothesis of identity. Again, Schelling's attention was soon diverted from Fichte to Kant; not, however, to the *Kritik*, but to the *Metaphysical Foundations of Natural Science*, wherein Kant had perversely tried to show that bodies are not impenetrable substances exerting repulsion and attraction, but are composed of these very forces. This work of Kant doubly affected Schelling: it suggested to him the idea of a *Naturphilosophie*, and of a construction of nature. But he passed Kantism, as well as Spinozism, through the pure idealism of Fichte. In the first place, he divided philosophy into two: (*a*) Transcendental philosophy proceeding from subject to object, (*b*) Natural philosophy proceeding from object to subject. He thus widened the method of philosophy by adding to Fichte's "transcendental" his own "natural" method. Secondly, he extended Fichte's process of construction from man's knowledge to Nature. According to him, not only knowledge, but also Nature, goes through the triple process of thesis, antithesis, and synthesis; Nature is the self-activity of the subject (*natura naturans*), which continually becomes an object, and issues in a product (*natura naturata*) in which subject and object are identical; and this identity in duplicity is the foundation of repulsion and attraction, and repeats itself throughout the whole world, ideal and real. Hence, instead of speaking, with Fichte, of the Absolute Ego positing Nature as the non-Ego, Schelling prefers to say that Absolute Reason becomes Nature, the subject becomes the object, only to return into itself as a unity of opposites; so that nature as well as knowledge is a system of the rational, and everything is identified in the Absolute Reason. How then is this Absolute known? According to Schelling, by intellectual intuition. Kant had attributed to God, in distinction from man's understanding, an intellectual intuition of things. Fichte had attributed to man an intellectual intuition of himself as the Absolute Ego. Schelling attributes to man an intellectual intuition of the Absolute God; and as there is, according to him, but one universal reason, the common intelligence of God and man, this intellectual intuition at once gives man an immediate knowledge of God, and identifies man with God Himself.

On Schelling's idealistic pantheism, or the hypothesis that there is nothing but one absolute reason identifying the opposites of subjectivity and objectivity, Hegel based his panlogism. But, while he fully recognized his indebtedness to his master, he differed from him profoundly in one respect, which, being fundamental, could not but have many consequences. He rightly objected that the system was wanting in logical proof. He rightly, therefore, rejected the supposed intellectual intuition of the Absolute. He rightly contended that, if we are to know anything beyond sense, we must know it by a process of logical reason. But, unfortunately, he meant not the logical inferences described in the *Organon* and the *Novum Organum*, the analogical, inductive, and deductive processes, which enable us to infer other things similar to what we perceive in ourselves. He meant a new "speculative" method, dialectic, founded on an assumption which he had already learnt from Schelling, namely, that things which are different but similar can have the same attribute, and therefore be also the same. With this powerful instrument of dialectic in hand, he attempted to show how the Absolute gradually develops into the world and maintains itself; how being passes into its opposite, not-being, and returns into itself; how the Idea becomes Nature, and returns into itself in Spirit; how, in short, absolute reason differentiates itself into subjective and objective, ideal and real, and yet is the identity of both—an identity of opposites, as Schelling had said. By the same dialectic Hegel was able to justify the gradual transformation of transcendental into noumenal idealism by Fichte and Schelling. If things different but similar have the same attributes, and are thereby the same, then in the first place the Kantian categories, though thoughts of mental origin and therefore confined to mind, are nevertheless applicable to things, because things, though different from, are the same as, thoughts, and have the categories of thoughts; in the second place, the Fichtian Ego of mankind is not the Absolute Reason of God, and yet is the same Absolute Reason; in the third place, the Schellingian Nature is the "other" of Spirit, and yet, being a mere reflex of the Idea of Nature, is identical with Spirit; and as this Spirit is everywhere the same in God and men, Nature is also identical with our Spirit, or rather with the Infinite Spirit, or Absolute Reason, which alone exists. The crux of all metaphysical idealism is the difficulty of reconciling the unity of the object with the plurality of subjects. Hegel's assumption of identity in difference at once enabled him to deal with the whole difficulty by holding that different subjects are yet one subject, and any one object, *e.g.*, the sun, is at once different from, and identical with, the one subject which is also many. By the rough magic of this modern Prospero, the universe of being is not, and yet is, thought, idea, spirit, reason, God. So elastic a solution established a dominant Hegelian school, which is now practically extinct, in Germany, and from Germany spread Hegelianism to France, England, America, and, in fact, diffused it over the civilized world to such an extent that it is still a widespread fashion outside Germany to believe that the world of being is a world of thought.

The plain answer is to contest the whole assumption. Different things, however similar, have only similar attributes, and therefore are never the same. God created man in His own image, and the world in the image of the Divine Idea; but I am not God, and the transitory sun is not the same as God's eternal idea of it. The creatures, however like, are not the same as the Creator and His thoughts. Each is a distinct thing, as Aristotle said. Reality is not Reason. It is strange that the underlying assumption of panlogism was not at once contested in this plain way. Nevertheless, objection was soon taken to the unsatisfactoriness of the system reared upon it. Schelling himself, as soon as he saw his own formulæ exposed in the logic or rather dialectic of his disciple, began to reconsider his philosophy of identity, and brought some powerful objections against both the conclusions and the method of Hegel. Schelling perceived that Hegel, in reducing everything to infinite mind, absorbed man's free but finite personality in God, and, in declaring that everything real is rational, failed to explain evil and sin: indeed, the English reader of T. H. Green's *Prolegomena to Ethics* can see how awkward is the Hegelian transition from "one spiritual principle" to different men's individual freedom of choice between good and evil. Again, Schelling urged that besides the rational element there must be something else; that there is in nature, as *natura naturans*, a blind impulse, a will without intelligence, which belongs to the existent; and that even God Himself as the Absolute cannot be pure thought, because in order to think He must have an existence which cannot be merely His thought of it, and therefore pure being is the prior condition of thought and spirit. Hence Schelling objected to the Hegelian dialectic on the ground that, although reason by itself can apprehend notions or essences, and even that of God, it cannot deduce *à priori* the existence either of God or of Nature, for the apprehension of which experience is required. He now distinguished two philosophies: negative philosophy starting from notions, and positive philosophy starting from being; the former a philosophy of conditions, the latter of causes, *i.e.*, of existence. Hegel, he said, had only supplied the logic of negative philosophy; and it must be confessed that the most which could be extracted from the Hegelian dialectic would be some connexion of thoughts without proving any existence of corresponding things. Schelling was right; but he had too much affinity with Hegelian assumptions, *e.g.*, the panlogistic confusion of the essences of things with the notions of reason, to construct a positive philosophy without falling into fresh mysticism, which failed to exorcise the effect of his earlier philosophy of identity in the growing materialism of the age.

(2) *Schopenhauer.*—Meanwhile, by the side of panlogism arose the panthelism of Schopenhauer (1788–1860). This new noumenal idealism began, like the preceding, by combining psychological idealism with the transcendentalism of Kant and Fichte. In *Die Welt als Wille und Vorstellung* Schopenhauer accepted Kant's position that the world as phenomenal is idea (*Vorstellung*); but he added that the world as noumenal is will (*Wille*). He got the hint of a noumenal will from Kant; but in regarding the noumenal as knowable, because mental, as well as in the emphasis he laid on the activity of will, he resembled Fichte. His theory of the nature of will was his own, and arrived at from a voluntaristic psychology leading to a voluntaristic metaphysics of his own. His psychological starting-point was the unproved assumption that the only force of which we are immediately aware is will; his metaphysical goal was the consistent conclusion that in that case the only force we can know, as the noumenal essence of which all else is phenomenal appearance is will. But by this noumenal will he did not mean a divine will similar to our rational desire, a will in which an inference and desire of a desirable end and means produces our rational action. He meant an unintelligent, unconscious, restless, endless will. In considering the force of instinct in animals, where, without any apprehension of a prospective end, a present feeling of pleasure or pain, such as hunger, produces an impulsive action, he was obliged to divest will of reason. When he found himself confronted with the blind forces of Nature, where bodies insensibly change one another, he was obliged to divest irrational will of feeling. As he resolved one force after another into lower and lower grades of will, he was obliged to divest will of all consciousness. In short, his metaphysics was founded on a misnomer, and simply consisted in calling unconscious force by the name of unconscious will (*Unbewusster Wille*). This abuse of language brought him back to Leibnitz. But, whereas Leibnitz imputed unconscious perception as well as unconscious appetition to monads, Schopenhauer supposed unconscious will to arise without perception, without feeling, without ideas, and to be the cause of ideas only in us. Hence he rejected the infinite intelligence supposed by Fichte, Schelling, and Hegel, against whom he urged that blind will produces intelligence, and only becomes conscious in us by using intelligence as a means to ends. He also rejected the optimism of Leibnitz and Hegel, and placed the most irrational of wills at the base of the worst possible of worlds, holding that the state of will is a state of endless striving, a state of evil; that the will to live brings no happiness; that pain is positive evil and pleasure only its absence; that misery only increases with the accession of intelligence, and so the world becomes worse, until intelligence, by supplying will with a knowledge of its evil nature, enables it in the individual man to negate itself by virtue and asceticism, and so to be at peace. This pessimistic panthelism, though of little account during the Hegelian domination, gradually won its way, and procured exponents such as J. Frauenstädt, J. Bahnsen, and, more recently, P. Deussen. The accident of its pessimism attracted F. W. Nietzsche, who afterwards, passing from the philosophy of will to the theory of evolution, ended by imagining that the struggle of the will to live produces the survival of the fittest, that is, the right of the strongest and the will to exercise power, which by means of selection may hereafter issue in a new species of superior man—the *Uebermensch*. Finally, Schopenhauer's voluntarism has had a profound effect on psychology inside and outside Germany, and to a less degree produced attempts to deduce from voluntaristic psychology new systems of voluntaristic metaphysics, such as those of Paulsen and Wundt.

(3) *E. von Hartmann.*—But the first to modify the pure voluntarism of Schopenhauer was E. von Hartmann, who, in *Die Philosophie des Unbewussten* (1869, 1st ed.), advanced the view that the world as noumenal is both unconscious intelligence and unconscious will, thus founding a panpneumatism which forms a sort of reconciliation of the panlogism of Hegel and the panthelism of Schopenhauer. In his tract entitled *Schelling's positive Philosophie*

als Einheit von Hegel und Schopenhauer (1869), he further showed that, in his later philosophy, Schelling had already combined reason and will in the Absolute. Indeed, Fichte had previously characterized the life of the Absolute by reason and will without consciousness; and, before Fichte, Leibnitz had asserted that the elements of Nature are monads with unconscious perception and appetition. Hartmann has an affinity with all these predecessors, and with Spinoza, with whom he agrees that there is but one substance unaltered by the plurality of individuals which are only its modifications. Following, however, in the footsteps of Schelling, he idealizes the one extended and thinking substance into one mental being; but he thinks that its essence consists in unconscious intelligence and will, of which all individual intelligent wills are only activities. The merit of this fresh noumenal idealism consists in its correction of the one-sidedness of Schopenhauer: intelligence is necessary to will. But Hartmann's criticism does not go far enough. Instead of concluding that will is intelligent desire to act by means to a future end, that instinct is feeling producing action, that unconscious force is stress of bodies mutually changing one another unconsciously, and that the conscious intelligent will of omnipresent God is the primary cause beneath all secondary causes, unconscious and conscious, he outdoes the paradox of Schopenhauer by concluding that Nature in itself is intelligent will, but unconscious, a sort of immanent unconscious God. As with his master, his reasons for this view are derived, not from a direct proof that unconscious Nature has the mental attributes supposed, but from human psychology and epistemology. Like Leibnitz, he proceeds from the fact that our perceptions are sometimes conscious, sometimes unconscious, to the inconsequent conclusion that there are beings with nothing but unconscious perceptions; and by a similar *non sequitur,* because there is the idea of an end in will, he argues that there must be an unconscious idea of an end in instinctive, in reflex, in all actions. Again, in his *Grundproblem der Erkenntnisstheorie* (1889) he uses without proof the hypothesis of psychological idealism, that we perceive psychical effects, to infer with merely hypothetical consistency the conclusion of noumenal metaphysical idealism that all we can thereby know is psychical causes, or something transcendent, beyond phenomena indeed, yet not beyond mind. But, according to him, this transcendent is the unconscious, which is *Kraftvolles unbewusst ideales Geschehen.* He calls this epistemology "transcendent realism"; it is really "transcendent idealism." On these foundations he builds the details of his idealistic metaphysics. He identifies matter with mind by identifying atomic force with the striving of unconscious will after objects conceived by unconscious intelligence, and by defining causality as logical necessity receiving actuality through will. Secondly, he contends that, when matter ascends to the evolution of organic life, the unconscious has a power, over and above its atomic volitions, of introducing a new element, and that in consequence the facts of variation, selection, and inheritance, pointed out by Darwin, are merely means which the unconscious uses for its own ends in morphological development. Thirdly, he explains the rise of consciousness by supposing that, while it requires brain as a condition, it consists in the emancipation of intelligence from will at the moment when in sensation the individual mind finds itself with an idea without will. Here follows his pessimism, like to, but differing from, that of his master. In his view consciousness begins with want, and pain preponderates over pleasure in every individual life, with no hope for the future, while the final end is not consciousness, but the painlessness of the unconscious, which mankind will attain when, convinced of the misery of life, it will work a common resolve not to will, and somehow stop all will. But why exaggerate? The truth of Nature is force; the truth of will is rational desire; the truth of life is neither the optimism of Leibnitz and Hegel, nor the pessimism of Schopenhauer and Hartmann, but the moderatism of Aristotle. Life is sweet, and most men have more pleasures than pains in their lives.

(4) *Lotze and Zeller.*—Lotze (1817–1881) elaborated a very different noumenal idealism, which perhaps we may express by the name "Panteleologism," to express its conclusion that the known world beyond phenomena is neither absolute thought, nor unconscious will, nor the unconscious at all, but the activity of God; causing in us the system of phenomenal appearances, which we call Nature, or bodies moving in time and space; but being in itself the system of the universal reciprocal actions of God's infinite spirit, animated by the design of the supreme good. The *Metaphysik* of Lotze in its latest form (1879) begins with a great truth: psychology cannot be the foundation of metaphysics, metaphysics must be the foundation of psychology. He saw that the theories of the origin of knowledge in idealistic epistemology are unsound and lead to no solid result. Like Aristotle, then, he proposed anew the question, What is being? Nevertheless he was too much a child of his age to keep things known steadily before him, but had no sooner asked the metaphysical question than he proceeded to find a psychological answer in a theory of sensation, which asserted the mere hypothesis that the being which we ascribe to things on the evidence of sensation consists in their being felt. He really accepted, like Kant, the hypothesis of a sense of sensations which led to the Kantian conclusion that the Nature we know in time and space is mere sensible appearances in us. Further, from an early period in his *Medicinische Psychologie* (1852) he reinforced the transcendental idealism of Kant by a general hypothesis of "local signs," containing the subordinate hypotheses, that we cannot directly perceive extension either within ourselves or without; that spatial bodies outside could not cause in us spatial images either in sight or in touch; but that besides the obvious data of sense, *e.g.*, pressure, heat, and colour, there must be other qualitative different excitations of different nerve-fibres, by means of which, as non-local signs of localities, the soul constructs in itself an image of extended space containing different places. This hypothesis of an acquired perception of a space mentally constructed by "local signs," brought forward in opposition to the nativistic hypothesis of Joh. Müller, supplied Lotze and many succeeding idealists, including Wundt, with a new argument for metaphysical idealism. Lotze concluded that we have no more reason for supposing an external space like space constructed out of our perceptions, than we have for supposing an external colour like perceived colour. Agreeing, then, with Kant that primary qualities are as mental as secondary, he agreed also with Kant that all the Nature we know as a system of bodies moving in time and space is sensible phenomena. But while he was in fundamental agreement with the first two positions of Kant, he differed from the third; he did not believe that the causes of sensible phenomena can be unknown things in themselves. What then are they? In answering this question Lotze regarded Leibnitz as his guide. He accepted the Leibnitzian fallacy that unity is indivisibility, which led to the Leibnitzian analysis of material bodies into immaterial monads, indivisible and therefore unextended, and to the theory of monadic souls and entelechies. Indeed, from the time of Leibnitz such attempts either to analyze or to construct matter had

become a fashion. Boscovich had supposed repulsive and attractive centres of force, and Kant had constructed matter with extension and impenetrability out of repulsion and attraction. Schelling had constructed all Nature out of the thesis, antithesis, and synthesis of spirit. Herbart had analysed it into "reals," or simple substances, each with an unknown quality. Lotze agreed with Leibnitz that the things which cause phenomena are immaterial elements, but added that they are not simple substances, self-acting, as Leibnitz thought, or preserving themselves against disturbance, as Herbart thought, but are interacting modifications of the one substance of God. In the first place, he resolved the doubt of Leibnitz about bodies by deciding entirely against his realistic alternative that an organic body is a *substantia realizans phænomena*, and for his idealistic alternative that every body is a phenomenon and not a substance at all. Secondly, he accepted the Leibnitzian hypothesis of immaterial elements without accepting their self-action. He believed in reciprocal action; and the very essence of his metaphysics consists in sublimating the interaction of bodies into the interaction of immaterial elements, which produce effects on one another and on the soul as one of them. According to the mechanics of Newton, when two bodies collide and by their mutual resistance make one another move in opposite directions, each impresses on the other an equal change of momentum, so that as much momentum as one causes in one direction, the other causes in the opposite direction. Each body moving makes the other move equally and oppositely; but it has become a convenient habit to express this concrete fact in abstract language by calling it the conservation of momentum, by speaking as if not the equivalent but the very same momentum lost by one body is gained by the other, and by talking of one body communicating its motion to the other; as if bodies exchanged motion as men do money. Now Lotze took this abstract language literally, and had no difficulty in showing that, as an attribute is not separated from its substance, this supposed communication of motion does not really take place: nothing passes. But instead of returning to the concrete fact of the equivalence of momentum, by which each body moving makes the other move oppositely, he denied that bodies do reciprocally act on one another, and even that bodies as mutually resisting substances press one another apart in collision. Having thus rejected all bodily mechanism, he had to suppose that reciprocal action somehow takes place between immaterial elements. This brought him to another difference from Leibnitz as well as from Newton. According to Leibnitz, while each immaterial element is a monadic substance and self-acting secondary cause, God is the primary cause of all. According to Lotze, the connexion required by reciprocity requires also that the whole of every reciprocal action should take place within one substance; the immaterial elements act on one another merely as the modifications of that substance interacting within itself; and that one substance is God, who thus becomes not merely the primary but the sole cause, and in scholastic language is not a *causa transiens*, or creator of works beyond, but a *causa immanens*, or agent of acts remaining within, the agent's being. At this point, having rejected both the Newtonian mechanism of bodily substances and the Leibnitzian automatism of monadic substances, he flew to the Spinozistic unity of substance; except that, according to him, the one substance, God, is not extended at all, and is not merely thinking, but is a thinking, willing, and acting Spirit. Lotze's metaphysics is thus distinguished from the theism of Newton and Leibnitz by its pantheism, and from the pantheism of Spinoza by its idealism. It is an idealistic pantheism, which is a denial of all bodily mechanism, a reduction of everything bodily to phenomena, and an assertion that all real action is the activity of God. At the same time it is a curious attempt to restore mechanism and reconcile it with teleology by using the word "mechanism" in a new meaning, according to which God performs His own reciprocal actions within Himself by uniform laws, which are also means to divine ends. It is also an attempt to reconcile this divine mechanism with freedom. In his *Metaphysik* (1879), as in his earlier *Mikrokosmus* (1856–64), Lotze vindicated the contingency of freedom by assigning to God a miraculous power of unconditional commencement, whereby not only at the very beginning but in the course of nature there may be new beginnings, which are not effects of previous causes, though once started they produce effects according to law. Thus his pantheistic is also a teleological idealism, which in its emphasis on free activity and moral order recalls Leibnitz and Fichte, but in its emphasis on the infinity of God has more affinity to Spinoza, Schelling, and Hegel. Indeed, it has been truly said by G. T. Ladd that Lotze tried to correct Hegel by substituting for a movement of absolute thought a movement of absolute life as the sum of reality. Hence his philosophy, like the Hegelian, continually torments one with the difficulty that its sacrifice of the distinct being of all individual substances to the universality of God entails the sacrifice of the individual personality of men. Our bodies were reduced by Lotze to the general ruck of phenomenal appearances. Our souls he tried his best to endow with a quasi-existence, arguing that the unity of consciousness requires an indivisible subject, which is distinct from the plurality of the body but interacting with it, is in a way a centre of independent activities, and is so far a substance, or rather able to produce the appearance of a substance. But at the end of his *Metaphysik*, from the conclusion that everything beyond phenomena is divine interaction, he drew the consistent corollary that individual souls are simply actions of the one genuine being. His final view was that certain actions of the divine substance are during consciousness gifted with knowledge of themselves as active centres, but during unconsciousness are non-existent. If so, we are not persons with a permanent being of our own distinct from that of God. But in a philosophy which reduces everything to phenomenal appearance except the self-interacting substance of God, there is no room for either the bodies or the souls of finite substances or human persons. Yet the pantheistic teleological idealism of Lotze has had, and still has, a wide influence in and out of Germany. The secret of this influence is the revival of the Leibnitzian analysis of matter into non-material elements. This influence appears in a most interesting way in Zeller's essay "Ueber die Gründe unseres Glaubens an die Realität der Aussenwelt," 1884 (in his *Vorträge*, iii. 225 *seq.*). After an able justification of our belief in the reality of the external world, Zeller contends that its forces are immaterial. He advances three arguments: the Leibnitzian argument that simple elements must be unextended, the Lotzian argument that the interactions of body and soul are explained by supposing them to belong to immaterial elements, and his own argument that, if the immaterial is common to the inner and outer worlds, we can at once maintain with Kant that space is *à priori*, and infer without fallacy that it also belongs to outer things in themselves made of immaterial elements. He remarks also that this reduction of the material to the immaterial is a point of agreement between Lotze and Fechner; but, while agreeing in other respects with Lotze, he adds, "I do not hold space, as he does, to be something merely belonging to our apprehension." In short, his view is that there is an inner and an outer spatial world, composed of immaterial elements, whose forces produce in us the appearance of impenetrable bodies. In a similar way, W. Ostwald, taking advantage of the abstraction of energy from bodies having the power of doing work on one another, concludes that energy is immaterial, and nature consists of immaterial energy. He neglects the facts, that the mass included in energy is known to us only as mass of body, that all we know about any energy has been discovered from bodies, and that all the elements of bodies known to us are more elementary bodies. This last is the fact neglected in the analysis of the material into the immaterial from Leibnitz to the present day. The original cause of error was the Pythagorean fancy that the "one" is the origin of all things. But everything known to us is, as Aristotle said, an individual substance, one as undivided not as indivisible; and some substances are bodies. We attend for simplicity to the undividedness of a body, or to its position, or to a central position in it, or to its power of doing work; but we have no evidence that a monad, or a point, or a centre of force, or an energy, has any reality distinct from a body.

(5) *Fechner and Paulsen.*—Fechner (1801–1887) affords a conspicuous instance of the idealistic tendency to mysterize nature in his Panpsychism, or that form of noumenal idealism which holds that the universe is a vast communion of spirits, souls of men, of animals, of plants, of earth and other planets, of the sun, all embraced as different members in the soul of the world, the highest spirit —God, in whom we live and move and have our being; that the bodily and the spiritual, or the physical and the psychical, are everywhere parallel processes which never meet to interact; but that the difference between them is only a difference between the outer and inner aspects of one identical psychophysical process; and yet that both sides are not equally real, because, while psychical and physical are identical, the psychical is what a thing really is as seen from within, the physical is what it appears to be to a spectator outside; or spirit is the self-appearance of matter, matter the appearance of one spirit to another. Fechner's panpsychism has a certain affinity both to Stahl's animism and to the hylozoism of materialists such as Haeckel. But, while it differs from both in denying the reality of body, it differs from the former in extending conscious soul not only to plants, as Stahl did, but to all nature; and it differs from the latter in the different consequences drawn by materialism and idealism from this universal animism. According to Haeckel, matter is the universal substance, spirit its universal attribute. According to Fechner, spirit is the universal reality, matter the universal appearance of spirit to spirit; and they are identical because spirit is the reality which appears. Hence Fechner describes himself as a twig fallen from Schelling's stem. The religious feeling inspired by his clerical parentage and his pursuit of natural science, of which he was at first a professor, inclined him to the theosophical author of the *Naturphilosophie.* It was Schelling's adherent Oken who by his *Lehrbuch der Naturphilosophie* conveyed to his mind the life-long impression that God is the universe and nature God's appearance. At the same time, while accepting the Schellingian parallelistic identity of all things in God, Fechner was restrained by his accurate knowledge of physics from the extravagant construction of Nature, which had failed in the hands of Schelling and Hegel. Besides, he was deeply impressed by the fact of man's personality and by the problem of his personal immortality, which brought him back through Schelling to Leibnitz, whose *Monadologie* throughout maintains the plurality of monadic souls and the omnipresence of perception, sketches in a few sections (§§ 23, 78–81) a panpsychic parallelism, though without identity, between bodily motions and psychic perceptions, and, what is most remarkable, already uses the conservation of energy to argue that physical energy pursues its course in bodies without interacting with souls, and that motions produce motions, perceptions produce perceptions. Leibnitz thus influenced Fechner, as in other ways he influenced Lotze. Both, however, used this influence freely; and, whereas Lotze used the Leibnitzian argument from indivisibility to deduce indivisible elements and souls, Fechner used the Leibnitzian hypotheses of universal perception and parallelism of motions and perceptions, in the light of the Schellingian identification of physical and psychical, to evolve a world-view (*Weltansicht*) containing something which was neither Leibnitz nor Schelling. Fechner's first point was his panpsychism. Emphasizing the many real analogies between physical and mental agency, but underrating the much stronger evidences that all the mental operations of men and animals require a nervous system, he flew to the paradox that soul is not limited to men and animals, but extends to plants, to the earth and other planets, to the sun, to the world itself, of which, according to him, God is the world-soul. In this doctrine of universal animation he was like Leibnitz, yet very different. Whereas Leibnitz confined a large area of the world to wholly unconscious perceptions, and therefore preferred to call the souls of inorganic beings "Entelechies," Fechner extended consciousness to the whole world; and accordingly, whereas Leibnitz believed in a supramundane Creator, "au dessus du Monde" and "dans le Monde," Fechner, in the spirit of Schelling, identified God with the soul of the world. Fechner's second point was that, throughout the animated universe, physical processes accompany psychical processes without interaction. In this panpsychistic parallelism he was again like Leibnitz, and he developed his predecessor's view, that the conservation of energy prevents interaction, into the supposition that alongside the physical there is a parallel psychical conservation of energy. Here, again, he went much further than Leibnitz, but along with Schelling, in identifying the physical and the psychical as outer and inner sides of the same process, in which the inner is the real and the outer the apparent. Fechner's third point carried him beyond all his predecessors, containing as it does the true originality of his "world-view." He advanced the ingenious suggestion that, as body is in body and all ultimately in the world-body, so soul is in soul and all ultimately in the world-soul. By this means he explained immortality by supposing that in this life every man, according to his works, fashions himself a higher body which is as much of the common body of the earth as he has developed in this life, and that death is only the continuation of the life of the soul with higher powers in this higher body of the earth, and, if the earth fell into the sun, then in the still higher body of the sun; while the soul throughout is interwoven with other spirits in the highest spirit of the world, or God. By the same means he vindicated our personality, on the ground that each spirit is a different member of the same great spirit, and that in a future state the new body is a continuation of the old body, and the new soul of the old soul, by an eternal conservation of the energy of both. Fechner's fourth point was connected with this inclusion of personal spirits in higher spirits and in the highest. It is his so-called "synechological view" of the soul. Herbart and Lotze, both deeply affected by the Leibnitzian hypothesis of indivisible monads, supposed that man's soul is seated at a central point in the brain; and Lotze supposed that this supposition is necessary to explain the unity of

consciousness. Fechner's supposition was that the unity of consciousness belongs to the unity of the whole body; that the seat of the soul is the living body; that the soul changes its place as in different parts a process rises above the "threshold of consciousness"; and that soul is not substance but the single psychical life which has its physical manifestation in the single bodily life. Applying this "synechological view" to the supposed inclusion of soul in soul, he deduced the conclusion that, as here the nature of one's soul is to unite one's little body, so hereafter its essence will be to unite a greater body, while God's spirit unites the whole world by His omnipresence; and he pertinently asked, in opposition to the "punctual" view, whether God's soul is centred in a point. Lastly, the whole of this "world-view" was developed by Fechner in early life, under the influence of his religious training, and out of a pious desire to understand those main truths of Christianity which teach us that we are children of God, that this natural body will become a spiritual body, and that, though we are different individual members, we live and move and are in God: "in Deo vivimus, movemus, et sumus." It is important to notice that Fechner maintained this "world-view" in a little book, *Das Büchlein vom Leben nach dem Tode*, which he originally published in 1836 under the pseudonym of Dr Mises, but which he afterwards republished in his own name in 1866, and again in 1887, as a sketch of his *Weltansicht*. Afterwards in *Nanna* (1848) he discussed the supposed souls of plants, and in *Zendavesta* (1851) the supposed souls of the earth and the rest of the world. Then in 1855 he published his *Atomenlehre*, partly founded on his physics, but mainly on his metaphysics. Under the influence of Leibnitz, Boscovich, Kant, and Herbart, he supposed that bodies are divisible into punctual atoms, which are not bodies, but centres of forces of attraction and repulsion; that impenetrability is a result of repulsive force; and that force itself is only law—taking as an instance that Newtonian force of attraction whose process we do not understand, and neglecting that Newtonian force of pressure and impact whose process we do understand from the collision of bodies already extended and resisting. But, in thus adapting to his own purposes the Leibnitzian analysis of material into immaterial, he drew his own conclusions according to his own metaphysics, which required that the supposed centres of force are not Leibnitzian "monads," nor Herbartian "reals," nor divine modifications such as Lotze afterwards supposed, but are elements of a system which in outer aspect is bodily and in inner aspect is spiritual, and obeying laws of spirit. At the same time, his synechological view prevented him from saying that every atom has a soul, because according to him a soul always corresponds to a unity of a physical manifold. Thus his metaphysics is Leibnitzian like that of Lotze, and yet is opposed to the most characteristic feature of monadology—the percipient indivisible monad.

In 1860 appeared Fechner's *Elemente der Psychophysik*, a work which has deeply affected recent psychology, and almost revolutionized recent metaphysics of body and soul, and of physical and psychical relations generally. It becomes necessary, therefore, to determine how far Fechner derived his psychophysics from experience, how far from fallacies of inference, from his romantic imagination and from his theosophic metaphysics, which indeed coloured his whole book on psychophysics. At the very outset he started with his previous metaphysical hypothesis of parallelistic identity without interaction. He now compared the spiritual and bodily sides of a man to the concave and convex sides of a circle, as inner and outer sides of the same process, which is psychical as viewed from within and physical as viewed from without. He also maintained throughout the book that physical and psychical energy do not interfere, but that the psychical is, like a mathematical quantity, a function of the physical, depending upon it, and *vice versâ*, only in the sense that a constant relation according to law exists, such that we may conclude from one to the other, but without one ever being cause of the other. By his psycophysics he meant the exact doctrine of the relations of dependency between physical and psychical. The name was new, but not the doctrine. From antiquity men had applied themselves to determine the relations between the physical stimuli and the so-called "quality" of sensations; and especially in acoustics the Pythagoreans showed that the lengths of strings, and the moderns that the vibrations of air, vary in a geometrical ratio as the height of audible sounds varies in an arithmetical progression, or that musical intervals are proportional to the logarithms of the ratios of the vibrations, or of the lengths of vibrating strings. But what was new in the 19th century was the application of this doctrine to the relations between the stimuli and the so-called "intensity" of sensations. By experiments on touch in 1849 E. H. Weber showed that in lifting weights the increase in weight of stimulus necessary to produce a sensible difference of intensity between two tactile sensations is not a constant quantity, but varies with the previous stimulus so as to be always a constant fraction of the previous stimulus. Thus, if an increase from 40 to 41 grammes produced a sensible difference, it required an increase from 80 to 82, from 400 to 410, from 800 to 820, to produce these higher sensible differences; or always $\frac{1}{40}$ of the previous stimulus. Thereupon Fechner, incited by a hypothesis which occurred to him in 1850, discovered by a great number of experiments, conducted in most methodical ways, that Weber's law, as he called it after the name of his master, admits of being generalized to all the senses, but that the constant function of the previous stimulus is different for different senses: in sound $\frac{1}{3}$, in light only $\frac{1}{100}$, and so forth. Hence he generalized Weber's law in the form that sensation generally increases in intensity as the stimulus increases by a constant function of the previous stimulus; or increases in an arithmetrical progression as the stimulus increases in a geometrical ratio; or increases by addition of the same amount as the stimulus increases by the same multiple; or increases as the logarithm of the stimulus. This law of the measure of sense Fechner called the *Massformel;* and as Herbart had called the least stimulus necessary to conscious sensation the "threshold," so Fechner called the least difference of stimulus necessary to conscious difference of sensation the "difference-threshold," which, according to the law, is always a constant fraction of the previous stimulus for any one sense. There are then, at least within the limits of moderate sensations, concomitant variations between stimuli and sensations, not only in "quality," as in the intervals of sounds, which were understood long ago, but also in "intensity"; and the discovery of the latter is the importance of Weber's and Fechner's law. By the rules of induction from concomitant variations, we are logically bound to infer the realistic conclusion that outer physical stimuli cause inner sensations of sensible effects. But, unfortunately for Fechner, the very opposite conclusion followed from the presuppositions of his parallelistic metaphysics, and from the Leibnitzian view of the conservation of energy, which he was the first in our time to use in order to argue that a physical cause cannot produce a psychical effect, on the ground that physical energy must be exactly replaced by physical energy.

It is certain that a body does work in the mechanical sense on body, and thereby always causes therein changes of motion and configuration or relative position; and it is very probable that, so far as its energy or working power is diminished by its being resisted, it always causes an increase of energy, so that the amount of energy before and after in the whole system is equivalent, so long as we count, besides molar, molecular energy of sound, heat, &c., and both kinetic energy, or power of doing work in virtue of actual motion (*e.g.*, in a body being raised), and potential energy, or power of doing work in virtue of configuration with potential motion (*e.g.*, in a body having been raised to a position from which it can fall). But, as Clerk Maxwell remarked, we do not know that all changes are in configuration and motion, or that all energy must be either potential or kinetic. Hence we cannot say that a body does nothing but work in the mechanical sense, or causes no other changes but those in motion and configuration, even in body. Still less can we say that a body causes no other changes in soul, which, not being a resisting substance, would not diminish the energy of a body acting upon it, and therefore would in any case be affected by a body only in a non-mechanical way. It is true that from the conservation, or rather equivalence, of energy, whenever a body does work, we can deduce that probably a change produced, *e.g.*, heat, though not apparently, is really a change either in motion or in configuration; but this evidence becomes less certain in proportion to our ignorance of the changes in question, and in any case does not prove that there are no other changes produced. Now, changes in a nervous organism are conspicuous instances of this uncertainty. What is a nervous process, and how far is it a change in motion and configuration? What is a sensation? Is it a nervous process or not, or partly so and partly not? (cf. Case, *Physical Realism*, chap. v.). In our uncertainty about the nature of these changes it is open to us to believe in the conservation of energy and yet recognize its limits. A stimulus, exerting as it always does some pressure on the nerves, and causing an internal pressure which we feel by touch, does work on the nerves; it therefore causes changes in motion and configuration, molar and molecular, in them, though these are very imperfectly understood; and, so far as its own energy is thereby diminished, it probably causes in them an equivalent increase of energy, potential or kinetic, though this sum has not been calculated. But it is quite consistent to contend that the stimulus, at the same time that it causes a nervous change in motion and configuration by work, also causes a sensation which is a different kind of change; that thereupon these mechanical and non-mechanical changes cause further mechanical changes in the brain together with the non-mechanical change of thinking, and these again still further mechanical changes together with non-mechanical volition; and that finally these mechanical and non-mechanical changes produce changes in the motor nerves, and so forth, without any breach of nervous continuity, and without disturbing the equivalence of mechanical energy, and yet so that the non-mechanical changes of body and soul co-operating complicate the result. This contention, no doubt, if it were drawn from mere consistency, would not infer truth. But we have other evidences of its truth; first, from consciousness itself, which assures us that operations with which it interferes, as in writing a book, far outstrip unconscious operations in complexity, by which is not meant mere mechanical energy, of effect; and, secondly, from experiment, the very experiments completed by Fechner himself, which make us practically certain that stimulus and sensation vary so concomitantly that the former produces the latter. We are more certain of this induction from concomitant variations than of any deduction from conservation of energy to organic change. Yet Fechner refused to draw the only logical conclusion from his own evidence, and in spite of it supposed that physical stimulus only causes physical nervous process, and not sensation. Why? Partly because he did not understand the limits of the conservation of energy, and partly because of his preconceived metaphysics, which had long condemned him to the fallacy of physical and psychical parallelism without mutual interference.

Having thus satisfied himself in what he called "outer psycophysics" that the stimulus causes only the nervous process and not sensation, he passed to what he called "inner psychophysics," or the theory of the relation between nervous and psychical processes. He rightly argued against the old theory that the continuity of nervous processes in the brain is interrupted by mental processes of thought and will: there is a nervous process for every mental process. But two questions then arose. What is the relation between nervous process and sensation? What causes sensation? The first question he answered from his imagination by supposing that, while the external world is stimulus of the nervous process, the nervous process is the immediate stimulus of the sensation, and that the sensation increases by a constant fraction of the previous stimulus in the nervous system, when Weber's law only proves that it increases by a constant fraction of the previous stimulus in the external world. The second question he answered from his parallelistic metaphysics by deducing that even within the organism there is only a constant dependency of sensation on nervous process without causation, because the nervous process is physical but the sensation psychical. This answer supposed that the whole physical process from the action of the external stimulus on the nervous system to the reaction of the organism on the external world is one series, while the conscious process beginning with sensation is only parallel and as it were left high and dry. What then is the cause of the sensation? Huxley, it will be remembered, in similar circumstances, answered this question by degrading consciousness to an epiphenomenon, or bye-product of the physical process. Fechner was saved from this absurdity, but only to fall into the greater absurdity of his own panpsychism. Having long assumed that the whole world is animated throughout, and that there are always two parallel series, physical and psychical, he concluded that, while a physical stimulus is causing a physical nervous process, a psychical accompaniment of the stimulus is causing the sensation, which, according to him, is the psychical accompaniment of the nervous process; and that, as the whole physical and the whole psychical series are the same, differing only as outer and inner, this identity holds both of stimulus and its psychical accompaniment and of nervous process and its accompanying sensation. Accordingly, he calls these and all other processes "psychophysical"; and as he recognized two parallel energies, physical and psychical, differing only as outer and inner aspects of the same energy, he called this "psychophysical energy." In such a philosophy all reality is "psychophysical." At the same time Fechner would not have us suppose that the two sides are equal; according to him, the psychical, being the psychophysical viewed from within, is real, the physical, being the psychophysical as viewed from without, is apparent; so in oneself, though nervous process and psychical process are the same, it is the psychical which is the reality of which the nervous is mere appearance; and so everywhere, spirit is the reality, body the appearance of spirit to spirit. Finally, he supposed that one spirit is in another, and all in the highest spirit, God. By this means also he explained unconsciousness. In point of fact, many stimuli are beneath the "threshold" of a man's consciousness. Leibnitz, in the *Nouveaux Essais*, ii. 11, had also said that we have many "petites perceptions," of which we are unconscious, and had further suggested that a perception of which we are, is composed of a quantity of "petites perceptions" of which we are not, conscious. Proceeding on this suggestion, and misled by the mathematical expression which he had given to Weber's law, Fechner held that a conscious sensation, like its stimulus, consists of units, or elements, by summation and increments of which conscious sensations and their differences are produced; so that consciousness, according to this unnecessary assumption, emerges from an integration of unconscious shocks or tremors. But by the hypothesis of the inclusion of spirit in spirit, he was further able to hold that what is unconscious in one spirit is conscious in a higher spirit, while everything whatever is in the consciousness of the highest spirit of God, who is the whole of reality of which the spirits are parts, while the so-called physical world is merely outer appearance of one spirit to another.

Fechner first confused physics and metaphysics in psychophysics, and next proceeded to confuse them again in his work on evolution (*Einige Ideen zur Schöpfungs- und Entwicklungs-geschichte der Organismen*, 1873). He perceived that Darwinism attributed too much to accident, and was also powerless to explain the origin of life and of consciousness. But his substitute was his own hypothesis of panpsychism, from which he deduced a "cosmorganic" evolution from a "cosmorganic" or original condition of the world as a living organism into the inorganic, by the principle of tendency to stability. The world, as he thought, on its physical side, always was a living body; and on its psychical side God always was its conscious spirit; and, so far from life arising from the lifeless, and consciousness from unconsciousness, the life and consciousness of the whole world are the origin of the lifeless and the unconscious in parts of it, by a kind of secondary automatism, while we ourselves are developed from our own mother-earth by differentiation. By thus supposing a psychical basis to evolution, Fechner, anticipating Wundt, substituted a psychical development of organs for Darwinian accidental variation. Where Darwin would say that a cock has crest and spurs because individuals happened to vary in this advantageous manner, Fechner would suppose, as the inner aspect of the physical organism, a "psychical impulse" (*psychische Streben*) to fight, predisposing the germs and therewith the offspring. The difficulty of such speculations is to prove that things apparently dead and mindless are living souls. Their interest to the metaphysician is their opposition to physics on the one hand and to theism on the other. We have nowadays to ask ourselves whether we are to resign our traditional belief that the greater part of the world is mere body, but that its general adaptability to conscious organisms proves its creation and government by God, and to take to the new hypothesis, which, by a transfer of design from God to Nature, supposes that everything physical is alive, and conducts its life by psychical impulses of its own. Fechner himself went even farther, and together with design transferred God Himself to Nature. This is the subject of his last metaphysical work, *Die Tagesansicht gegenüber der Nachtansicht* (1879). The "day-view" is the view that God is the psychophysical all-embracing being, the law and consciousness of the world; as opposed to the "night-view," according to which the world is not throughout psychical, but consciousness appears only transiently in men and animals, while the rest of the world is dark night. The "day-view," which is Fechner's, resembles the views of Hegel and Lotze in its pantheistic tendency. But it does not, like theirs, sacrifice our personality; because, according to Fechner, there is neither one infinite mind with which our mind is identical, nor one infinite active substance of which we are modifications, but one divine consciousness, which includes us as a larger circle includes smaller circles. By this ingenious suggestion of the membership of one spirit in another, Fechner's "day-view" also puts Nature in a different position; neither with Hegel sublimating it to the thought of God's mind, nor with Lotze degrading it to the phenomena of our human minds, but identifying it with the outer appearance of one spirit to another spirit in the highest of spirits.

We have dwelt on this curious metaphysics of Fechner because it contains the master-key to the philosophy of the present moment. While he was developing it during the domination of Hegelianism, and the subsequent reaction to materialism, it attracted little notice. But when the later reaction to Kant arose against both Hegelianism and materialism, the nearly contemporary appearance of Fechner's *Psychophysics* began to attract experimental psychologists by its real as well as its apparent exactness, and both psychologists and metaphysicians by its novel way of putting the relations between the physical and the psychical in man and in the world. Fechner enjoyed the felicity of seeing psychology deriving advantage from the methods, as well as the results, of his experiments, and of seeing in 1879 the first psychological laboratory erected by Wundt in his own Leipzig. But he had also to endure countless objections to his mathematical statement of Weber's law, to his unnecessary assumption of units of sensation, and to his unjustifiable transfer of the law from physical to physiological stimuli of sensations, involving in his opinion his parallelistic view of body and mind. Among psychologists Helmholtz, Mach, Brentano, Hering, Delbœuf were all more or less against him. Sigwart in his *Logic* has also opposed the parallelistic view itself; and James has criticized it from the point of view that the soul selects out of the possibilities of the brain means to its own ends. Nevertheless, largely under the influence of the exaggeration of the conservation of energy, many psychologists—Wundt, Paulsen, Riehl, Jodl, Ebbinghaus, Münsterberg, and in England Lewes, Clifford, Romanes, Stout—have accepted Fechner's Leibnitzian hypothesis of non-interacting parallelism between stimuli and sensations, nervous-processes and sensations, body and soul; as far at least as men and animals are concerned. Most stop here, preferring with Wundt to content themselves with this psychological parallelism. But some go with Fechner to the full length of his metaphysical parallelism of the physical and psychical, as psychophysical, throughout the whole world; and this influence has extended from Germany to Denmark, where it has been embraced by Höffding, and to England, where it has been accepted by Romanes, and in a more qualified manner as "a working hypothesis" by Stout. But the most thorough and most eloquent of Fechner's metaphysical disciples is F. Paulsen, who has spread panpsychism far and wide in his well-known *Einleitung in die Philosophie*, published in 1892, and republished at least seven times since. Here reappear all the characteristic points of Fechner's "world-view"—the panpsychism, the universal parallelism with the identification of physical and psychical, the inclusion of spirit in spirit, the synechological view of spirit, and the final "day-view" that all reality is spirit, and body the appearance of spirit to spirit. But this is not all: Paulsen tries to supply something wanting in Fechner. Fechner was a psychophysical metaphysician, and a metaphysical psychologist, but he troubled himself little about epistemology, and the question—How do we know all these psychophysical things? He thought little of Kant's criticism, which ended in admitting without explaining things in themselves. Now, the originality of Paulsen consists in trying to supply an epistemological explanation of the metaphysics of Fechner, by reconciling him with Kant and Schopenhauer. He borrows from Kant's "rationalism" the hypothesis of a spontaneous activity of the subject with the deduction that knowledge begins from sense, but arises from understanding; and he accepts from Kant's metaphysical idealism the consequence that everything we perceive, experience, and know about physical nature, and the bodies of which it consists, is phenomena, and not bodily things in themselves. But he has a different theory of human nature and soul, and so does not accept the Kantian conclusion that things in themselves, in the sense of things beyond phenomena, are all unknowable. On the contrary, his contention is that of Fechner—that all knowable things are inner psychical realities beneath outer physical appearances—the invisible symbolized by the visible. Kant, however, had no epistemology for such a contention, because according to him both outer and inner senses give mere appearance, from which we could not know either body in itself, or soul in itself. Parting, then, from Kant, Paulsen resorts to a paradox which he shares with Fechner and Wundt. He admits, indeed, Kant's hypothesis that by inner sense we are conscious only of mental states, but he contends that this very consciousness is a knowledge of a thing in itself. He agrees with Fechner and Wundt that there is no substantial soul, and that soul is nothing but the mental states, or rather their unity—thus identifying it with Kant's synthetic unity. On this assumption he deduces that in being conscious of our mental states we are conscious of soul not merely as it appears, but as it is in itself, and therefore can infer similar souls, other psychical unities, which are also things in themselves. But what is the essence of this psychical reality which we thus immediately and mediately know? For an answer to this question he appeals from Fechner to Schopenhauer, believing that, while Fechner excels Schopenhauer in his clear insight that the inner world is no explanation of the physical world, Schopenhauer on his side has the advantage of a voluntaristic psychology. Hence he is one of the now numerous band who tell us, after Schopenhauer, that will of some sort is the fundamental fact of mental life. Taking, then, will to be the essential thing in itself of which we are conscious, he deduces that we can infer that the psychical things in themselves beyond ourselves are also essentially "wills." Then combining the central dogma of Fechner that spirit extends throughout the world of bodily appearance, and the central dogma of Schopenhauer that what in idea appears to us as body is in itself "will," he concludes that the realities of the world are "wills," that bodies are mere appearances of "wills," and that there is one universal and all-embracing spirit, which is "will." His ultimate metaphysics, then, is this:—Everything is spirit, and spirit is "will." Lastly, he interprets "will" according to his premisses. By "will" he does not mean "rational desire," which is its proper meaning, but inapplicable to Nature; nor unconscious irrational will, which is Schopenhauer's forced meaning; nor unconscious intelligent will, which is Hartmann's more correct meaning, though inapplicable to Nature. What he does mean by "will" is instinct, impulsive feeling, a "will to live," not indeed unconscious, but often subconscious, without idea, without reasoning about ends and means, yet pursuing ends—in short, what he calls, after K. E. von Baer, *Zielstrebigkeit.* In this sense of appetition he makes out everything, which appears as a body, to be really in inner essence a "will." How persistent is ancient animism! Empedocles, Plato, and Aristotle; Telesio, Bruno, and Campanella; Leibnitz; the idealists, Schopenhauer and Hartmann, Fechner and Paulsen; and the materialist, Haeckel—all have agreed in according some sort of appetition to Nature. So prone are men to exaggerate adaptation into aim! So prone are they to transfer to Nature the part played by the providence of God! (see Bacon, *De Augmentis,* iii. 4, *sub fin.*).

It would be a mistake to suppose that noumenal idealism is dead in Germany. It died down for a time in the decline of Hegelianism and the rise of materialism. It has since revived. The pure idealism of Fichte is at the bottom of it all. The panlogism of Schelling and Hegel survives in its influence. So still more does the panthelism of Schopenhauer. The three most vital idealisms of the kind at the moment are the panpneumatism of Hartmann, combining Hegel with Schopenhauer; the panteleologism of Lotze, reviving Leibnitz; and the panpsychism of Paulsen, continuing Fechner, but with the addition of an epistemology combining Kant with Schopenhauer. All these systems of metaphysics, differ as they may, agree that things are known to exist beyond sensible phenomena, but yet are mental realities of some kind. Meanwhile, the natural substances of Aristotelian realism are regarded with common aversion.

§ 5. Phenomenal Idealism in Germany.

Phenomenal idealism is the metaphysics which deduces that, as we begin by perceiving nothing but mental phenomena of sense, so all we know at last from these data is also phenomena of sense, actual or possible. So far it is in general agreement not only with Hume, but also with Kant in his first two positions. But it follows Fichte in his revolt against the unknown thing in itself. On the other hand, as the speculative systems of noumenal idealism, starting from Fichte, succeeded one another, like ghosts who "come like shadows, so depart," without producing conviction, and often in flagrant opposition to the truths of natural science, and when, in consequence, a wave of materialism threatened to submerge mind altogether by reducing it to a function of matter, many philosophers began to despair of the ambitious attempts which had been made to prove that there is a whole world of mind beyond phenomena, as the noumenalists had supposed. Thus they were thrown back on the limits of human knowledge prescribed by Kant, but purged of the unknown thing in itself by Fichte. They contented themselves with the result that the world we know is phenomenal, a world of experience (*Erfahrungswelt*), with no power of reason to infer things beyond phenomena of sense, actual and possible; and they endeavoured to show that this world of phenomena provides a sufficient field for natural science, a sufficient vindication of mind against materialism, a sufficient justification of idealism. Phenomenal idealism, in short, is the Kantian contention that Nature, as known to science, is phenomena of experience. Unfortunately, the word "phenomenon" is equivocal (see *Mind,* xiv. 309). Sometimes it is used for any positive fact, as distinguished from its cause; in this sense everything is a phenomenon, and indeed in this sense Aristotle spoke of God's intelligence as the divinest of phenomena. But sometimes also it means what appears, or can appear, to the senses, as distinguished from what does not appear, but can be inferred to exist. Now, Kant and his followers start from this second and narrower meaning, and usually narrow it still more by assuming that what appears to the senses is as mental as the sensation, being undistinguishable from it or from the idea of it, and that an appearance is a mental idea (*Vorstellung*) of sense; and then they conclude that we can know by influence nothing but such mental appearances, actual and possible, and therefore nothing beyond sensory experience. When, on the other hand, the objects of science are properly described as phenomena, what is meant is not this pittance of sensible appearances, but positive facts of all kinds, whether perceptible or imperceptible, whether capable of being experienced or of being inferred from, but beyond, experience, *e.g.*, the farther side of the moon which, as the moon only rotates once in a revolution, is always turned away from a spectator on the earth, from his senses, from his experience, actual or possible, and yet is known to exist by inference. Hence the doctrine of Kant, that Nature as known to science is phenomena, means one thing in Kantism and another thing in science. In the former it means that Nature is mental phenomena, actual and possible, of sensory experience; in the latter it means that Nature is positive facts, either experienced or inferred. It is most important also to notice that Kantism denies, but science asserts, the logical power of reason to infer actual things beyond experience. But the phenomenal idealists have not, any more than Kant, noticed the ambiguity of the term "phenomenon"; they fancy that, in saying that all we know is phenomena in the Kantian sense of mental appearances, they are describing all the positive facts that science knows; and they follow Kant in supposing that there is no logical inference of actual things beyond experience.

(1) *The Reaction to Kant.*—The reaction to Kant ("Zurück zu Kant!") was begun by O. Liebmann in *Kant und die Epigonen* (1865), and expressed in his often-quoted words, "Es muss auf Kant zurückgegangen werden." Immediately afterwards, in 1866, appeared Lange's *Geschichte des Materialismus.* In 1870 J. B. Meyer published his *Kant's Psychologie*, and in 1871 H. Cohen his more important *Kant's Theorie der Erfahrung*, which led Lange to modify his interpretation of Kant in the second edition of his own book. Lange (1828–1875) by his *History of Materialism* has exercised a profound influence, which is due partly to its apparent success in answering materialism by Kantian arguments, and partly to its ingenious attempt to give to Kantism itself a consistency, which, however, has only succeeded in producing a new philosophy of Neo-Kantism, differing from Kantism in modifying the *à priori* and rejecting the thing in itself. Lange to some extent modified the transcendentalism of Kant's theory of the origin of knowledge. *À priori* forms, according to Kant, are contributions of the mental powers of sense, understanding, and reason; but, according to Lange, they are rooted in "the physico-psychical organization." This modification was the beginning of a gradual lessening of the antithesis of *à priori* to *à posteriori*, until at last the *à priori* forms of Kant have been transmuted into "auxiliary conceptions," or "postulates of experience." But this modification made no difference to the Kantian and Neo-Kantian deduction from the epistemological to the metaphysical. Lange entirely agreed with Kant that *à priori* forms can have no validity beyond experience when he says, "Kant is at any rate so far justified as the principle of intuition in space and time *à priori* is in us, and it was a service to all time that he should, in this first great example, show that what we possess *à priori*, just because it arises out of the disposition of our mind, beyond our experience has no longer any claim to validity" (*Hist. of Materialism*, translated by E. C. Thomas, ii. 203). Hence he deduced that whatever we know from sensations arranged in such *à priori* forms are objects of our own experience and mental phenomena. Hence also his answer to materialism. Science, says the materialist, proves that all known things are material phenomena. Yes, rejoins Lange, but Kant has proved that material are merely mental phenomena; so that the more the materialist proves his case the more surely he is playing into the hands of the idealist—an answer which would be complete if it did not turn on the equivocation of the word "phenomenon," which in science means any positive fact, and not a mere appearance, much less a mental appearance, to sense and sensory experience. Having, however, made a deduction, which is at all events consistent, that on Kantian assumptions all we know is mental phenomena, Lange proceeded to reduce the rest of Kantism to consistency. He saw that if all logical inference is limited to mental phenomena of experience, we can form ideas of things beyond, but not know corresponding realities. Consequently he retracted Kant's admission that the thing in itself is something existing though unknowable. He regarded the thing in itself as a mere idea of limit, a limitative idea, an ideal, which we must conceive as a necessary outcome of our organization—but that is all; and when Cohen, taking advantage of some passages in which Kant speaks of the thing in itself as the idea of phenomena under the conception of an object in general, had, like Fichte before him, contended that this was all Kant had really meant, Lange, in his second edition, adopted this interpretation, and contended that the thing in itself is, and was meant by Kant to be, a mere idea. But his ardent love of consistency led him far away from Kant in the end; for he proceeded consistently from the assumption, that whatever we think beyond mental phenomena is ideal, to the logical conclusion that in practical matters our moral responsibility cannot prove the reality of a noumenal freedom, because, as on Kant's assumption we know ourselves from inner sense only as phenomena, we can prove only our phenomenal freedom. Lange thus transmuted inconsistent Kantism into a consistent Neo-Kantism, consisting of these reformed positions: (1) we start with sensations in *à priori* forms; (2) all things known from these data are mental phenomena of experience; (3) everything beyond is idea, without any corresponding reality being knowable. "The intelligible world," he concluded, "is a world of poetry." Our reflection is that there is a great difference between the essence and the consistency of Kant's philosophy. Its essence, as stated by Kant, was to reduce the logical use of reason to mental phenomena of experience in speculation, in order to extend the practical use of reason to the real noumena, or things in themselves, required for morality. Its consistency, as deduced by Lange, was to reduce all use of reason, speculative and practical, to its logical use of proceeding from the assumed mental data of outer and inner sense, arranged *à priori*, to mental phenomena of experience, beyond which we can conceive ideas but postulate nothing. As H. Vaihinger, himself a profound Kantian of the new school, says, "Critical scepticism is the proper result of the Kantian theory of knowledge."

There is only one Neo-Kantian way out of this dilemma, but it is to alter the original assumptions of Kant's psychological idealism. This is the alternative of A. Riehl, who in *Der philosophische Kriticismus* (1876, &c.) proposes the non-Kantian hypothesis that, though things in themselves are unknowable through reason alone, they are knowable by empirical intuition, and therefore also by empirical thought starting from intuition; or, in other words, that we have an immediate perception of an external world. Like all true followers of Kant, Riehl prefers epistemology to metaphysics; and indeed wishes to avoid metaphysics, but really proceeds to found a metaphysics on epistemology, which he calls "critical realism," so far as it asserts a knowledge of things beyond phenomena, and "critical monism," so far as it holds that these things are unlike both physical and psychical phenomena, but are nevertheless the common basis of both. He starts by accepting the Kantian positions that unity of consciousness combines sensations by *à priori* synthesis, and that therefore all that natural science knows about matter moving in space is merely phenomena of outer sense; and he agrees with Kant that from these data we could not infer things in themselves by reason. But his point is that the very sensation of phenomena or appearances implies the things which appear. "Sensory knowledge," he says, "is the knowledge of the relations of things through the relations of the sensations of things." Further, holding that, "like every other perception, the perception of a human body immediately involves the existence of that body," and, like Fichte, believing in a "common consciousness," he concludes that the evidence of sense is verified by "common consciousness" of the external world as objective in the Kantian sense of universally valid. He interprets the external world to be the common basis of physical and psychical phenomena, and so far his "critical realism" reminds us of Trendelenburg's "Lückentheorie" and Dühring's "Wirklichkeitsphilosophie." But whereas Trendelenburg thought that motion is common to thought and being, and Dühring thinks that matter underlies all bodily and mental states, Riehl's view is different, and is founded on his interpretation of Kant. He rightly relies on the numerous passages, neglected by Lange, in which Kant regards things in themselves as neither phenomena nor ideas, but things existing beyond both. But his main reliance is on the passage in the *Kritik*, where Kant, speaking of the Cartesian difficulty of communication between body and soul, suggests that, however body and soul appear to be different in the phenomena of outer and inner sense, what lies as thing in itself at the basis of the phenomena of both may perhaps be not so heterogeneous (*ungleichartig*) after all. Riehl elaborates this bare suggestion into the metaphysical theory that the single basis of physical and psychical phenomena is neither bodily nor mental, nor yet space and motion. In order to establish this paradox of "critical monism," he accepts to a certain extent the psychophysical philosophy of Fechner. He agrees with Fechner that physical process of nerve and psychical process of mind are really the same psychophysical process as appearing on the one hand to an observer and on the other hand to one's own consciousness; and that physical phenomena only produce physical phenomena, so that those materialists and realists are wrong who say that physical stimuli produce sensations. But whereas Fechner and Paulsen hold that all physical processes are universally accompanied by psychical processes which are the real causes of psychical sensations, Riehl rejects this paradox of universal parallelism in order to fall into the equally paradoxical hypothesis that something or other, which is neither physical nor psychical, causes both the physical phenomena of matter moving in space and the psychical phenomena of mind to arise in us as its common effects. In supposing a direct perception of such a nondescript thing, he shows to what straits idealists are driven in the endeavour to supplement Kant's limitation of knowledge to phenomena by some sort of knowledge of things.

(2) *The Reaction to Hume.*—When the Neo-Kantians, led by Lange, had modified Kant's hypothesis of *à priori* forms, and retracted Kant's admission and postulation of things in themselves beyond phenomena and ideas, and that too without proceeding farther in the direction of Fichte and the noumenal idealists, there was not enough left of Kant to distinguish him essentially from Hume. For what does it matter to metaphysics whether by association sensations suggest ideas, and so give rise to ideas of substance and causation *à posteriori*, or synthetic unity of consciousness combines sensations by *à priori* notions of substance and causation into objects which are merely mental phenomena of experience, when it is at once allowed by the followers of Hume and Kant alike that reason in any logical use has no power of inferring things beyond the experience of the reasoner? In either case, the effective power of inference, which makes us rational beings, is gone. Naturally then the reaction to Kant was followed by a second reaction to Hume, partly under the name of "Positivism," which has attracted a number of adherents, such as C. Göring and E. Laas, and partly under the name of the "Physical phenomenology" of E. Mach.

C. Göring (1841–1879), author of an incomplete *System der Kritischen Philosophie* (1874–1875), recalled Hume's sensationalism by saying that the origin of all knowledge is in sense and no knowledge is possible beyond experience. E. Laas (1837–1885) signalized himself in *Kant's Analogien der Erfahrung* (1876) by his keen criticism of Kant's transcendentalism, and in his later *Idealismus und Positivismus* (1879, &c.) by his clear contrast between Platonism, from which he derived transcendentalism, and Positivism, of which he considered Protagoras to have been the founder. Under the head of Platonism he condemned all belief in mathematical method, in absolute principles, in *à-priorism*, in freedom, and in the transcendent; while Protagoreanism seemed to him to contain three great truths—the inseparability of subject and object, the concomitant variability of both, and the reduction of all higher processes to sensation. He thought that the mantle of Protagoras had descended to Hume and Mill. Now, it is true that the ancient sophistry of Protagoras has issued in the modern sensationalism of Hume, the positivism of Comte, the relativism of Mill, and the universal relativism or correlativism of Laas. Indeed, all these views are varieties of scepticism. Nevertheless, we must not confuse ancient and modern scepticism. Though both asserted a relativity of object and subject, Protagoras thought that there are two different but accompanying streams, the stream of matter and the stream of sense, whereas Hume and Mill positively identified matter with sensations. Now, Laas appealed to Protagoras; but in reality he was a disciple of Hume. So again, if we are to call him a positivist because he believed in nothing but phenomena, we must remember the equivocation of the term "phenomenon." Laas was not so near to the positivism of Comte, who said that the mind can observe all phenomena but its own, as to the psychological positivism of Mill, who thought that it has no other phenomena to observe.

E. Mach (b. 1838) is a conspicuous instance of a confusion of physics and psychology ending in a scepticism like that of Hume. He tells us how from his youth he pursued physical and psychological studies, how at the age of fifteen he read Kant's *Prolegomena*, and two or three years later rejected the thing in itself, and came to the conclusion that the world with his ego is one mass of sensations. For a time, under the influence of Fechner's *Psychophysics*, he thought that Nature has two sides, a physical and a psychological, and added that all atoms have feeling. But in the progress of his physical work, which taught him, as he thought, to distinguish between what we see and what we mentally supply, he soon passed from this noumenalism to a "universal physical phenomenology," which still remains his philosophy. It retains some relics of Fechner's influence; first, the theory of identity, according to which the difference between the physical and psychical is not a dualism, but everything is at once both; and secondly, the substitution of mathematical dependence for physical causality, except that, whereas Fechner only denied causality between physical and psychical, Mach rejects the entire distinction between causality and dependence, on the ground that "the law of causality simply asserts that the phenomena of Nature are dependent on one another." He comes near to Hume's substitution of succession of phenomena for real causality. He holds, like Hume, that nothing is real except our sensations and complexes of sensory elements; that the ego is not a definite, unalterable, sharply bounded unity, but its continuity alone is important; and that we know no real causes at all, much less real causes of our sensations; or, as he expresses it, bodies do not produce sensations, but complexes of sensations form bodies. If he has any originality, it consists in substituting for the association of ideas the "economy of thinking," by which he means that all theoretical conceptions of physics, such as atoms, molecules, energy, &c., are mere helps to facilitate our consideration of things. But he limits this power of mind beyond sensations to mere ideas, and like Hume, and also like Lange, holds at last that, though we may form ideas beyond sensations or phenomena, we cannot know things. If we ask how Mach arrived at this scepticism, which is contained in his well-known scientific work on the History of Mechanics (*Die Mechanik in ihrer Entwickelung*, 1883) as well as in his psychological work on the Analysis of Sensations (*Beiträge zur Analyse der Empfindungen*, 1886), we find two main causes, both psychological and epistemological; namely, his views on sense and on inference. In the first place, he displays in its most naked form the common but unproved idealistic paradox of a sense of sensations, according to which touch apprehends not pressure but a sensation of pressure, sight apprehends not colour but a sensation of colour, and there is no difference between touch and pressure felt, between vision and colour seen, or between the sensory operation and the sensible object apprehended by any sense, even within the sentient organism. Hence, according to him, sensations are not apprehensions of sensible objects (*e.g.*, pressures felt) from which we infer similar objects beyond sense (*e.g.*, similar pressures of outside things), but are the actual elements out of which everything known is made; as if sensations were like chemical elements. Within the limits of these supposed sensory elements he accords more than many psychologists do to sense; because, following the nativists, Johannes Müller and Hering, he includes sensations of time and space, which, however, are not to be regarded as "pure intuitions" in the style of Kant. But here again he identifies time and space with the sensations of them, which he calls time-sensations (*Zeitempfindungen*) and space-sensations (*Raumempfindungen*). On the assumption, then, that time and space are not objects, but systems, of sensations, he concludes that a body in time and space is "a relatively constant sum of touch-and-light-sensations, joined to the same time-and-space-sensations," that each man's own body is included in his sensations, and that to explain sensations by motions would only be to explain one set of sensations from another. In short, according to Mach sensations are elements and bodies complexes of these elements. Secondly, his theory of inference contains the admission that we infer beyond sensations: he remarks that the space of the geometer is beyond space-sensations, and the time of the physicist does not coincide with time-sensations, because it uses measurements such as the rotation of the earth and the vibrations of the pendulum. But by inference beyond sense he does not mean a process of concluding from sensible things to similar things, *e.g.*, from tangible pressures to other similar pressures in the external world. Inference, according to him, is merely mental completion of sensations; and this mental completion has two characteristics: it only forms ideas, and it proceeds by an "economy of thought." In the course of his learned studies on the History of Mechanics he became deeply impressed with Galileo's appeals to simplicity as a test of truth. Galileo, for instance, recommended his discovery of the law of the uniform acceleration of a falling body as the "simplest and most natural." But unfortunately he had previously said the same thing about his first and false hypothesis that the uniform acceleration is directly proportional to the space; and, when he resigned the false for the true hypothesis that it is directly proportional to the time, his real evidence was not simplicity, but his carefully conducted experiments of letting bodies fall down inclined planes, and measuring the time by the flow of water. Mach, however, oblivious to these distinctions, converts what is at best only one characteristic of thinking into its essence. Generalization, for instance, which essentially consists in inferring that all similar things of a kind have the attributes of particular instances, does also abbreviate thought by embracing all instances in a universal; but Mach supposes that it essentially consists in this mere economy, and that only an economy of conception, without arriving at true beliefs about things. According to him, whatever inferences we make, certain or uncertain, are mere economies of thought, adapting ideas to sensations, and filling out the gaps of experience by ideas; whatever we infer, whether bodies, or molecules, or atoms, or space of more than three dimensions, are all without distinction equally provisional conceptions, things of thought; and "bodies or things are compendious mental symbols for groups of sensations—symbols which do not exist outside thought." Moreover, he applies the same scepticism to cause and effect. "In Nature," says he, "there is no cause and no effect." He thinks that repetitions of similar conjunctions occur in Nature, the connexion of cause and effect only in abstraction. He refers to Hume as recognizing no causality but only a customary and habitual succession, but adds that Kant rightly recognizes that mere observation cannot teach the necessity of the conjunction. But in reality his theory is neither Hume's theory of association nor Kant's of an *à priori* notion of understanding under which a given case is subsumed. He thinks that there is a notion of understanding (*Verstandesbegriff*), under which every new experience is subsumed, but that it has been developed by former experience, instinctively, and by the development of the race, as part of the economy of thinking. "Cause and effect are therefore," he concludes, "thought-things of economical function (*Gedankendinge von ökonomischer Function*)." His philosophy, therefore, is that all known things are sensations and complexes of sensory elements, supplemented by an economy of thinking which cannot carry us beyond ideas to real things, or beyond relations of dependency to real causes.

It is important to understand that Mach had developed this economical view of thought in 1872, or more than ten years before the appearance of his work on the History of Mechanics in 1883, as he tells us in the preface, where he adds that at a later date similar views were expressed by Kirchhoff in his *Vorlesungen über Mathematische Physik* (1874). Kirchhoff asserted that the whole object of mechanics is "to describe the motions occurring in Nature completely in the simplest manner." This view involves the denial of force as a cause, and the assertion that all we know about force is that the acceleration of one mass depends on that of another, as in mathematics a function depends on a variable; and that even Newton's third law of motion is merely a description of the fact that two material points determine in one another, without reciprocally causing, opposite accelerations. It is evident that Kirchhoff's descriptive is the same as Mach's economical view. "When I say," says Mach, "that a body A exerts a force on a body B, I mean that B, on coming into contraposition with A, is immediately affected by a certain acceleration with respect to A." In a word, Mach and Kirchhoff agree that force is not a cause, convert Newtonian reciprocal action into mere interdependency, and, in old terminology, reduce mechanics from a natural philosophy of causes to a natural history of mere facts. Now, Mach applies these preconceived opinions to "mechanics in its development," with the result that, though he shows much skill in mathematical mechanics, he misrepresents its development precisely at the critical point of the discovery of Newton's third law of motion, "Actioni contrariam semper et æqualem esse reactionem."

The order of discovery, recorded in the *Philosophical Transactions* of the Royal Society, was as follows :—

(*a*) Sir Christopher Wren made many experiments before the Royal Society, which were afterwards repeated in a corrected form by Sir Isaac Newton in the *Principia*, experimentally proving that bodies of ascertained comparative weights, when suspended and impelled against one another, forced one another back by impressing on one another opposite changes of velocity inversely as their weights and therefore masses; that is, by impressing on one another equal and opposite changes of momentum.

(*b*) Wallis showed that such bodies reduce one another to a joint mass with a common velocity equal to their joint momentum divided by their joint weights or masses. This result is easily deducible also from Wren's discovery. If m and m' are the masses, v and v' their initial velocities, and V the common velocity, then

$$m(v-V)=m'(V-v')$$
$$\therefore mv+m'v'=(m+m')V$$
$$\therefore \frac{mv+m'v'}{m+m'}=V.$$

(*c*) Wren and Huyghens further proved that the law of equal action and reaction, already experimentally established by the former, is deducible from the conservation of the velocity of the common centre of gravity, which is the same as the common velocity of the bodies; that is, deducible from the fact that their common centre of gravity does not change its state of motion or rest by the actions of the bodies between themselves; and they further extended the law to bodies, *qua* elastic.

(*d*) Hence, first inductively and then deductively, the third law was originally discovered only as a law of collision or impact between bodies of ascertained weights and therefore masses, impressing on one another equal and opposite changes of momentum, and always reducing one another to a joint mass with a common velocity to begin with, apart from the subsequent effects of elasticity.

(*e*) Newton in the *Principia*, repeating and correcting Wren's experiments on collision, and adding further instances from attractive forces of magnetism and gravity, induced the third law of motion as a general law of all forces.

This order of discovery shows that the third law was generalized from the experiments of Wren on bodies of ascertained comparative weights or masses, which are not material points or mass-points. It shows that the bodies impress on one another opposite changes of velocity inversely as their weights or masses; and that in doing so they always begin by reducing one another to a joint mass with a common velocity, whatever they may do afterwards in consequence of their elasticities. The two bodies therefore do not penetrate one another, but begin by acting on one another with a force precisely sufficient, instead of penetrating one another, to cause them to form a joint mass with a common velocity. Bodies then are triply extended substances, each occupying enough space to prevent mutual penetration, and by this force of mutual impenetrability or inter-resistance cause one another to form a joint mass with a common velocity whenever they collide. Withdraw this foundation of bodies as inter-resisting forces causing one another in collision to form a joint mass with a common velocity but without penetration, and the evidence of the third law disappears; for in the case of attractive forces we know nothing of their *modus operandi* except by the analogy of the collision of inter-resisting bodies, which makes us believe that something similar, we know not what, takes place in gravity, magnetism, electricity, &c. Now, Mach, though he occasionally drops hints that the discovery of the law of collision comes first, yet never explains the process of development from it to the third law of motion. On the contrary, he treats the law of collision with other laws as an application of the third law of motion, because it is now unfortunately so taught in books of mechanics. He has therefore lost sight of the truths that bodies are triply extended, mutually impenetrable substances, and by this force causes which reduce one another to a joint mass with a common velocity on collision, as for instance in the ballistic pendulum; that these forces are the ones we best understand; and that they are reciprocal causes of the common velocity of their joint mass, whatever happens afterwards. In the case of this one force we know far more than the interdependence supposed by Mach and Kirchhoff; we know bodies with impenetrable force causing one another to keep apart. It might have been expected that scepticism on this subject would not have had much effect. But the idealists are only too glad to get any excuse for denying bodily substances and causes; and, while Leibnitz supplied them with the fancied analysis of material into immaterial elements, and Hume with the reduction of bodies to assemblages of sensations, Mach adds the additional argument that bodily forces are not causes at all. In Great Britain, at this moment, Mach's scepticism is welcomed by Karl Pearson to support an idealistic phenomenalism derived from Hume, and by Ward to support a noumenal idealism derived from Lotze. No real advance in metaphysics can take place, and natural science itself is in some danger, until the true history of the evidences of the laws of mechanical force is restored; and then it will soon appear that in the force of collision what we know is not material points determining one another's opposite accelerations, but bodies by force of impenetrable pressure causing one another to keep apart. Mechanics is a natural philosophy of causes.

(3) *Dualism within Experience.*—As it comes to be realized that Hume and Kant agreed more than they differed, German philosophers tend to make new philosophies out of their common points. Hume thought that knowledge has its origin from experience, and Kant that *à priori* elements are contained in this experience; but, in differing about the origin, they agreed about the limits of knowledge, which, according to both, is a knowledge of mental phenomena of sense, and a knowledge limited to objects of experience, without any power of knowing by logical inference anything existing beyond, anything transcending, experience, actual and possible. Now, besides philosophies which are reactions to Kant or to Hume, there are a number of other philosophies in our day which start with this common hypothesis as a principle—knowledge is experience. The consequence is that whatever is true of experience they transfer to all knowledge. One of the characteristics of actual experience is that its object is, or has been, present to an experiencing subject; and of possible experience that it can be present. As a matter of fact, this characteristic differentiates experience from inference. By inference we know that things, such as the farther side of the moon, which neither are, nor have been, nor can be, present to an experiencing subject on the earth, nevertheless exist, and only become objects of inference. But, on the

hypothesis that knowledge contains no inferences beyond experience, it follows that all the objects of knowledge, being objects of experience, are, or have been, or can be, present to an experiencing subject. Hence it is common nowadays to hold that there is indeed a difference between knower and known, ego and non-ego, subject and object, but that they are inseparable; or that all known things are objects and subjects inseparably connected in experience. This view, however, is held in different forms; and two opposite forms have lately arisen in Germany, "immanent philosophy" and "empirio-criticism," the former nearer to Kant, the latter to Hume.

"Immanent philosophy" is the hypothesis that the world is not transcendent, but immanent in consciousness. Among the upholders of this view are Anton von Leclair, who expresses it in the formula—"Denken eines Seins = gedachtes Sein," and R. von Schubert-Soldern, who says that every fragment of the pretended transcendent world belongs to the immanent. But the best known representative of Immanent Philosophy is W. Schuppe, who, in his *Erkenntnistheoretische Logik* (1878), and in his shorter *Grundriss der Erkenntnistheorie und Logik* (1894), gives the view a wider scope by the contention that the real world is the common content or object of common consciousness which, according to him, as according to Fichte, is one and the same in all individual men. Different individual consciousnesses plainly differ in having each its own content, in which Schuppe includes each individual's body as well as the rest of the things which come within the consciousness of each; but they also as plainly agree, *e.g.*, in all admitting one sun. Now, the point of Schuppe is that, so far as they agree, individual consciousnesses are not merely similar, but the same in essence; and this supposed one and the same essence of consciousness in different individuals is what he calls consciousness in general (*Bewusstsein überhaupt*). While in this identification he follows Fichte, in other respects he is more like Kant. He supposes that the conscious content is partly *à posteriori*, or consisting of given data of sense, and partly *à priori*, or consisting of categories of understanding, which, being valid for all objects, are contributed by the common consciousness. He differs, however, from Kant, not only because he will not allow that the given data are received from things in themselves, but also because, like Mach, he agrees with the nativists that the data already contain a spatial determinacy and a temporal determinacy, which he regards as *à posteriori* elements of the given, not, like Kant, as *à priori* forms of sense. He allows, in fact, no *à priori* forms except categories of the understanding, and these he reduces, considering that the most important are identity with difference and causality, which in his view are necessary to the judgments that the various data which make up a total impression (*Gesammteindruck, Totaleindruck*) are each different from the others, together identical with the total impression, and causally connected in relations of necessary sequence and coexistence. At the same time, true to the hypothesis of "immanence," he rigidly confines these categories to the given data, and altogether avoids the inconsistent tendency of Kant to transfer causality from a necessary relation between phenomena to a necessary relation between phenomena and things in themselves as their causes. Hence he strictly confines true judgment and knowledge to the consciousness of the identity or difference, and the causal relations of the given content of the common consciousness. From this epistemology he derives the metaphysical conclusion that the things we know are indeed independent of my consciousness and of yours, taken individually, or, to use a new phrase, are "trans-subjective"; but, so far from being independent of the common consciousness, one and the same in all of us, they are simply its contents in the inseparable relation of subject and object. To the objection that there are objects, *e.g.*, atoms, which are never given to any consciousness, he returns the familiar Kantian answer that, though unperceived, they are perceptible. The whole known world, then, according to him, is the perceived and the perceptible content of common consciousness. Schuppe has been compared by Wundt with Berkeley. But Schuppe himself distinguishes himself from Berkeley on the ground that, by supposing an object to be the one content of our common consciousness, he explains the unity of an object, which Berkeley's theory of the different ideas of different minds certainly does not; and further, on the ground that he does not, like Berkeley, suppose the will of God to be the direct cause of sensations, but simply regards them as given. The world, according to Berkeley, is immanent in God's consciousness as well as severally in ours; according to Schuppe, it is immanent jointly in ours. Again, this hypothesis of one consciousness reminds us of the Hegelian one reason, the same in God and man. But Schuppe only means one common consciousness uniting the finite consciousnesses of us men. He really descends from Fichte; except that the common consciousness of finite individuals, according to Fichte, by its own activity posits Nature in consciousness itself, but, according to Schuppe, finds Nature given in its own content. From Fichte also comes the supposed inseparability of subject and object. Kant held that the thing in itself can, the thing as object cannot, exist without the synthetic subject. It was Fichte who, identifying thing and object, enunciated the formula—no subject without object and no object without subject, as an exhaustive description not only of knowledge but also of existence. Schuppe reduces the formula from a position of the common ego to a fact of its common experience.

The "empirio-criticism" of R. Avenarius (1843–1896), the former editor of the *Vierteljahrsschrift für wissenschaftliche Philosophie*, is the hypothesis of the inseparability of subject and object, or, to use his own phraseology, of ego and environment, in purely empirical, or *à posteriori* form. It is like "immanent philosophy," in opposing experience to the transcendent; but it also opposes experience to the transcendental, or *à priori*. It opposes "pure experience" to "pure reason," while it agrees with Kant's limitation of knowledge to experience. Avenarius held a view of knowledge very like that of Mach's view of the economy of thinking. In his first philosophical treatise, *Philosophie als Denken der Welt gemäss dem Princip des kleinsten Kraftmaasses, Prolegomena zu einer Kritik der reinen Erfahrung* (1876), he based his views on the principle of least action, contending that, as in Nature the force which produces a change is the least that can be, so in mind belief tends in the easiest direction. In illustration of this tendency, he pointed out that mind tends to assimilate a new impression to a previous content, and by generalization to bring as many impressions under as few general conceptions as possible, and succeeds so far as it generalizes from pure experience of the given. Nor is there any objection to this economical view of thought, as long as we remember what Avenarius and Mach forget, that the essence of thought is the least action neither more nor less than necessary to the point, which is the reality of things. Afterwards, in his *Kritik der reinen Erfahrung* (1888–90), Avenarius aimed at giving a description of pure experience, which he identified with the natural view of the world held by all unprejudiced persons. What, then, is this pure experience? "Every human individual," says he, "originally accepts over against him an environment with manifold parts, other individuals making manifold statements, and what is stated in some way dependent upon the environment." Statements dependent upon the environment are what he means by pure experience. At first this starting-point looks like dualistic realism, but in reality the author only meant dualism within experience. By the environment he meant not a thing existing in itself, but only a counterpart (*Gegenglied*) of ourselves as central part (*Centralglied*). "We cannot," he adds, "think ourselves as central part away." He went so far as to assert that, where one assumes that at some time there was no living being in the world, all one means is that there was besides oneself no other central part to whom one's counterparts might also be counterparts. The consequence is that all the world admitted into his philosophy is what he called the "empirio-critical essential co-ordination" (*empiriokritische Prinzipialkoordination*), an inseparable correlation of central part and counterpart, of ego and environment. Within this essential co-ordination he distinguished three values—*R-values* of the environment as stimulus, *C-values* of the central nervous system, and *E-values* of human statements; the latter being characterized by that which at the time of its existence for the individual admits of being named, and including what we call sensations, &c., which depend indirectly on the environment and directly on the central nervous system, but are not, as the materialist supposes, in any way reducible to possessions of the brain or any other part of that system. This division of values brings us to the second point in his philosophy, his theory of what he called "vital series," by which he essayed to explain all life, action, and thought. A vital series he supposed to be always a reaction of C against disturbance by R, consisting in first a vital difference, or diminution by R of the maintenance-value of C, and then the recovery by C of its maintenance-value, in accordance with the principle of least action. He further supposed that, while this independent vital series of C is sometimes of this simple kind, at other times it is complicated by the addition of a dependent vital series in E, by which, in his fondness for too general and far-fetched explanations, he endeavoured to explain conscious action and thought. Thus, if a pain is an E-value directly dependent on a disturbance in C, and a pleasure another E-value directly dependent on a recovery of C, it will follow that a transition from pain to pleasure will be a vital series in E directly dependent on an independent vital series in C, recovering from a vital difference to its maintenance-maximum. Similarly, when in consequence of the stimulus of vibrations of ether, I have a perception of blue, the stimulus R is followed by a vital difference and a recovery of its maintenance-value in C, and this vital series is accompanied by another expressed in the statement E, "I have a perception of blue." Lastly, supposing that all human processes can in this way be reduced to vital series in an essential co-ordination of oneself and environment, Avenarius held that this empirio-critical supposition, which according to him is also the natural view of pure experiences, contains no opposition of physical and psychical, of an outer physical and an inner psychical world—an opposition which seemed to him to be a division of the inseparable. According to him, we should not say that a sensation is in us, but that an E-value is a sign of an object (*e.g.*, blue); and of the relation of object and subject (*e.g.*, perception of blue); nor should we say that the change in C is the cause of another change, E, in us, but only that, if there is a change in C, there is a change in E. He considered that the whole hypothesis that an outer physical thing causes a change in one's central nervous system, which again causes another change in one's inner psychical system or soul, is a departure from the natural view of the universe, and is due to what he called "introjection," or the hypothesis which encloses soul and its faculties in the body, and then, having created a false antithesis between outer and inner, gets into the difficulty of explaining how an outer physical stimulus can impart something into an inner psychical soul. He concluded therefore that, having disposed of this fallacy of introjection, we ought to return to the view of reality as an essential co-ordination of ego and environment, of central part and counterpart, with R-values, C-values, and E-values. It is curious that Avenarius should have brought forward this artificial hypothesis as the natural view of the world, without reflecting that on the one hand the majority of mankind believes that the environment (R) exists, has existed, and will exist, without being a counterpart of any living being as central part (C); and that on the other hand it is so far from being natural to man to believe that sensation and thought (E) are different from, and merely dependent on, his body (C), that throughout the Homeric poems, though soul is required for other purposes, all thinking as well as sensation is regarded as a purely bodily operation. It is indeed difficult to assign any rational place to the empirio-criticism of Avenarius. It is materialistic without being materialism, because, while it regards the supposition of a soul as due to the fallacy of "introjection," it separates thought from the brain. It is realistic without being realism, because, while it distinguishes R-values, C-values, and E-values, it regards the environment, as well as the nervous system, as existing only in relation to the ego, which cannot think itself away. It borrows tenets of different philosophers,—self-maintenance against disturbance from the realist Herbart, and interdependence without causality between stimulus and ego from the idealist Fechner; while it agrees with Mach's views on the economy of thinking, and in opposition to transcendentalism as well as transcendence. Its rejection of the whole relation of physical and psychical makes it almost too indefinite to classify among philosophical systems. But its main point is the essential co-ordination of ego and environment, as central part and counterpart, in experience. It is therefore nearly connected with "immanent philosophy." Schuppe, indeed, wrote an article in the *Vierteljahrsschrift* of Avenarius to prove their essential agreement. At the same time Schuppe's hypothesis of one common consciousness uniting the given by *à priori* categories could hardly be accepted by Avenarius as pure experience, or as a natural view of the world. His "empirio-criticism" is idealistic dualism within experience in an *à posteriori* form, but with a tendency towards materialism.

(4) *Voluntaristic Phenomenalism of Wundt.*—Wundt's metaphysics will form an appropriate conclusion of this sketch of German idealism, because his patient industry and eclectic spirit have fitted him to assimilate many of the views of his predecessors. Wundt proves, not exactly as Hegel thought that all philosophies are one philosophy, but that all idealisms are in a way one. He starts as a phenomenalist from the hypothesis, which we have just described, that knowledge is experience containing subject and object in inseparable connexion, and has something in common with the premature attempt of Avenarius to develop the hypothesis of dualism in experience into a scientific philosophy comprehending the universe in the simplest possible manner. Again he agrees with the reaction both to Hume and to Kant in limiting knowledge to mental phenomena, and has affinities with Mach as well as with Lange. His main sympathies are with the Neo-Kantians, and especially with Lange in modifying the *à priori*, and in extending the power of reason beyond phenomena to an ideal world; and yet the cry of his phenomenalism is not "back to Kant," but "beyond

Kant." Though no noumenalist, in many details he is with noumenalists; with Fechner in psychophysics, in psychophysical parallelism, in the independence of the physical and the psychical chains of causality, in reducing physical and psychical to a difference of aspects, in substituting impulse for accident in organic evolution, and in wishing to recognize a gradation of individual spiritual beings; with Schopenhauer and Hartmann in voluntarism; and even with Schelling and Hegel in their endeavour, albeit on an artificial method, to bring experience under notions, and to unite subject and object in one concrete reality. He has a special relation to Fichte in developing the Kantian activity of consciousness into will and substituting activity for substantiality as the essence of soul, as well as in breaking down the antithesis between phenomena and things in themselves. At the same time, in spite of his sympathy with the whole development of idealism since Kant, which leads him to reject the thing in itself, to modify *à-priorism,* and to stop at transcendent "ideals," without postulates of practical reason, he nevertheless has so much sympathy with Kant's *Kritik* as on its theories of sense and understanding to build up a system of phenomenalism, according to which knowledge begins and ends with ideas, and then on its theory of pure reason to build a crown to his edifice by according to reason a power of logically forming an "ideal" of God as ground of the moral "ideal" of humanity—though without any power of logically inferring any corresponding reality. He constructs his system on the Kantian order—sense, understanding, reason—and exhibits most clearly the necessary consequence from psychological to metaphysical idealism. His philosophy is the best exposition of the method and argument of modern idealism—that we perceive the mental and, therefore, all we know and conceive is the mental. The order of his philosophy is unmistakably as follows:—

(*a*) Psychology, which he says is, in relation to natural science the supplementary, in relation to mental science the fundamental, in relation to philosophy the propœdeutic, empirical science.

(*b*) Logic and epistemology, whose problem of knowledge he calls the precondition for the answer to all other questions.

(*c*) Metaphysics, which deals, according to him, with the fundamental principles of all the natural and spiritual sciences, on the foundation of experience, and on a method based on the principle of ground and consequent. Its positive conclusion, drawn from all the previous psychological, logical, and epistemological considerations, is that all we know from sense is ideas (*Vorstellungen,* so translated by himself), distinguishable, but not separable, into subject and object within unitary experience, and dominated by will; while reason logically and necessarily transcends this experience by the principle of ground, but only to form transcendent "ideals" (*Ideen,* to us an untranslatable term), and ultimately the universally valid and necessary "ideal" of God as will of the world (*Weltwille*). Its negative conclusion is that reason has no power to give us a real knowledge of a reality corresponding to the "ideal," and no power in any case of logically inferring things beyond experience, actual and possible. The phenomenal metaphysics of Lange and of Wundt are exceedingly alike; but perhaps we may say that the intelligible world beyond experience is with Lange a world of poetry; with Wundt a world of logic; with both a world of "ideals."

Wundt founds his whole philosophy on four psychological positions—his phenomenalistic theory of unitary experience, his voluntarism, his actualistic theory of soul, and his psychological theory of parallelism. They are positions also which deeply affect, not only the psychological, but also the metaphysical idealisms of our time, in Germany, and in the whole civilized world. His first position is his phenomenalistic theory of unitary experience. According to him, we begin with an experience of ideas, in which object and idea are originally identical (*Vorstellungsobject*); we divide this unitary experience into its subjective and objective factors, and especially in natural science we so far abstract the objects as to believe them at last to be independent things; but it is the office of psychology to warn us against this popular dualism, and to teach us that there is only a duality of psychical and physical, which are divisible, not separable, factors of one and the same content of our immediate experience; and experience is our whole knowledge. His metaphysical deduction from this psychological view is that all we know is mental phenomena, "the whole outer world exists for us only in our ideas," and all that our reason can logically do beyond these phenomena is to frame transcendent "ideals." His second position is his voluntarism. He agrees with Schopenhauer that not intellect but will is the fundamental form of the spiritual (*die Grundform des Geistigen*). He does not mean that will is the only mental operation; for he recognizes idea derived from sensation, and feeling, as well as will. Moreover, he contends that we can neither have idea without feeling and will, nor will without idea and feeling; that idea alone wants activity, and will alone wants content; and that will is ideating activity (*vorstellende Thätigkeit*), which always includes motives and ends and therefore ideas. He is therefore a follower of Schopenhauer as corrected by Hartmann. Like these predecessors, and like his younger contemporary Paulsen, in calling will fundamental he includes impulse (*Trieb*). Accordingly he divides will into two species; on the one hand, simple volition, or impulse, which in his view requires as motive a feeling directed to an end, and therefore an idea, *e.g.,* the impulse of a beast arising from hunger and sight of prey; on the other hand, complex volition issuing in a voluntary act, requiring decision (*Entscheidung*) or conscious adoption of a motive, with or without choice. Like other German voluntarists, he imputes "impulsive will" to the whole organic world. He holds that not only reflex action in animals, but also irritability in plants is originally an impulse which becomes secondarily automatic; that the protozoon acts in all its parts by "will-impulses," as well as in its whole organism; and that the simplest forms of life are impulsive animals from which plants are developed as chlorophyll-producing organisms. He follows Fechner closely in his answer to Darwin. If he is to be believed, at the bottom of all organic evolution, organic impulses becoming habits produce structural changes, which are transmitted by heredity; and as an impulse thus gradually becomes secondarily automatic, the will passes to higher activities, which in their turn become secondarily automatic, and so on. As now he supposes feeling even in "impulsive will" to be directed to an end, he deduces the conclusion that in organic evolution the pursuit of final causes precedes and is the origin of mechanism. But at what a cost! He has endowed all the plants in the world with motives, feelings directed to an end, and ideas, all of which, according to him, are required for impulse! He apparently forgets that mere feelings often produce actions, as when one writhes with pain. But even so, have plants even those lowest impulses from feelings of pain or pleasure? Wundt, however, having gone so far, there stops. It is not necessary for him to follow Schopenhauer, Hartmann, and Fechner in endowing the material universe with will or any other mental operation, because his phenomenalism already reduces inorganic nature to mere objects of experiencing subjects. Wundt's voluntarism takes a new departure, in which, however, he was anticipated by the paradox of Descartes that will is required to give assent to anything perceived (*Principia Philosophiæ*, i. 34). Wundt supposes not only that all organisms have outer will, the will to act, but also that all thinking is inner will, the will to think. Now, there is a will to think, and Aristotle pointed out that thinking is in our power whenever one pleases, whereas sense depends on an external stimulus (*De Anima*, ii. 5). There is also an impulse to think, *e.g.*, from toothache. But it does not follow that thought is will, or even that there is no thinking without either impulse or will proper. The real source of thinking is evidence. Wundt, however, having supposed that all thinking consists of ideas, next supposes that all thinking is willing (*jedes Denken ein Wollen*). What is the source of this paradox? It is a confusion of impulse with will, and activity with both. He supposes that all agency, and therefore the agency of thinking, is will. In detail, to express this supposed inner will of thinking, he borrows from Leibnitz and Kant the term "apperception," but in a sense of his own. Leibnitz, by way of distinction from unconscious perception, gave the name "apperception" to consciousness, or the reflective knowledge of our inner states which, according to his monadology, is not given to all souls, nor always to the same soul. Kant further insisted that this apperception, "I think," is an act of spontaneity, distinct from sense, necessary to regarding all my ideas as mine, and to combining them in a synthetic unity of apperception; which act Fichte afterwards developed into an active construction of all knowledge, requiring will directed to the end of duty. Wundt, in consequence, thinking with Kant that apperception is a spontaneous activity, and with Fichte that this activity requires will, and indeed that all activity is will, infers that apperception is inner will. Further, on his own account, he identifies apperception with the process of attention, and regards it as an act necessary to the general formation of compound ideas, to all association of ideas, to all imagination and understanding. According to him, then, attention, even involuntary attention, requires inner will; and all the functions imputed by Hume to association, as well as those imputed to understanding by Kant, require apperception, and therefore inner will. At the same time, he does not suppose that they all require the same kind of will. In accordance with his previous division of outer will into impulsive and decisive, he divides the inner will of apperception into (1) passive apperception, or impulsive will necessary to association, passive in receiving the content of sensations, but active so far as this content is a motive rousing it to ideating activity, and (2) active apperception, or decisive will necessary to understanding, and giving rise to what he awkwardly calls "apperceptive combinations," among which come judgments. Apperception in general thus becomes activity of inner will, constituting the process of attention, passive in the form of impulsive will required for association, and active in the form of decisive will required for understanding and judgment. Now, beneath these confusing phrases the point to be regarded is that, in Wundt's opinion, though we can receive sensations, we cannot think at all beyond sense, without some will; we cannot form any compound idea, or any association of ideas without impulse, and we cannot make any comparison or any judgment without decision, and a decision, not in the intellectual sense of a conclusion from evidence, but on the practical sense of a conscious adoption of a motive. This exaggeration of the real fact of the will to think ignores throughout the position of little man in the great world and at the mercy of things which drive him perforce to sense and from sense to thought. (See article on Logic.) It is a substitution of will for evidence as ground of assent, and a neglect of our consciousness that we often believe against our will (*e.g.*, that we must die), often without even an impulse to believe, often without taking any interest, or when taking interest in something else of no importance. "The Dean is dead (Pray, what is trumps?)." Yet many psychologists accept the universality of this will to believe, and among them James, who says that "it is far too little recognized how entirely the intellect is built up of practical interests." We should rather say "far too much." Wundt, however, goes still farther. According to him, that which acts in all organisms, that which acts in all thinking, that which divides unitary experience into subject and object, the source of self-consciousness, the unity of our mental life, the most proper being of the individual subject, is will (*das eigenste Sein des einzelnen Subjectes das Wollen ist*). In short, his whole voluntarism means that, while the inorganic world is mere object, all organization is congealed will, and all thinking is apperceptive will. But it must be remembered that these conclusions are arrived at by confusing action, reaction, life, excitability, impulse, and rational desire, all under the one word "will," as well as by omitting the involuntary action of intelligence under the pressure of evidence. Nothing is gained by obliterating the distinctions between physical agency of which vegetative excitability and reflex action are instances, instinctive action from feeling, and voluntary action of will from reason and desire of end. It may well be that impulsive feeling is the beginning of mind; but then the order of mind is feeling, sense, inference, will, which instead of first is last, and implies the others. To proceed, however, with voluntarism, Wundt, as we have seen, makes personality turn on will. He does not accept the universal voluntarism of Schopenhauer and Hartmann, but believes in individual wills, and a gradation of wills, in the organic world. The protozoon, he says, has "will-impulses" in its parts, as well as in the whole organism. Similarly, he supposes, our personal individual will is a collective will containing simpler will-unities, and he thinks that this conclusion is proved by the continuance of actions in animals after parts of the brain have been removed. In a similar way, he supposes, our wills are included in the collective will of society. He does not, however, think with Schuppe that there is one common consciousness, but only that there is a collective consciousness and a collective will; not perceiving that then the sun, in his view a mere object in the experience of every member of the collection, would be only a collective sun. Lastly, he believes that reason forms the "ideal" of God as world-will, though without proof of existence. On the whole, his voluntarism, though like that of Schopenhauer and Hartmann, is not the same; not Schopenhauer's, because the ideating will of Wundt's philosophy is not a universal irrational will; and not Hartmann's, because, although ideating will, according to Wundt's phenomenalism, is supposed to extend through the world of organisms, the whole inorganic world remains a mere object of unitary experience. His third position is his actualistic theory of soul, which need not detain us, as he shares it with Fichte, Hegel, Fechner, and Paulsen. When Fichte had rejected the Kantian soul in itself and developed the Kantian activity of apperception, he considered that soul consists in constructive activity. Fechner added that the soul is the whole unitary spiritual process manifested in the whole unitary bodily process without being a substance. Wundt accepts Fichte's theory of the actuality, and Fechner's synechological view, of the soul. Taking substance entirely in the sense of substrate, he argues that there is no evidence of a substantial substrate beneath mental operations; that there is nothing except unitary experience consisting of ideas, feelings, volitions, and their unity of will; and that soul in short is not *substantia*, but *actus*. He does not see that this unity is only apparent, for men think not always, and will not always. Nor does he see that a man is conscious not of idea, feeling, will, experience, but of something conceiving, feeling, willing, and experiencing, which he gradually learns to call himself, and that he is never conscious of doing all this "minding" without his body. If, then, these mental operations were merely actuality, they would be actuality of a man's bodily substance. In truth, there is no sound answer to Materialism, except that, besides bodily substance, psychical substance is also necessary to explain how man performs mental actualities consciously (see *Physical Realism*, ch. v.). Wundt, however, has satisfied himself, like Fechner, that there is no real opposition of body and soul, and concludes, in accordance with his own phenomenalism, that his body is only an object abstracted from his unitary experience, which is all that really is of him. Hence his fourth point is his psychological theory of parallelism of physical and psychical reduced to identity in unitary experience. Here his philosophy is Fechnerism phenomenalized. He delivered a well-deserved encomium on Fechner's experimental psychology at his master's grave. He accepts Fechner's extension of Weber's law of the external stimuli of sense, while judiciously remarking that "the physiological interpretation is entirely hypothetical." He accepts psychophysical parallelism in the sense that every psychical process has a physical accompaniment, every physiological function has a psychical meaning, but neither external stimulus nor physiological stimulus is cause of a psychical process, nor *vice versa*. Precisely like Fechner, he holds that there is a physical causality and energy, and there is a psychical causality and energy, parallels which never meet. He uses this psychical causality to carry out his voluntarism into detail, regarding it as an agency of will directed to ends, causing association and understanding, and further acting on a principle which he calls the heterogony of ends; remarking very truly that each particular will is directed to particular ends, but that beyond these ends effects follow as unexpected consequences, and that this heterogony produces social effects, which we call custom. But while thus sharply distinguishing the physical and the psychical in appearance, he follows Fechner in identifying them in reality; except that Fechner's identification is noumenal, Wundt's phenomenal. Wundt does not allow that we know beyond experience any souls of earth, or any other inorganic being. He does not, therefore, allow that there is a universal series of physical and psychical parallels. According to his phenomenalism, the external stimulus and the physiological stimulus are both parallels of the same psychical process; the external body, as well as my body, is merely an object abstracted from an idea of my experience; and what is really known in every case is a unitary experience divisible, but not separable, into body and soul, physical and psychical factors of one and the same unitary experience. Wundt is confined by his starting-point to his deduction that what we know is mental phenomena, ideas regarded as objects and subjects of experience.

With these four positions in hand, Wundt's philosophy consecutively follows, beginning with his psychology. I am conscious of having sensations of pressure between the members of my body, and of inferring similar pressures between my body and external bodies, and between external bodies themselves. I am conscious of having other sensations of heat, colour, sound, odour, flavour, and of inferring that the same external body, *e.g.*, an orange, which causes in me sensible pressure, causes in me these other sensible effects. I am conscious that I never perceive any of these sensible objects except as enduring temporally, or any pressure or colour except as extended spatially; and that I feel triply-extended pressure, as when I suck my tongue or clench my fist. I am conscious that I infer distinct triply-extended bodies, *e.g.*, an orange. I am not conscious of fusing my sensations and ideas into a compound object. I am conscious that I have acquired a habit of confusing my sensations, ideas, inferences; but that I can distinguish them by consciousness. In defiance of these conscious facts Wundt constructs his psychology. He begins with psychical elements, sensations and feelings, but he asserts that these always exist in a psychical compound, from which they can be discovered only by analysis and abstraction; and his paradox that "*a pure sensation is an abstraction*" is repeated by W. James. Further, Wundt declares that the psychical compound of sensations, with which, according to him, we actually start, is not a complex sensation, but a compound idea; so that I am expected to believe that, when I hear the chord of D, I am not conscious of single sensations of D, F, A, and have only a compound idea of the chord—as if the hearing of music were merely a series of ideas! Wundt, however, has a reason for substituting compound idea for sensation: he accepts Lotze's hypothesis of local signs, and adds a hypothesis of temporal signs. He supposes that we have no sensations of space and time, as the nativists suppose, but that, while local signs give us spatial ideas, feelings of expectation are temporal signs giving us temporal ideas, and that these ideas enter into the psychical compound, which is our actual starting-point. It follows that every psychical compound into which temporal and spatial ideas enter must itself be an idea; and, as time at any rate accompanies all our sensations, it follows that every psychical compound of sensations, containing, as it does, always temporal, if not also spatial, ideas, must be a compound idea, and not, as nativists suppose, Schuppe for instance, a compound sensation. The next question is, how compounded? Wundt's answer is that inner impulse will, in the form of passive apperception, forms compound ideas by association; so that all these operations are necessary to the starting-point. He prefixes to the ordinary associations, which descend from Hume, an association which he calls fusion (*Verschmelzung*), and supposes that it is a fundamental process of fusing sensations with spatial and temporal ideas into a compound idea. But he also recognizes association by similarity, or assimilation, or "apperception" in Herbart's more confined sense of the word, and association by contiguity, or complication. Recognizing, then, three kinds of association in all, he supposes that they are the first processes, by which inner will, in the form of passive apperception, generates ideas from sense. So far his psychology is a further development of Hume's. But he does not agree with Hume that mind is nothing but sensations, ideas, and associations, but with Kant, that there are higher combinations. According to him, inner decisive will, rising to active apperception, proceeds to what he calls "apperceptive combinations" (*Apperceptionverbindungen*); first to simple combinations of relating and comparing, and then to complex combinations of synthesis and analysis in imagination and understanding; in consequence of which synthesis issues in an aggregate idea (*Gesammtvorstellung*), and then at last analysis, by dividing an aggregate idea into subject and predicate, forms a judgment. For a criticism of this extraordinary theory of judgment we may refer to the article on LOGIC. At present the main point is that, if it were true, we should be for ever confined to a jumble of ideas. Wundt, indeed, is aware of the consequences. If judgment is an analysis of an aggregate idea into subject and predicate, it follows, as he says, that "as judgment is an *immediate*, so is inference a *mediate*, reference of the members of any aggregate of ideas to one another" (*System der Philosophie*, 66, first ed.). He cannot allow any inference of things beyond ideas. His psychology poisons his logic.

In his logic, and especially in his epistemology, Wundt appears as a mediator between Hume and Kant, but with more leaning to the latter. While he regards association as lying at the basis of all knowledge, he does not think it sufficient, and objects to Hume that he does not account for necessity, nor for substance and causation as known in the sciences. He accepts on the whole the system of synthetic understanding which Kant superimposed on mere association. He agrees with Kant about the spontaneous activity of apperception, which he develops into inner will to think. Unlike Hume, but like Kant, he distinguishes between an idea and a judgment so far as the latter involves a bifurcation into subject and predicate; and consequently he regards the processes by which we form judgments as not passive associations of ideas but active synthesis and analysis. Once more, he agrees with Kant that the function of understanding consists in "the interpretation of experience by its arrangement under common notions." He does not think that all these notions are empirical, or contained in the primary ideas of unitary experience, or in the object of idea (*Vorstellungsobject*) in which idea and object are as yet undistinguished. Yet he will not proceed to the length of Kant's transcendentalism, but says that "an *à-priority* of forms of intuition and notion in the Kantian sense cannot be rightly maintained" (*System*, 202). Between Hume's *à posteriori* and Kant's *à priori* hypothesis, he proposes a *logical* theory of the origin of notions beyond experience. He explains that the arrangement of facts requires "general supplementary notions (*Hülfsbegriffe*), which are not contained in experience itself, but are gained by a process of logical treatment of this experience." Of these supplementary notions he holds that the most general is that of causality, coming from the necessity of thought that all our experiences shall be arranged according to ground and consequent. That sense only gives to experience coexistences and sequences of appearances, as Hume said and Kant allowed, is also Wundt's starting-point. How then do we arrive at causality? Not, says Wundt, by association, as Hume said, but by thinking; not, however, by *à priori* thinking, as Kant said, but by logical thinking, by applying the logical principle of ground and consequent (which Leibnitz had called the principle of sufficient reason) as a causal law to empirical appearances. Now, Wundt is aware that this is not always possible, for he holds that the logical principle of ground belongs generally to the connexion of thoughts, the causal law to the combination of empirical appearances. Nevertheless he believes that, when we can apply measures to the combination of empirical appearances, then we can apply the logical principle as causal law to this combination, and say that one appearance is the cause of another, thus adding a notion of causality not contained in the actual observations, but specializing the general notion of causality. He quotes as an instance that Newton in this way added to the planetary appearances contained in Kepler's laws the gravitation of the planets to the sun, as a notion of causality not contained in the appearances, and thus discovered that gravitation is the cause of the appearances. But Newton had already discovered beforehand in the mechanics of terrestrial bodies that gravitation constantly causes similar facts on the earth, and did not derive that cause from any logical ground beyond experience, any more than he did the third law of motion. Wundt does not realize that, though we can often use a cause or real ground (*principium essendi*) as a logical ground (*principium cognoscendi*), for deducing effects, we can do so only when we have previously inferred from experience that that kind of cause does produce that kind of effect (see article on LOGIC). Otherwise, logical ground remains logical ground, as in any non-causal syllogism, such as the familiar one from "All men are mortal," which causes me to know that I shall die, without telling me the cause of death. Wundt, however, having satisfied himself of the power of mere logical thought beyond experience, goes on to further apply his hypothesis, and supposes that, in dealing with the physical world, logical thinking having added to experience the "supplementary notion" of causality as the connexion of appearances which vary together, adds also the "supplementary notion" of substance as substratum of the connected appearances. But, using substance as he does always in the Kantian sense of permanent substratum beneath changing phenomena, and never in the Aristotelian sense of any distinct thing, he proceeds to make distinctions between the applications of causality and of substance. Even in the physical, he confines substance to matter, or what Aristotle would call material causes, thus makes its power to be merely passive, and limits substantial causality to potential energy, while he supposes that actual causality is a relation not of substances but of events. On this false abstraction Sigwart has made an excellent criticism in an appendix at the end of his *Logic*, where he remarks that we cannot isolate events from the substances of which they are attributes. Motions do not cause motions; one body moving causes another body to move: what we know is causal substances. Secondly, when Wundt comes to the psychical, he naturally infers from his narrow Kantian definition of substance that there is no proof of a substrate over and above all mental operations, and falsely thinks that he has proved that there is no substance mentally operating in the Aristotelian sense. Thirdly, on the grounds that logical thinking adds the notion of substance, as substrate, to experience of the physical, but not of the psychical, and that the most proper being of mind is will, he concludes that wills are not active substances, but substance-generating activities ("nicht thätige Substanzen sondern substanzerzeugende Thätigkeiten," *System*, 429).

What kind of metaphysics, then, follows from this compound of psychology and epistemology? As with Kant against Hume, so with Wundt against Mach and Avenarius, the world we know will contain something more than mere complexes of sensations, more than pure experience: with Wundt it will be a world of real causes and some substances, constituted partly by experience and partly by logical thinking, or active inner will. But as with Kant, so with Wundt, this world will be only the richer, not the wider, for these notions of understanding; because they are only contributed to the original experience, and, being mentally contributed, only the more surely confine knowledge to experience of mental phenomena. Hence, according to Wundt, the world we know is still unitary experience, distinguished, not separated, into subject and object, aggregates of ideas analysed by judgment and combined by inference, an object of idea elaborated into causes and substances by logical thinking, at most a world of our ideas composed out of our sensations, and arranged under our categories of our understanding by our inner wills, or a world of our ideating wills; but nothing else. It is Wundt's own statement of his solution of the epistemological problem "that on the one hand the whole outer world exists for us only in our ideas, and that on the other hand a consciousness without objects of idea is an empty abstraction which possesses no actuality"

(*System*, 212–213). There remains his theory of reason. His pupil, O. Külpe, who bases his *Grundriss der Psychologie* on the hypothesis of unitary experience, says in his *Einleitung in die Philosophie* (1895) that Wundt in his *System* derives the right of metaphysics to transcend experience from similar procedure within the limits of the special sciences. This is Wundt's view, but only in the sense that reason passes from ideas to "ideals," whether in the special sciences or in metaphysics. Reason, as in most modern psychologies and idealisms, is introduced by Wundt, after all sorts of operations, too late; and, when at length introduced, it is described as going beyond ideas and notions to "ideals" (*Ideen*), as an ideal continuation of series of thoughts beyond given experience —nothing more. Reason, according to Wundt, is like pure reason according to Kant; except that Wundt, receiving Kantism through Neo-Kantism, thinks that reason arrives at "ideals" not *à priori*, but by the logical process of ground and consequent, and, having abolished the thing in itself, will not follow Kant in his inconsequent passage from pure to practical reason in order to postulate a reality corresponding to "ideals" beyond experience. Wundt, in fact, agrees with Lange that reason transcends experience of phenomena only to conceive "ideals." This being so, he finds in mathematics two kinds of transcendence—real, where the transcendent, though not actual in experience, can become partly so, *e.g.*, the divisibility of magnitudes; imaginary, where it cannot, *e.g.*, *n*-dimensions. He supposes in metaphysics the same transcendence in forming cosmological, psychological, and ontological "ideals." He supposes real as well as imaginary transcendence in cosmological "ideals"; the former as to the forms of space and time, the latter as to content, *e.g.*, atoms. But he limits psychological and ontological "ideals" entirely to imaginary transcendence ("die psychologischen und ontologischen Ideen dagegen fallen ganz und gar dem Gebiet imaginärer Transcendez zu"). The result is that he confines metaphysical transcendence to "a process into the imaginary" as regards the substantial and causal content of cosmological "ideals," and altogether as regards psychological and ontological "ideals." Thus, according to him, in the first place reason forms a cosmological "ideal" of a multitude of simple units related; secondly, it forms a psychological "ideal" of a multitude of wills, or substance-generating activities, which communicate with one another by ideas so that will causes ideas in will, while together they constitute a collective will, and it goes on to form the moral ideal of humanity (*das sittliche Menschheitsideal*); and thirdly, it forms an ontological "ideal" of God as ground of this moral "ideal," and therewith of all being as means to this end, and an "ideal" of God as world-will, of which the world is development, and in which individual wills participate each in its sphere. "Herein," says Wundt, "consists the imperishable truth of the Kantian proposition that the moral order of the world is the single real proof of the existence of God" (*System*, 405, cf. 439). "Only," he adds, "the expression *proof* is here not admissible. Rational 'ideals' are in general not provable." As the same limit is applied by him to all transcendent rational "ideals," and especially to those which refer to the content of the notion of the world, and, like all psychological and ontological "ideals," belong to the imaginary transcendent, his conclusion is that reason, in transcending experience, logically conceives "ideals," but never logically infers corresponding realities. He contends, indeed, that at least the moral "ideal" of humanity and the ontological "ideal" of God are universally valid, and that therefore reason alone can give an account of them. But what account? "While in this way philosophical inquiry exhibits the ground of their universal validity, it indicates at the same time the 'ideals' themselves as *necessary*. To contribute more it is neither called nor capable. Especially must it completely abstain from exhibiting besides that necessity of the '*ideal*' also the necessity of a *reality* corresponding to the idea. Philosophy can prove the necessity of faith; to convert it into knowledge is beyond its power." These are the concluding words of the part of his *System der Philosophie* (1889) which deals with metaphysics.

The conclusion that reason in transcending experience can show no more than the necessity of "ideals" is the only conclusion which could follow from Wundt's phenomenalism in psychology, logic, and epistemology. If knowledge is experience of ideas distinguished by inner will of apperception into subject and object in inseparable connexion, if the starting-point is ideas, if judgment is analysis of an aggregate idea, if inference is a mediate reference of the members of an aggregate of ideas to one another, then, as Wundt says, all we can know, and all reason can logically infer from such data, is in our ideas, and consciousness without an object of idea is an abstraction; so that reason, in transcending experience, can show the necessity of ideas and "ideals," but infer no corresponding reality beyond, whether in Nature, or in Man, or in God. Wundt, starting from a psychology of unitary experience, deduces a consistent metaphysics of no inference of things transcending experience throughout,—or rather until he comes to the very last sentence quoted above, when he suddenly passes from a necessity of "ideals" (*Ideen*), to a necessity of "faith" (*Glauben*), without "knowledge" (*Wissen*). He forgets apparently that faith is a belief in things beyond ideas and ideals, which is impossible on his psychology of judgment and logic of inference. The fact is that his *System* may easily seem to prove more than it does. He describes it as idealism in the form of ideal realism, because it recognizes an ideating will requiring substance as substratum or matter for outer relations of phenomena. But when we look for the evidence of any such will beyond ourselves and our experience, we find Wundt offering nothing but an ontological "ideal" of reason, and a moral "ideal" requiring a religious "ideal," but without any power of inferring a corresponding reality. The *System* then ends with the necessity of an "ideal" of God as world-will, but provides no ground for the necessity of any belief whatever in the being of God, or indeed in any being at all beyond our own unitary experience.

Wundt, however, has since written an *Einleitung in die Philosophie* (1901), in which he speaks of realism in the form of ideal realism as the philosophy of the future. It is not to be idealism which resolves everything into spirit, but realism which gives the spiritual and the material each its own place in harmony with scientific consciousness. It is not to be dualistic but monistic realism, because matter is not separate from spirit. It is not to be materialistic but ideal realism, because the physical and the psychical are inseparable parallels inexplicable by one another. It is to be monistic ideal realism, like that of Fichte and Hegel; not, however, like theirs idealistic in method, a *Phantastisches Begriffsgebäude*, but realistic in method, a *Wissenschaftliche Philosophie*. It is to be ideal realism, as in the *System*. It is not to be a species of idealism, as in the *System*,—but of realism. How are we to understand this change of front? We can only explain it by supposing that Wundt wishes to believe that, beyond the "ideal," there really is *proof* of a transcendent, ideating, substance-generating will of God; and that he is approaching the noumenal voluntarism of his younger contemporary, Paulsen. But to make such a conversion from phenomenalism plausible, it is necessary to be silent about his whole psychology, logic, and epistemology, and the consequent limitation of knowledge to experience, and of reason to ideas and "ideals," without any power of inferring corresponding things.

What a pity it is that Wundt had committed himself by his psychology to phenomenalism, to unitary experience, and to the limitation of judgment and reason to ideas and "ideals"! For his phenomenalism prevents him from consistently saying the truth inferred by reason, that there is a world beyond experience, a world of Nature, and a will of God, real as well as ideal. To understand Wundt is to discover what a mess modern psychology has made of metaphysics. To understand phenomenal idealism in Germany is to discover what a narrow world is to be known from the transcendental idealism of Kant shorn of Kant's inconsistencies. To understand noumenal idealism in Germany and the rise of metaphysical idealism in modern times is to discover that psychological is the origin of all metaphysical idealism. If we perceive only what is mental, all that we know is only mental. But who has proved that psychological starting-point? Who has proved that, when I scent an odour in my nostrils, I apprehend not odour but a sensation of odour; that when I taste a flavour in my mouth, I apprehend not flavour but a sensation of flavour; that, when I hear a sound in my ears, I apprehend not sound but a sensation of sound; that, when I see a colour in my eyes, I apprehend not colour but a sensation of colour; that, when I feel a pressure and heat in my body, I apprehend not pressure and heat but a sensation of pressure and of heat? Sensation, as Aristotle said, is not of itself: it is the apprehension of a sensible object in the organism. I perceive pressure, heat, colour, sound, flavour, odour, in my five senses. Having felt reciprocal pressures in touch, I infer similar pressures between myself and the external world.

§ 6. Recent English Idealism.

(1) *The Followers of Hume's Phenomenalism.*—Compared with the great systems of the Germans, English idealism in the 19th century shows but little originality. It has been largely borrowed either from previous English or from later German idealism, and what originality it has possessed has been mainly shown in that spirit of eclectic compromise which is so dear to the English mind. The predominant influence, on the whole, has been the phenomenalism of Hume, with its slender store of sensations, ideas, and associations, and its conclusion that all we know is sensations without any known thinkers or any other known things. This phenomenalism was developed by James Mill (1773–1836) and J. S. Mill (1806–1873), and has since been continued by A. Bain. It also became the basis of the philosophies of Huxley and of Spencer on their phenomenalistic side. It is true that Spencer's "transfigured realism" contains much that was not dreamt of by Hume. Spencer widens the empirical theory of the origin of knowledge by his brilliant hypothesis of inherited organized tendencies, which has influenced all later psychology and epistemology, and tends to a kind of compromise between Hume and Kant. He describes his belief in an unknowable absolute as "carrying a step farther the doctrine put into shape by Hamilton and Mansel." He develops this belief in an absolute in connexion with his own theory of evolution into something different both from the idealism of Hume and the realism of Hamilton, and rather falling under the head of materialism. Nevertheless, as he believes all the time that everything knowable throughout the whole world of evolution is phenomena in the sense of subjective affections of consciousness, and as he applies Hume's distinction of impressions and ideas as a distinction of vivid and faint states of consciousness to the distinction of ego and non-ego, spirit and matter, inner and outer phenomena, his philosophy of the world as knowable remains within the limits of phenomenalism. Nothing could be more like Hume than his final statement that what we are conscious of is subjective affections produced by objective agencies unknown and unknowable. The "anti-realism," which takes the lion's share in "transfigured realism," is simply a development of the phenomenalism of Hume. Hume was also at the bottom of the philosophies of G. H. Lewes, who held that there is nothing but feelings, and of W. K. Clifford. Nor is Hume yet dethroned, as we see from the works of Karl Pearson and of William James, who, though an American, is exercising a considerable influence on English thought. The most flourishing time of phenomenalism, however, was during the lifetime of J. S. Mill. It was counteracted to some extent by the study at the universities of the deductive logic of Aristotle and the inductive logic of Bacon, by parts of Mill's own logic, and by the natural realism of Reid, Stewart, and Hamilton, which met Hume's scepticism by asserting a direct perception of the external world. But natural realism, as finally interpreted by Hamilton, was too dogmatic, too unsystematic, and too confused with elements derived from Kantian idealism to withstand the brilliant criticism of Mill's *Examination of Sir William Hamilton's Philosophy* (1865), a work which for a time almost persuaded us that Nature as we know it from sensations is nothing but permanent possibilities of sensation, and oneself only a series of states of consciousness.

(2) *The Influence of Kant and Hegel.*—Nevertheless, there have never been wanting more soaring spirits who, shocked at the narrowness of the popular phenomenalism of Hume, have tried to find a wider idealism. They have, as a rule, sought it in Germany. Before the beginning of the 19th century, Kant had made his way to England in a translation of some of his works, and in an account of the *Elements of the Critical Philosophy* by A. F. M. Willich, both published in 1798. After a period of struggle, the influence of Kant gradually extended, and, as we see in the writings of Coleridge and Carlyle, of Hamilton and Mansel, of Green and Caird, of Laurie and Martineau, has secured an authority over English thought almost equal to that of Hume, with whom, indeed, Kant had much in common. Both philosophers appeal to the English love of experience, and Kant had these advantages over Hume, that within the narrow circle of sensible phenomena his theory of understanding gave to experience a fuller content, and that beyond phenomena, however inconsistently, his theory of reason postulated the reality of God, freedom, and immortality. Other and wider German philosophies gradually followed that of Kant to England. Coleridge (1772–1834) not only called attention to Kant's distinction between understanding and reason, but also introduced his countrymen to the noumenal idealism of Schelling. In the *Biographia Literaria* (1817) he says that in Schelling's *Naturphilosophie* and *System des transcendentalen Idealismus* he first found a general coincidence with much that he had toiled out for himself, and he repeated some of the main tenets of Schelling. Carlyle (1795–1881) laid more emphasis on Fichte. At the height of his career, when between 1840 and 1850 many of Fichte's works were being translated in the Catholic Series, he called attention to Fichte's later view that all earthly things are but as a vesture or appearance under which the Divine idea of the world is the reality. Extravagant as this noumenalism is, it was a healthy antidote to the phenomenalism of the day. Not

long afterwards, J. F. Ferrier (1808–1864) published his *Institutes of Metaphysics* (1854). Ferrier held a theory that reality is "thing-mecum," or object *plus* subject, which reminds us of Fichte and his successors. The key to his metaphysics is that, starting from Hamilton's theory that what we know is always the ego and the non-ego in inseparable connexion, he also imbibed Hamilton's love of historical research, and affected by the Germans through Hamilton, gradually deserted his master. Thus he did not agree with Hamilton, but with Schelling, about the absolute. Schelling asserted that we know the absolute by an intellectual intuition which we have in common with it, Hamilton that by the constitution of our faculties we know only the conditioned. Ferrier perceived that the victory is with Schelling, if there is a common intelligence, and not only accepted this condition, but also founded his lectures on Greek philosophy on the assumption that absolute truth is truth for this universal intelligence, and that the object of philosophy is to find this absolute truth. Ferrier then ended with the hypothesis of Schelling and Hegel that there is one absolute intelligence (see Ferrier, *Lectures and Philosophical Remains*, 1866, i. 1–33; ii. 545–68). In 1865 his compatriot J. Hutchison Stirling published *The Secret of Hegel*. While the Scottish philosophers were thus passing from natural realism to the noumenal idealism of Schelling and Hegel, B. Jowett (1817–1893), then tutor of Balliol College, Oxford, had been studying the philosophy of Hegel, as we learn from his *Life* by Campbell and Abbott (i. 90–92). Throughout his life he continued to admire the flashes which illuminate the obscurity, and the habit of looking at both sides of the question which palliates the confusion, of the Hegelian writings. But, being a man endowed with much love of truth but with little belief in first principles, he was too wise to take for a principle Hegel's assumption that different things are the same. He had, however, sown seeds in the minds of two distinguished pupils, T. H. Green and E. Caird, the present Master of Balliol. Both proceeded to take Hegelianism seriously, and between them spread a kind of Hegelian orthodoxy in metaphysics and in theology throughout Great Britain. Green (1836–1882) in his lectures, delivered as professor of moral philosophy at Oxford, and posthumously published under the title of *Prolegomena to Ethics* (1883), tried to effect a harmony of Kant and Hegel by proceeding from the epistemology of the former to the metaphysics of the latter. Taking for granted the Kantian hypothesis of a sense of sensations requiring synthesis by understanding, and the Kantian conclusion that Nature as known consists of phenomena united by categories as objects of experience, Green argued, in accordance with Kant's first position, that knowledge, in order to unite the manifold of sensations by relations into related phenomena, requires unifying intelligence, or what Kant called synthetic unity of apperception, which cannot itself be sensation, because it arranges sensations; and he argued, in accordance with Kant's second position, that therefore Nature itself as known requires unifying intelligence to constitute the relations of its phenomena, and to make it a connected world of experience. When Green said that "Nature is the system of related appearances, and related appearances are impossible apart from the action of an intelligence," he was speaking as a pure Kantian, who could be answered only by the Aristotelian position that Nature consists of related bodies beyond appearances, and by the realistic supposition that there is a tactile sense of related bodies, of the inter-resisting members of the organism, from which reason infers similar related bodies beyond sense. But now, whatever opinion we may have about Nature, at all events, as Green saw, it does not come into existence in the process by which this person or that begins to think. Nature is not my nature, nor your nature, but one. Everything in it is one; the sun is not lit up every time a man looks at it, as Hume would make us suppose. From this fact of the unity of Nature and of everything in Nature, combined with the two previous positions accepted, not from Nature, but from Kant, Green proceeded to argue, altogether beyond Kant, that Nature, being one, and also requiring unifying intelligence, requires one intelligence, an eternal intelligence, a single spiritual principle, prior to, and the condition of, our individual knowledge. According to him, therefore, Nature is one system of phenomena united by relations as objects of experience, one system of related appearances, one system of one eternal intelligence which reproduces itself in us. The "true account" of the world in his own words is "that the concrete whole, which may be described indifferently as an eternal intelligence realized in the related facts of the world, or as a system of related facts rendered possible by such an intelligence, partially and gradually reproduces itself in us, communicating piecemeal, but in inseparable correlation, understanding and the facts understood, experience and the experienced world." Nobody can mistake the Schellingian and Hegelian nature of this conclusion, which had already been imported into Great Britain by Ferrier, and which, as it became Green's, so is now in its essence Caird's metaphysics. It is the Hegelian view that the world is a system of absolute reason. But it is not a Kantian view; and it is necessary to correct two confusions of Kant and Hegel, which have been imported with Hegelianism by Green and Caird. Ferrier was aware that in Kant's system "there is no common nature in all intelligence" (*Lectures*, ii. 568). Green, on the other hand, in deducing his own conclusion that the world is, or is a system of, one eternal intelligence, incautiously put it forward as "what may be called broadly the Kantian view" (*Prolegomena*, § 36), and added that he follows Kant "in maintaining that a single active conscious principle, by whatever name it be called, is necessary to constitute such a world, as the condition under which alone phenomena, *i.e.*, appearances to consciousness, can be related to each other in a single universe" (§ 38). He admitted, however, that Kant also asserted, beyond this single universe of a single principle, a world of unknowable things in themselves, which is a Kantian not a Hegelian world. But Caird has since endeavoured to break down even this second barrier between Kant and Hegel. According to Caird, Kant "reduces the inaccessible thing in itself (which he at first speaks of as affecting our sensibility) to a noumenon which is projected by reason itself" (Caird, *Essays*, ii. 405); and in the Transcendental Dialectic, which forms the last part of Kant's *Kritik*, the noumenon becomes the object of an intuitive understanding "whose thought," says Caird, "is one with the existence of the objects it knows" (*ib.* 412, 413). Kant, then, as interpreted by English Hegelians, already believed, before Hegel, that there is one intelligence common to all individuals, and that a noumenon is a thought of this common intelligence, "an ideal of reason"; so that Kant was trying to be a Hegelian, holding that the world has no being beyond the thoughts of one intelligence. But history repeats itself; and these same two interpretations of Kant had already been made in the lifetime of Kant by Fichte. In 1797 Fichte published two Introductions to the *Wissenschaftslehre* in his *Philosophical Journal*. In the first he said, "My system is no other than the Kantian." In the second he admitted that the Kantians, and Kant himself, "assert the contrary," but contended that really the two systems are the same, and that in two respects. By the pure unity of apperception Kant meant, according to Fichte, "not the consciousness of our individuality," but "the notion of the *pure ego* exactly as the *Science of Knowledge* puts it." Secondly, by the thing in itself Kant, according to Fichte, meant a noumenon, and by a noumenon something "which arises only through our thinking." These are the very two views imputed to Kant by Green and Caird. Now, the curious fact is, that two years after Fichte had published these two interpretations, Kant himself wrote a most indignant letter, dated 7th August 1799, and published in the *Intelligenzblatt der Allgem. Literatur-Zeit.* v. J., 1799, No. 109 (*Kant's Werke*, ed. Hartenstein, viii. 600–601), on purpose to repudiate all connexion with Fichte. Fichte's *Wissenchaftslehre*, he said, is a completely untenable system, and a metaphysics of fruitless *apices*, in which he disclaimed any participation; his own *Kritik* he refused to regard as a propœdeutic to be construed by the Fichtian or any other standpoint, declaring that it is to be understood according to the letter; and he went so far as to assert that his own critical philosophy is so satisfactory to the reason, theoretical and practical, as to be incapable of improvement, and for all future ages indispensable for the highest ends of humanity. After this letter, it cannot be doubted that Kant not only differed wholly from Fichte, both about the synthetic unity of apperception and about the thing in itself, but also is to be construed literally throughout. When he said that the act of consciousness, "I think," is *in allem Bewusstsein ein und dasselbe*, he meant, as the whole context shows, not that it is one in all thinkers, but only that it accompanies all my other ideas and is one and the same in all my consciousness, while it is different in different thinkers. Though again in the Transcendental Dialectic he spoke of pure reason conceiving "ideals" of noumena, he did not mean that a noumenon is nothing but a thought arising only through thinking, or projected by reason, but meant that pure reason can only conceive the "ideal," while, over and above the "ideal" of pure reason, a noumenon is a real thing, a thing in itself, which is not indeed known, but whose existence is postulated by practical reason in the three instances of God, freedom, and immortality. Consequently Kant's explanation of the unity of a thing is that there is always one thing in itself causing in us many phenomena, which as understood by us are objectively valid for all our consciousnesses. What Kant never said, and what his whole philosophy prevented his saying, was that a single thing is a single thought of a single consciousness; either of men, as in Fichte's philosophy, or of God and man, as in Hegel's. The passage from Kant to Hegel attempted by Green, and the harmony of Kant and Hegel attempted by Green and Caird, are unhistorical, and have caused much confusion of thought. The success, therefore, of the works of Green and Caird must stand or fall by their Hegelianism, which has indeed secured many adherents, partly metaphysical and partly theological. Among the former we may mention W. Wallace, the translator of most of Hegel's *Encyklopädie*, who had previously learnt Hegelianism from Ferrier; W. H. Fairbrother, who has written a faithful account of *The Philosophy of Thomas Hill Green* (1896); R. L. Nettleship, D. G. Ritchie, J. H. Muirhead, J. S. Mackenzie, and J. M. E. M'Taggart, who closes his acute *Studies in Hegelian Cosmology* (1901) with "the possibility of finding, above all knowledge and volition, one all-embracing unity, which is only not true, only not good, because all truth and all goodness are but distorted shadows of its absolute perfection—'das Unbegreifliche, weil es der Begriff selbst ist.'"

There are still to be mentioned two English Hegelians, who have not confused Kant and Hegel as Green did; namely, S. S. Laurie, who attempts to discover a new passage from Kant to Hegel, and F. H. Bradley, who builds a more independent system on the Hegelian assumption that contradictions are capable of being reconciled in a higher unity. Laurie is the author of *Metaphysica Nova et Vetusta, a Return to Dualism*, by Scotus Novanticus, 1884; 2nd edition, enlarged, 1889. His attitude to Green is expressed towards the end of his book, where he says, "The more recent argument for God, which resolves itself into the necessity of a self-distinguishing one basis to which Nature as a mere system of relations must be referred, is simply the old argument of the necessity for a First Cause dressed up in new clothes Not by any means an argument to be despised, but stopping short of the truth through an inadequate analytic of knowledge." His aim is to remedy this defect by psychology, under the conviction that a true metaphysics is at bottom psychology, and a true psychology fundamentally metaphysics. His psychology is founded on a proposed distinction between "attuition" and reason. His theory of "attuition," by which he supposes that we become conscious of objects outside ourselves, is his "return to dualism," and is indeed so like natural realism as to suggest that, like Ferrier, he starts from Hamilton to end in Hegel. As, however, he does not suppose that we have a direct perception of something resisting the organism, such as Hamilton maintained, it becomes necessary to explain exactly what he means by "attuition." It is, according to him, something more than sensation, but less than perception; it is common to us with lower animals such as dogs; its operation consists in co-ordinating sensations into an aggregate which the subject throws back into space, and thereby has a consciousness of a total object outside itself, *e.g.*, a stone or a stick, a man or a moon. He carries its operation before reason still farther, supposing that "attuition" makes particular inferences about outside objects, and that a man, or a dog, through association "attuites" sequence and invariableness of succession, and, in fact, gets as far in the direction of causation as Hume thought it possible to go at all. Laurie's view is that "attuition," and a dog who has no higher faculty, can go no farther; but that a man goes farther by reason. He thinks that "attuition" gives us consciousness of an object, but without knowledge, and that knowledge begins with reason. His theory of reason brings him into contact with the German idealists: he accepts from Kant the hypothesis of synthesis and *à priori* categories, from Fichte the hypothesis that will is necessary to reason, from Schelling and Hegel the hypothesis of universal reason, and of an identity between the cosmic reason and the reason of man, in which he agrees also with Green and Caird. But he has a peculiar view of the powers of reason; that (1) under the law of excluded middle it states alternatives, A or B or C or D; (2) under the law of contradiction it negates B, C, D; (3) under the law of sufficient reason it says "therefore"; and (4) under the law of identity it concludes, A is A. In working out this process, he supposes that reason throws into consciousness *à priori* categories, synthetic predicates *à priori*, or, as he also calls them, "dialectic percepts." Of these the most important is cause, of which his theory, in short, is that by this *à priori* category and the process of reason we go on from sequence to consequence; first stating that an effect may be caused by several alternatives, then negating all but one, next concluding that this one as sufficient reason is cause, and finally attaining the necessity of the causal nexus by converting causality into identity, *e.g.*, instead of "Fire burns wood," putting "Fire is comburent, wood is combustible." Lastly, while he agrees with Kant about *à priori* categories, he differs about the knowledge to be got out of them. Kant, applying them only to sensations, concluded that we can know nothing beyond by their means. But Laurie, applying them to "attuitions" of objects outside, considers that, though they are "reason-born," yet they make us know the objects outside to which they are applied. This is the farthest point of his dualism, which suggests a realistic theory of knowledge, different in process from Hamilton's, but with the same result. Not so: Laurie is a Hegelian, using Kant's categories, as Hegel did, to argue that they are true not only of thoughts but of things; and for the same reason, that things and thoughts are the same. At first in his psychology he speaks of the "attuition" and the rational perception of an outside object. But in his metaphysics founded thereon he interprets the outside object to mean an object outside you and me, but not self-subsistent; not outside universal reason, but only "*Beent* reason." He quotes, with approval, Schelling's phrase, "Nature is visible Intelligence and Intelligence visible Nature." He agrees with Hegel that there are two fundamental identities, the identity of all reason, and the identity of all reason and all being. Hence, he explains, what is a duality for us is only a "quasi-duality" from a universal standpoint. In fact, his dualism is not realism, but merely the distinction of subject and object within idealism. Laurie's metaphysics is an attempt to supply a psychological propœdeutic to Hegelian metaphysics.

Bradley's *Appearance and Reality* (1893) is a more original performance. It proceeds on the opposite method of making metaphysics independent of psychology. "Metaphysics," says he, "has no direct interest in the origin of ideas" (254), and "we have nothing to do here with the psychological origin of the perception" (35). This metaphysical method, which we have already seen attempted by Lotze, is the true method, for we know more about things than about the beginnings of our knowledge. Bradley is right to go straight to reality, and right also to inquire for the absolute, in order to take care that his metaphysical view is comprehensive enough to be true of the world as a whole. He is unconsciously returning to the metaphysics of Aristotle in spirit; yet he differs from it *toto cœlo* in the letter. Let us see first what Aristotle says. Aristotelian metaphysics is the view that reality consists of natural and supernatural substances, in the sense of distinct individuals, numerically different; and that these substances, though distinct, are variously quantified, qualified, related; that two substances being related are still different, *e.g.*, father and son, and *qua* different each *per se*, self-subsistent, independent; that a thing cannot be contradictory in the sense of being and not being something at the same time and in the same respect, *e.g.*, a square circle; but that without contradiction it can be and not be at different times, or at the same time in different respects, so that a body can change from one moment to the next in the same time, and any substance can be one as a whole and many either in its attributes or in its parts; that the same thing is capable of opposites, but is not actually both at once; that the same thing can appear sweet to one man and bitter to another at the same moment or to the same man at different moments, but not to the same man at the same moment; that finally everything is either different or the same, but not both at once. This is Aristotelianism in contrast with Bradleianism in metaphysics. The moderating genius of Aristotle introduced qualifications into metaphysical propositions in order to keep them within the truth and guard them against "sophistical difficulties." By simply omitting these qualifications, Bradley constructs his metaphysics. His starting-point is the view that things as ordinarily understood, and (we may add) as Aristotle understood them, are self-contradictory, and are therefore not reality, but appearances. If they were really contradictory they would be non-existent. However, he illustrates their supposed contradictoriness by examples, such as one substance with many attributes, and motion from place to place in one time. But he fails to show that a substance is one and many in the same respect, and that motion requires a body to be in two places at the same moment of one time. There is no contradiction between a man being determined by many attributes, as rational, six-foot-high, white, and a father, and yet being one whole substance distinct from any other including his own son; nor is there any contradiction between his body being in bed at 8.15 and at breakfast at 8.45 within the same hour. Bradley's supposed contradictions are really mere differences. So far he reminds one of Herbart, who founded his "realistic" metaphysics on similar misunderstandings; except that, while Herbart concluded that the world consists of a number of simple "reals," each with a simple quality but unknown, Bradley concludes that reality is one absolute experience which harmonizes the supposed contradictions in an unknown manner. If his starting-point recalls Herbart, his method of arriving at the absolute recalls Spinoza. In his Table of Contents, chapter xiii., on the General Nature of Reality, he says, in true Spinozistic vein, "The Real is one substantially. Plurality of Reals is not possible." In the text he explains that, if there were a plurality of reals, they would have to be beings independent of each other, and yet, as a plurality, related to each other; and this again seems to him to be a contradiction. Throughout the rest of the work he often repeats that a thing which is related cannot be an independent thing. Now, if "independent" means "existing alone" and unrelated, the same thing could not be at once related and independent; and, taking substance as independent in that sense, Spinoza concluded that there could only be one substance. But this is not the sense in which a plurality of things would have to be independent in order to exist, or to be substances in the Aristotelian sense. "Independent" (*χωριστόν*), or "self-subsistent" (*καθ' αὑτό*) means "existing apart," *i.e.*, existing differently, as I am not you: it does not mean "existing alone," solitary, unrelated. This existing apart is the only sense in which a plurality of things need be independent in order to be real, or in order to be substances; and it is a sense in which they can all be related to each other, as I am not you, but I am addressing you. There is no contradiction, then, though Bradley supposes one, between a thing being an individual, independent, self-subsistent substance, existing apart as a distinct thing, and being also related to other things. Accordingly, the many things of this world are not self-discrepant, as Bradley says, but are distinct and relative substances, as Aristotle said. The argument, therefore, for one substance in Spinoza's *Ethics*, and for one absolute, the Real which is one substantially, in Bradley's *Appearances and Reality*, breaks down, so far as it is designed to prove that there is only one substance, or only one Real. Though the universe is one substance, one distinct thing, it includes many substances, many things distinct from, but related to, one another. Bradley, however, having satisfied himself, like Spinoza, by an abuse of the word "independent," that "the finite is self-discrepant," goes on to ask what the one Real, the absolute, is; and, as he passed from Herbart to Spinoza, so now he passes from Spinoza to Kant. Spinoza answered realistically that the one substance is both extended and thinking. Bradley answers idealistically that the one Real is one absolute experience, because all we know is experience. "This absolute," says he, "is experience, because that is really what we mean when we predicate or speak of anything." But in order to identify the absolute with experience, he is obliged, as he before abused the word "contradictory" and the word "independent," so now to abuse the word "experience," which he takes in a far wider sense than any philosopher before him. "Experience," says he, "may mean experience only direct, or indirect also. Direct experience I understand to be confined to the given simply, to the merely felt or presented. But indirect experience includes all fact that is constructed from the basis of the 'this' and the 'mine.' It is all that is taken to exist beyond the bare moment" (248). This is to substitute "indirect experience" for all inference, and to maintain that when, starting from any "direct experience," I infer the back of the moon, which is always turned away from me, I nevertheless have experience of it; nay, that it is experience. Having thus confused contradiction and difference, independence and solitariness, experience and inference, Bradley is able to deduce finally that reality is not different substances, experienced and inferred, as Aristotle thought it, but is one absolute super-personal experience, to which the so-called plurality of things, including all bodies, all souls, and even a personal God, is appearance—an appearance, as ordinarily understood, self-contradictory, but, as appearing to one spiritual reality, somehow reconciled. But how?

(3) *Other German Influences.*—Meanwhile, but less noticeably, other English idealists, inside and outside the dominant phenomenalism of Hume, have quarried in the rich mines of German idealism. G. H. Lewes (1817–1878) was a thorough disciple of Hume's phenomenalism in his main position, that all phenomena, objective and subjective, all we perceive, all we know, things in themselves, the absolute, all are feelings, which are felt or might be felt. He saw, moreover, how Spencer has enriched empiricism "by showing that the constant experiences of the race become *organized tendencies* which are transmitted as a heritage"; and also how he has confused empiricism by supposing with Hamilton the existence, apart from all appearances, of an absolute noumenon, which, according to Spencer, is unknowable, but, according to Lewes, "metempirical," or in other words, beyond all sense, inference, and verification, an ideal construction, not of science, but of imagination. So far Lewes was an English philosopher. At the same time a sympathetic lover of literature of all kinds, he absorbed something from French and more from German sources. Affected by the positivism of Comte in his earlier days, he retained the positivist's convictions that there is no metaphysics of a world beyond phenomena, and that psychology is a branch of biology. But he was really nearer to Mill's psychological positivism, based on the method of introspection which Comte had rejected. In his later days, when he gradually elaborated his final system in *Problems of Life and Mind* (1875–79), Lewes had fallen under the spell of Kant and his successors, and produced a compromise between Hume and Kant, which reminds us of some of the later German phenomenalisms which we have already described. He agreed with Kant, as with Hume, in limiting knowledge to experience of mental phenomena of sense. He also went beyond Hume, and developed Kant's view of understanding—according to which understanding forms conceptions which must, however, be reduced to sensory intuition in experience—into a theory of inference. Inference, according to Lewes, is an ideal construction of universal conceptions symbolical of the sensible, and requiring verification by reduction to sense; it is not concluding that there are extrasensible like sensible things. Such a theory ignores the fact that science infers not only universals but also particulars, *e.g.*, a particular eclipse, and particulars which are not always verifiable, *e.g.*, the back of the moon, a star only inferrible from a photograph, &c. But it is a theory of all the inferences which the phenomenalism of Hume could allow, or the phenomenalism of Kant when reduced to consistency. Lewes, moreover, thought that there was something even in Kant's transcendentalism; but that Kant was wrong in preferring "selbstgedachte erste Principien *à priori*" to "eingepflanzte Anlagen zum Denken," in order to vindicate a knowledge of necessity, and Spencer right in asserting inherited organized experiences. He rejected, in fact, everything in Kant's *Kritik* which savoured of the "metempirical," whether it was Kant's belief in the transcendental power of the mind to generate the *à priori*, or his belief in the transcendent existence of a noumenon. With Hegel, however, noumenalist as he was, the phenomenalist Lewes sympathized in one respect; namely, in the identification of cause and effect, except that he interpreted the hypothesis phenomenalistically by saying that "cause and effect are two aspects of the same phenomenon." But his main sympathy was with another noumenalist—Fechner. In the second volume of *Problems of Life and Mind*, Problem VI., on "The Absolute in the Correlations of Feeling and Motion," is simply an adaptation of Fechner's psychophysical parallelism. It begins by quoting the now celebrated passage from the *Elemente der Psychophysik*, i. 2, in which Fechner compares the spiritual and bodily sides of a man to the inner and outer sides of a circle; and it agrees with Fechner throughout that the two sides are to be identified by first regarding them as the objective and subjective aspects of one process, and then regarding that one process as only apparently bodily, but really spiritual, or, as Lewes thought in his phenomenalistic way, feeling; so that the absolute is feeling. In detail, he agreed closely with Fechner's "inner psychophysics," holding that neural process and feeling are one process viewed objectively and subjectively; that feeling is a function of the organism quantitatively varying with it; but that the neural process does not produce the feeling. "If it did," says he, "the law of the conservation of energy would be at fault, since a motion would terminate in what was neither motion nor a mode of motion." He thought that, if we identify feeling and neural process, the old mystery of the mutual action of mind and body is dispelled. He saw the difficulty, as Fechner did, that there are neural processes below and above consciousness and sensation; and he adopted Fechner's solution, that sensation is an integration of sensible units parallel to and identical with neural units or tremors, and that there are certain limits between which neural tremors are fused into neural processes and emerge in consciousness; while *beyond* these limits, on either side, there is no sensation, only sensible units. In fact, he adopted the gist of Fechner's "inner psychophysics," without, however, Fechner's noumenalistic hypothesis that what is unconscious in us is conscious in the all-embracing spirit of God. His phenomenalism also compelled him to give a more modified adhesion to Fechner's "outer psychophysics." It will be remembered that Fechner regarded every composite body as the appearance of a spirit; so that when, for example, molecular motion of air is said to cause a sensation of sound in me, it is really a spirit appearing as air which causes the sensation in my spirit. This noumenalism would not do for Lewes, who says that air is a group of qualities, and qualities are feelings, and motion is a mode of feeling. What, then, could he make of the external stimulus? He was obliged by his phenomenalism to say that it is only one feeling causing another in me. He ingeniously suggested that the external agent is one feeling regarded objectively, and the internal effect another feeling regarded

subjectively; "and therefore," to quote his own words, "to say that it is a molecular movement which produces a sensation of sound, is equivalent to saying that a sensation of sight produces a sensation of hearing." Accordingly his final conclusion is that "existence—the absolute—is known to us in feeling," and "the external changes are symbolized as motion, because that is the mode of feeling into which all others are translated when objectively considered: objective consideration being the attitude of *looking at* the phenomena, whereas subjective consideration is the attitude of any other sensible response." He does not say what happens when we use vision alone, and still infer that an external stimulus causes the internal sensation. But his metaphysics is an interesting example of a phenomenalist, sympathizing with noumenalists so different as Hegel and Fechner, and yet maintaining his phenomenalism. In this feature, in reducing Fechner's cosmic to a psychological parallelism of psychical and physical, and in supposing that all we know is feelings, in which mind and matter are opposed but not as distinct existents, while inference can make ideal constructions but without knowing anything beyond, the phenomenalism of Lewes is the English parallel to the German phenomenalism of Wundt. At the same time, and under the derivative influence of Wundt, rather than the more original inspiration of Fechner, W. K. Clifford (1845–1879) was working out the hypothesis of psychophysical parallelism to a conclusion different from that of Lewes, and more allied to that of Leibnitz the prime originator of all these hypotheses. Leibnitz had asserted that all monads have perceptions, that motions and perceptions are merely parallel, and that conscious perceptions are composed of unconscious "petites perceptions." Fechner developed this panpsychistic parallelism into an idealistic and noumenalistic identity, and gave a more mathematical form to the composition of consciousness out of units in his *Elemente der Psychophysik*, ii. 45. After the publication of this work in 1860, the hypothesis that conscious states are composed of unconscious units became common not only in Germany, but also in England and in France. We have traced its influence on Lewes. But before the publication of Lewes's *Problems*, Spencer, in discussing the Substance of Mind (*Principles of Psychology*, 2nd edition, 1870, Part II., chap. i.), had already supposed that feelings, *e.g.*, sensations of sound, are resolvable into simpler feelings, or nervous shocks corresponding to the shocks of molecular change, that perhaps all the units of feeling are homogeneous, and that possibly units of external force may be identical with units of feeling; only that we must remember that this phenomenal analysis does not reach to the substance of noumenal matter or noumenal mind, both of which are unknowable things in themselves. Clifford broke down this artificial distinction by advancing the further hypothesis that the supposed unconscious units of feeling, or psychical atoms, are the "mind-stuff" out of which everything physical and psychical is composed, and are also things in themselves, such as Kant supposed when he threw out the hint that after all "the *Ding-an-sich* might be of the nature of mind" (see *Mind*, 1878, 67). As a matter of fact, this "mind-stuff" of Clifford is far more like the "petites perceptions" of Leibnitz, from which it is indirectly derived. Clifford first brought out this hypothesis at the Sunday Lecture Society, 1st November 1874. Both then and afterwards he connected it with the hypothesis of psychophysical parallelism. He maintained that the physical and the psychical are two orders which are parallel without interference; that the physical or objective order is merely phenomena, or groups of feelings, or "objects," while the psychical or subjective order is both a stream of feelings of which we are conscious in ourselves, and similar streams which we infer beyond ourselves, or, as he came to call them, "ejects"; that, if we accept the doctrine of evolution at all, we must carry these ejective streams of feelings through the whole organic world and beyond it to the inorganic world, as a "quasi-mental fact"; that at bottom both orders, the physical phenomena and the psychical streams, are reducible to feelings; and that therefore there is no reason against supposing that they are made out of the same "mind-stuff," which is the thing-in-itself. The resemblance of this noumenal idealism to that of Fechner is unmistakable. The difference is that Clifford considers "mind-stuff" to be unconscious, and denies that there is any evidence of consciousness apart from a nervous system. He agrees with du Bois-Reymond in refusing to regard the universe as a vast brain animated by conscious mind. He disagrees with Fechner's hypothesis of a world-soul, the highest spirit, God, who embraces all psychophysical processes. Curiously enough, his follower G. J. Romanes (1848–1894) took the one step needed to bring Cliffordism completely back to Fechnerism. In his Rede Lecture on *Mind and Motion* (1885), he said that Clifford's deductions, that the dissolution of a human brain implies the dissolution of a human mind, and hence also that the universe, although entirely composed of mind-stuff, is itself mindless, did not follow by way of any logical sequence from his premisses. Afterwards, when the Lecture was published in *Mind and Motion and Monism* (1895), this work also contained a chapter on "The World as an Eject," in which Romanes again contended against Clifford that the world does admit of being regarded as an eject, that is, as a mind beyond one's own. At the same time, he refused to regard this "world-eject" as personal, because personality implies limitation. It seems reasonable to conclude, he says, that the integrating principle of the whole—the Spirit, as it were, of the Universe—must be something akin to, but immeasurably superior to, the "psychism" of man. Nothing can be more curious than the way in which a school of English philosophers, which originally started from Hume, the most sceptical of phenomenalists, thus gradually passed over to Leibnitz and Fechner, the originators of panpsychistic noumenalism. The Spirit of the Universe contemplated by Romanes is identical with the World-soul contemplated by Fechner.

Karl Pearson, in *The Grammar of Science* (1892, 2nd enlarged edition 1900), starting from Hume's phenomenal idealism, has developed views so like Mach's universal physical phenomenology, that it is hardly necessary to repeat here what we have already said about Mach. What Hume called repeated sequence Pearson calls "routine" of perceptions, and, like his master, holds that cause is an antecedent stage in a routine of perceptions; while he also acknowledges that his account of matter leads him very near to John Stuart Mill's definition of matter as "a permanent possibility of sensations." He copies a picture from Mach's *Beiträge zur Analyse der Empfindungen*, designed to show that one's body, so far as visible, with its environment is part of the world of sense appearing to be outside. His views, in his chapter on the Laws of Motion, that the physicist forms a conceptual model of the universe by aid of corpuscles, that these corpuscles are only symbols for the component parts of perceptual bodies, and that force is a measure of motion, and not its cause, are the views of Mach. At the end of this chapter he says that the views put forward in it were reached when the author was studying the laws of motion for teaching purposes in 1882, and were developed for the purpose of college lectures in 1884, but that the only published work in which the author has found any indication of similar opinions, or from the perusal of which he has received any help, is Mach's *Die Mechanik in ihrer Entwicklung* (1883). In point of fact, Mach had begun to put them forward in 1872, and Kirchhoff in 1874. But they may very well have been developed independently in Germany and in England from their common source in Hume. Their point is to stretch Hume's phenomenalism so as to embrace all science, by contending that mechanism is not at the bottom of phenomena, but is only the conceptual shorthand by aid of which men of science can briefly describe phenomena, and that all science is description and not explanation. These are the views of Mach and of Pearson, as we read them in the latter's Preface. Nor can we find any difference, except the minute shade that Pearson takes up a position of agnosticism between Clifford's assertion of "mind-stuff" and Mach's denial of things in themselves. J. Ward, in *Naturalism and Agnosticism* (1899), starts from the same phenomenalistic views of Mach and Kirchhoff about mechanics; he proceeds to the hypothesis of duality within experience, which we have traced in the phenomenalisms of Schuppe, Avenarius, and Wundt, and to the hypothesis of one consciousness, which appears variously in the German idealisms, not of Kant, as Ward thinks, but of Fichte, Hegel, and Schuppe; and somehow he manages to end with the noumenalistic conclusion that Nature is God's Spirit. Though this work evinces a thoroughly English love of compromise, yet it is not merely eclectic, but is animated throughout by the inspiration of his "old teacher, Lotze," as Ward affectionately calls him. Lotze, as we saw, rejected bodily mechanism, reduced known bodies to phenomena, and concluded that reality is the life of God. Ward on the whole follows this triple scheme, but modifies it by new arguments founded on later German phenomenalism. Under the first head, mechanics, according to Ward, can dispense entirely with "real categories." He means, in obedience to the views of Mach and Kirchhoff, that mass and force are not substance and cause; that, while mass means "mass-points," force only means mass-acceleration which is not a cause but an event; and that mechanics, requiring not causality but only dependence, is merely descriptive, or kinematical. He also identifies mass with quantity of inertia, and concludes with Leibnitz that there is passivity but no activity in the physical world. He adds that mechanics, having gradually rid itself of the categories of substance and cause, begins and ends with abstractions; that it is clear of all induction; and that the application of abstract mechanics to real bodies is throughout hypothetical, while ether is "non-matter in motion," and inconsistent with realism. "Molecules, atoms, ether, *prima materia*—one and all," says he without making any distinctions, "are hypothetical." They are even less according to him; for he holds that whatever is inferred beyond "perceptual realities" in mechanics, or any other natural science, matter and force, "mass-points" and motions, time and space, are conceptions; ideas not facts; thoughts not things; not "perceptual realities," not "phenomena," but abstract ideal conceptions devised for the description of such; and conceptions not causes. All this attack on mechanics is pure Machism, and, if consistently carried out, would have carried Ward no farther than Mach. Under the second head, according to Ward, as according to Wundt, knowledge is experience; we must start with the duality of subject and object, or perceptual reality, phenomenon, in the unity of experience, and not believe, as realists do, that either subject or object is distinct from this unity; moreover, experience requires "conation," because it is to interesting objects that the subject attends; conation is required for all synthesis, associative and intellective; thinking is doing; presentation, feeling, conation are one inseparable whole; and the unity of the subject is due to activity and not to a substratum. But, in opposition to Wundt and in common with Schuppe, he believes that experience is (1) experience of the individual, and (2) experience of the race, which is but an extension of individual experience, and is variously called, in the course of the discussion, universal, collective, conceptual, rational experience, consciousness in general, absolute consciousness, intelligence, and even, after Caird, "a perfect intelligence." He regards this universal experience as the result entirely of intersubjective intercourse, and concludes that its subject is not numerically distinct from the subject of individual experience, but is one and continuous with it, and that its conceptions depend on the perceptions of individual experience. He infers the corollary that universal experience contains the same duality of subjective and objective factors without dualism. He thinks that it is the origin of the categories of causality, which he refers to "conation," and substance, which he attributes to the interaction of active subjects with their environment and to their intercourse with each other. He applies universal experience, as Schuppe does, to explain the unity of the object, and its independence of individual but not of universal experience, holding that the one sun, and the whole world of intersubjective intercourse, or the "trans-subjective" world, though "independent of the individual percipient as such," is "not independent of universal experience, but the object of that experience" (ii. 196–197). He applies universal experience to explain how we come, falsely in his opinion, to believe that the object of experience is an independent thing; and he uses three arguments, which are respectively those of Schuppe, Avenarius, and Wundt. He supposes first, that we falsely conclude from the sun being independent of each to being independent of all; secondly, that by "introjection" we falsely conclude that another's experience is in him and therefore one's own in oneself, while the sun remains outside; and thirdly, that by "reification" of abstractions, natural science having abstracted the object and psychology the subject, each falsely believes that its own abstract, the sun or the subject, is an independent thing. What, then, could we know from this "duality in experience"? He hardly has a formal theory of inference, but implies throughout that it only transcends perceptions, and perceptual realities or phenomena, in order to conclude with ideas, not facts. When we combine his view of Nature under the first head that whatever is inferred in the natural sciences is ideas, with his view of knowledge under the second head that knowledge is experience, and experience, individual or universal, is of duality of subject and object in the unity of experience, it follows that all we could know from the data would be one experience of the race, one subject consisting of individual subjects, and in Nature single objects in the unity of this universal experience; and beyond we should be able to form conceptions dependent on the perceptions of individual experience in the unity of universal experience: that is all. There can be no doubt that Mach, Schuppe, and Wundt drew the right phenomenalistic conclusions from such phenomenalistic data. Not so Ward, who proceeds to a Natural Theology, on the ground that "from a world of spirits to a Supreme Spirit is a possible step." He had definitely confined universal experience to the one experience of the race. But perhaps Caird's phrase "a perfect intelligence" has beguiled him into thinking that the one subject of universal experience is not mere mankind, but God Himself. Under the third head, however, his guide is Lotze. The argument may be shortly put as follows:—As the Nature which is the object of mechanics and all natural sciences, is not natural substances, but phenomena and ideas; as mass is not substance, and force is not cause; as activity is not in the physical but in the psychical world; as the laws of Nature are not facts but teleological conceptions, and Nature is teleological, as well as not mechanical but kinematical; as the category of causality is to be referred to "conation"; as, in short, "mind is active and matter inert," what then? One subject of universal experience, one with the subjects of individual experience, you would suppose, and that Nature as a whole is its one object. Not so, according to Ward; but "God as the living unity of all," and "no longer things, but the connecting conserving acts of the one Supreme." What, then, is the relation of God to the one universal experience, the experience of the race, which was under the second head the unity in duality of all knowledge? He does not say. But instead of any longer identifying the experience of the race and universal experience, he concludes his book by saying "our reason is confronted and determined by universal reason." This is his way of destroying Naturalism and Agnosticism.

(4) *Personal Idealism.*—Mechanics does not abstract from the essentials of bodies, but only from their accidents; for, as we saw in dealing with Mach, the third law of motion was generalized by induction from the collision of bodies, which, as triply extended and mutually impenetrable substances, by their inter-resistance reduce one another to a joint mass with a common velocity so as to avoid penetration. The essential extension, inertia, and mutual impenetrability of bodies constitute the negative instance to all idealism: unless these are the attributes of Spirit, Nature is not Spirit. Again, Nature is one, but not one system of one consciousness. There is no one consciousness; the supposition of it is a confusion of same and similar. Men's minds are alike, but different. Not only do men disagree and contradict one another, but also they differ more in their minds than in their bodies. What would I not give for the mind of Aristotle or of Bacon? Moreover, men know but little of one another's minds, and that indirectly; only through their bodies, as far as we know. Consciousness is personal. I am conscious of myself, but infer everybody else. Hence it is a healthy sign that, even among the idealists, a protest is beginning to be made against the hypothesis of one mind, in favour of the personality of individuals. That this protest should arise in England against Green, Caird, and Bradley is only what might be expected. The English have long believed in individuality, in private judgment, in freedom, in the individual conscience. English moral philosophy cannot long tolerate a metaphysics which, by merging all minds in one, would destroy personality, personal causation, and moral responsibility, as J. Martineau well said. Moreover, there are signs that Green would have agreed with Martineau; for, though he resolves the whole world into one eternal intelligence, yet, however inconsistently, he wanted to make out that this absolute reproduces itself in each of us, and even in connexion with an individual animal organism. But the rise of a personal idealism is not directed merely against the English Hegelians and their master. It is also opposed to the one substance of Spinoza, the pure ego of Fichte, the absolute of Schelling in his first philosophy, and the common consciousness of Schuppe and of Ward. It is a return to the idealistic theories of personality held by Descartes, Leibnitz, Berkeley, Kant, Schelling in his later philosophy, and Fechner. Indeed, we must not suppose that recent personal idealists form one school, or that they have mastered the nature of personality, or that they have as yet worked out great systems. They are only united by their consciousness of the existence of personality.

Andrew Seth Pringle Pattison is the protagonist of the movement in his books on *Scottish Philosophy* (1885), and *Hegelianism and Personality* (1887). "The radical error," says he, "both of Hegelianism and of the allied English doctrine I take to be the identification of the human and the divine self-consciousness, or to put it more broadly, the unification of consciousness in a single self"; and immediately afterwards, "Each of us is a self"; and in another passage, "The real self is one and indivisible, and is unique in each individual. This is the unequivocal testimony of consciousness." What makes his vindication of conscious personality all the more interesting is that he has so much in common with the Hegelians; agreeing as he does with Hegel that self-consciousness is the highest fact, the ultimate category of thought through which alone the universe is intelligible, and an adequate account of the great fact of existence. He agrees also that there is no object without subject. It is difficult to see exactly where he begins to differ from Hegel; but at any rate he believes in different self-conscious persons; he does not accept the dialectical method, but believes in beginning from the personal experience of one's own self-consciousness; and, though he is not very clear on the subject, he would have to admit that a thing, such as the sun, is a different object in each person's consciousness. "Every Ego," says he, "carries in itself a Non-Ego, but that does not justify us in sweeping all existence without more ado into the circle of a single self-consciousness, identifying Nature with the Non-Ego of God, and simplifying the problem by extruding our own self-consciousness altogether" (*Hegelianism*, p. 162). He is not a systematic thinker, but is too much affected by the eclectic notion of reconciling all philosophies. Thus, he thinks, on the one hand, that the Berkeleian analysis of Mill and Bain is absolutely true as psychology, but must not pass off as metaphysics, although, if any metaphysics but idealism is true, the Berkeleian psychology is false; and he thinks, on the other hand, that Natural Realists who believe in an intuition of the external world can accept the Hegelian metaphysics that Nature is "the other" of thought, when the former believe that the external world is perceived as body resisting the organism. F. C. S. Schiller, in *Riddles of the Sphinx* (1891), is a more systematic thinker. He rejects the difference between matter and spirit. He agrees with Leibnitz in the analysis of the material into the immaterial, but with Lotze in holding that the many immaterial elements coexist and interact. At the same time he differs from Lotze's conclusion that their union requires one absolute substance. Again, he thinks that substance is activity; differing from both Leibnitz and Lotze herein, and still more in not allowing the existence of the many beyond experience. Hence his personal or pluralistic idealism is the view that the world is a plurality of many coexisting and interacting centres of experience, while will is the most fundamental form of experience. In connexion with these views, it is a pleasure to welcome the appearance of *Personal Idealism, Philosophical Essays by Eight Members of the University of Oxford* (1902), edited by H. Sturt, and numbering Schiller, as well as G. F. Stout, H. Rashdall, and others among its contributors. They do not all agree with one another, or perhaps even with the title. Nevertheless, there is a common tendency in them, and in the University of Oxford, towards the belief that, to use the words of the editor, "We are free moral agents in a sense which cannot apply to what is merely natural." There is indeed much more activity of thought at Oxford than the world suspects. Mansel and Jowett, Green and Caird, Bradley and Bosanquet have arisen in quick succession, and in 1902 are being succeeded by a generation which is the centre of a new movement in metaphysics. We may also notice that the same sort of antithesis between the one and the many has appeared in the United States. J. Royce is a believer in the absolute like Green and Bradley, in "the unity of a single self-consciousness, which includes both our own and all finite conscious meanings in one final eternally present insight," as he says in *The World and the Individual* (1900). G. T. Ladd also believes in "a larger all-inclusive self," and goes so far as the paradox that perfect personality is only reconcilable with one infinite being. While Royce is Hegelian, Ladd prefers Lotze, but both believe in one mind. William James, on the other hand, in his psychological works shows that the tendency of recent psychology is to personality, interpreted idealistically; though without a very clear appreciation of what a person is, and personality means. By a curious coincidence, almost at the time of the appearance of the *Essays on Personal Idealism* in England, an American writer, G. H. Hewison, published *The Limits of Evolution, and other Essays illustrating the Metaphysical Theory of Personal Idealism* (1901). But lately there has been an increase of philosophical intercourse between English and American universities, which is a hopeful sign of progress in both: they have much to learn from one another.

The advent of personal idealism is a welcome protest against the confusion of God and man in one mind, and against the confusion of one man's mind with another's. But it has not passed as yet from negative to positive philosophy. As it advances, it will carry the new school in different and unexpected directions. It will end in realism. I am conscious only of myself as a person, and of my bodily signs. I know the existence of other human persons and minds only through their giving similar bodily signs. If the personal idealist consistently denies other bodies, then the bodily signs become, according to him, only part of his experience, which can prove only the existence of himself. To infer another mind he must infer another body, and the bodily environment including his and other bodies. Again, in being conscious of myself, I am not conscious of my mind in the abstract without my body. I cannot separate touching from my tactile organs, seeing from my eyes, or hearing from my ears. I cannot think my body away. Moreover, I am not conscious of my whole personal life at all. How do I know that I was born, though I cannot remember it, and that I shall die, though I am not now conscious of death? How do I know that I am the same person from birth to death? Not by my consciousness, but by knowing the bodies of others—of babies on the one hand, and of old men on the other hand. It is usual to say that the body has not enough unity to be part of the person: the objection is much more true of conscious mind. The truth is that not the unity of consciousness but the fact of its existence is the important point. The existence of my consciousness is my evidence for my soul. But it does not prove that I am nothing but soul. As a human person, I am body and soul; and the idealistic identification of the ego with soul or mind, involving the corollary that my body belongs to the non-ego and is no part of myself, is the *reductio ad absurdum* of idealism. Lastly, though the personal idealists are right in rejecting the hypothesis of one mind, they are too hasty in supposing that the hypothesis is useless for idealistic purposes. No idealism can explain how we all know one sun, except by supposing that we all have one mind. The difficulty of personal idealism, on the other hand, is to reconcile the unity of the thing with the plurality of thinkers. The unity of the sun can only be explained either idealistically by supposing it to be one object of one mind, or realistically by supposing it to be one thing distinct from the many minds which think about it. The former alternative is false, the latter true. Personal idealism, therefore, must end in personal realism.

§ 7. REALISM.

(1) *Metaphysical and Psychological Realism.*—Realism is the view that some known things are bodily, and some are mental. At its best, it is the Aristotelian view that both are substances. The modern misunderstanding of "substance" has been a main cause of the confusion of modern thought. Aristotle meant by it any distinct thing; *e.g.*, I, you, an animal, a plant, the earth, the moon, the sun, God. He calls each of these, as existing apart, a thing *per se* (*καθ' αὑτό*). It is true that, having divided a natural substance into form and matter, he called each element "substance." But these are not primary meanings; and matter, or supposed substratum, in particular, he says, is not actually substance (*Met.* Z 3) or is only potentially substance (*Met.* H 1–2). In modern times, Spinoza, by a mere mistake, changed the meaning of "substance" from "existing apart" to "existing alone," and consistently concluded that there is only one. Locke mistook it to mean "substratum," or support of qualities, and naturally concluded that it is unknown. Kant, taking it in the mistaken meaning of Locke, converted it into the *à priori* category of the permanent substrate beneath the changes of phenomena, and even went so far as to separate it from the thing in itself, as *substantia phenomenon* from *noumenon.* When it had thus lost every vestige of its true meaning, Kant's successors naturally began to speak of things as being distinct without being substances. Fichte began this by saying that ego is activity, and being is life. Hegel said that spirit is not substance but subject, which to Aristotle would have meant that it is not a distinct thing, yet is a distinct thing. Fechner, Wundt, and Paulsen have fixed the conclusion in psychology that soul is not substance but unity of mental life; and Wundt concludes from the modern history of the term that substance or "substrate" is only a secondary conception to that of causality, and that, while there is a physical causality distinct from that of substance, psychical causality requires no substance at all. The result of this confusion is that the moderns, who think themselves a thousand times wiser than Aristotle, have no name at all for a distinct thing, and, being mere slaves of abstract terms, constantly speak of mere attributes, such as activity, life, will, actuality, unity of mental operations, as if they were distinct things. Attributes, it may be said, are knowable things, and indeed are often objects of science: thus, arithmetic deals with unity and number; geometry, with extension and figures; mechanics, with motion, force, and energy; morals, with happiness, virtue, and conscience; and politics with government and taxes. But an attribute, though real, is not a distinct reality, but is only a determinant of a substance, and has no being of its own apart from the substance so determined; whereas a substance, determined by all its attributes, is different from everything else in the world. Though, for simplicity and universality of thought, even in science, we must use the abstraction of attributes, and, by the necessity and weakness of language, must signify what are not substances by nouns substantive, we must guard against the over-abstraction of believing that a thing exists as we abstract it. A thing, as it is known to exist *in rerum naturâ*, is never a single attribute, *e.g.*, unity; nor a sum of attributes, *e.g.*, humanity; nor a substratum beneath these attributes in the abstract; but is always a single thing, wholly determined by all its attributes in the concrete, and different from everything else, *e.g.*, a man, a body, God. The point of true realism is Aristotle's point that the world consists of such distinct, though related, things, and therefore of substances, natural and supernatural. Again, the method of true realism is that of Aristotle, and

consists in recognizing the independence of metaphysics. The contrary method is psychological metaphysics, which makes metaphysics dependent on psychology, on the ground that the origin of knowledge determines its limits. This is the method which, as we have seen, has led from psychological to metaphysical idealism, by the argument that what we begin by perceiving is mental, and, therefore, what we end by knowing is mental. Now, there is no principle of method superior to that of Aristotle—we must begin with what is known to us. If one could begin as a child to register a history of one's own operations, one might proceed from origin to limits. But the psychologist and the metaphysician is always a grown man—too late for this process from his psychology to his metaphysics. The things best known to him are the things which he now knows as a man. About these known things there is some agreement: about the beginnings of knowledge there is nothing but controversy. We do not know enough about the origin of knowledge to determine its limits. Hence, to proceed from psychology to metaphysics is to proceed from the less to the more known; and the paradoxes of psychological have caused those of metaphysical idealism. The realist, then, ought to begin with metaphysics without psychological prejudices. He must ask what are known things, and especially what has been discovered in the sciences; in mechanics, in order to find the essence of bodies which is neglected by idealism; in mental science, in order to understand consciousness which is neglected by materialism. With the conviction that the only fair way of describing metaphysics has been to avoid putting forward one system, and even to pay most attention to the dominant idealism, we have nevertheless been driven occasionally to test opinions by this independent metaphysical method. The chief results we have found against idealism are that bodies have not been successfully analysed except into bodies, as real matter; and that bodies are known to exert reciprocal pressure in reducing one another to a joint mass with a common velocity by being mutually impenetrable, as real forces. The chief results we have found against materialism are that bodies evolving account neither for the origin of themselves, their nature, and their fundamental order of resemblance and difference, nor for the nature and origin of consciousness, nor even as yet for their becoming good for conscious beings. Hence we come to the realistic conclusions, that among known substances some are bodies, others are souls; that man is body and soul; and that God is a pure soul or spirit. At the same time, while the independence of metaphysics leads us to metaphysical realism, this is not to deny the value of psychology, still less of logic. Besides the duty of determining what we know, there is the duty of determining how we know it. But in order to discharge it, a reform of psychology as well as of metaphysics is required. Two psychological errors, among many others, constantly meet us in the history of idealism—the arbitrary hypothesis of a sense of sensations, or of ideas, and the intolerable neglect of logical inference. The latter error we have endeavoured to correct in dealing with Logic. Logical inference from sense is a process from sensible to insensible existence. The former error needs something deeper than a Kantian critique of reason, or an Avenarian criticism of experience; it needs a criticism of the senses. We want an answer to this question—What must we know by the senses in order to enable us to know what we infer by reason in the sciences? Without here aiming at exhaustiveness, we may bring forward against the dominant idealism a psychological theory of sense and reason. By touch, I perceive one bodily member reciprocally pressing another in myself, *e.g.*, lip pressing lip; by touch again, I perceive one bodily member similarly pressing but not another member in myself, *e.g.*, only one lip pressing; by inference from touch, I infer that it is reciprocally pressing another body similar to my other bodily member, *e.g.*, another body similar to my other lip. Johannes Müller recognized this sense of resistance between one's own members, and its importance for knowledge, but confused it with the inference of external resistance (see his *Elements of Physiology*, translated by Baly, p. 1081). On this theory, then, founded on the conscious facts of double and single pressure in touch, and on the logic of inference, we have at once a reason for our knowledge of external bodies, and an explanation of the early appearance of that knowledge. The child has only to have its mother's nipple in its mouth in order to infer something very like the mutually pressing parts of its own mouth. Having thus begun by touch and tactile inference, we confirm and extend our inferences of bodies in Nature by using the rest of the senses. This is not to forget that the five senses are not our whole stock, or to confine inference to body. We have also the inner sense of consciousness which is inexplicable by body alone. By combining, moreover, our knowledge of Nature with our consciousness of our own works, we can infer that Nature is a work of God. Next, finding that He gives signs of bodily works, but no signs of bodily organs, we can infer that God is a Spirit. Finally, returning to ourselves, we can conclude that, while the conscious in God is Spirit without Body, in us it is spirit with body. This final distinction between bodily and spiritual substances we owe to Descartes.

(2) *The Undercurrent of Modern Realism.*—Coming after the long domination of Aristotelian realism, Descartes and Locke, though psychological idealists, were metaphysical realists. They were what Hamilton called cosmothetic idealists and hypothetical realists. Their position was so illogical that it was easily turned into metaphysical idealism. But their psychological method and idealism produced another mistake—the tendency to a modicum of realism, as much as seemed to this or that author to follow from psychological idealism. Thus we have Spinoza and Leibnitz, and then his disciple Wolff (1679–1754), who emphasized the realistic side of Leibnitz. In Germany, since the victory of Kant over Wolff, realism has always been in difficulties, which we can appreciate when we reflect that the Germans by preference apply the term "realism" to the paradoxes of Herbart (1776–1841), who, in order to avoid supposed contradictions, supposed that bodies are not substances, but show (*Schein*), while "reals" are simple substances, each with a simple quality, and all preserving themselves against disturbance by one another, whether physically or psychologically, but not known to be either material or spiritual because we do not know the simple quality in which the nature of the real consists. There have indeed been other realisms in Germany. Trendelenburg (1802–1872), a formidable opponent of Hegel, tried to surmount Kant's transcendental idealism by supposing that motion, and therefore time, space, and the categories, though *à priori*, are common to thought and being. Dühring, with a similar object, makes matter a common basis. While these realisms come dangerously near to materialism, that of the Roman Catholic A. Günther (1783–1863), "Cartesius correctus," erected too mystical an edifice on the psychological basis of Descartes to sustain a satisfactory realism. Yet Güntherism has produced a school, of which the most distinguished representative is the Old Catholic Bishop in Bonn, Th. Weber, whose *Metaphysik*, completed in 1891, starting from the ego and the analysis of consciousness, aims at arriving at the distinction between spirit and nature, and at rising to the spirit of God the Creator.

Another realism is that of J. H. von Kirchmann (1802–1884), author, among other works, of *Die Philosophie des Wissens* (1864), and *Ueber die Principien des Realismus* (1875). His point was that being and knowing are identical in content, and are only different in the form in which the content appears. Hence he deduced, on the one hand, that being can exist without knowing, and on the other hand that the object of perception is an image of being. Further, according to him, perception is the sole way of knowing the content, while thinking does nothing but purify the perceived content from contradictions; and therefore there are two principles of truth, (1) "Das Wahrgenommene ist," (2) "Das sich Widersprechende ist nicht." When an author thus supposes that perception knows only an image of a thing, that thinking knows no more, and that therefore knowledge is a sort of imaging of being, one cannot wonder that the idealists object that realism is a false transition from ideas to things, and speak of what they call "naive realism" with contempt. Other realisms of our time are those of G. K. Uphues, directed against the scepticism of Shute's *Discourse on Truth*, and of H. Schwarz, who completes the psychological view of Uphues that we can know objects as they are, by the metaphysical view that they can be as we know them. But German realism lacks critical power, and is little better than a weed overshadowed by the luxuriant forest of German idealism.

In France, the home of Cartesian realism, after the vicissitudes of sensationalism and materialism, which became connected in the French mind with the Revolution, the spirit of Descartes revived in the 19th century in the spiritualistic realism of Victor Cousin (1792–1867). But Cousin's psychological method of proceeding from consciousness outwards, and the emphasis laid by him on spirit in comparison with body, prevented a real revival of realism. He essayed to answer Locke by Kant, and Kant by Reid, Maine de Biran, and Schelling. From Reid, whose works had been introduced by Royer-Collard, he adopted the belief in an external world beyond sensation, from Biran the explanation of personality by will, from Schelling the identification of all reason in what he called "impersonal reason," which he supposed to be identical in God and man, to be subjective and objective, psychological and ontological. We start, according to him, from a psychological triplicity in consciousness, consisting of sensation, personal will, and impersonal reason, which by *à priori* laws of causality and substance carries us to the ontological triplicity of oneself as ego willing, the non-ego as cause of sensation, and God as the absolute cause beneath these relative causes. So far this ontological triplicity is realism. But when we examine his theory of the non-ego, and find that it resolves matter into active force and this into animated activity, identifies law with reason, and calls God absolute substance, we see at once that this spiritual realism is not very far from idealism. About 1840, owing largely to the teaching of E. Saisset in the spiritualistic school, the influence of Descartes began to give way to that of Leibnitz, whose monadism literally taken was consistent with bodies and recognized a supramundane God, but nevertheless, through its endowing monads with mental perception and appetition, could easily pass into systems of idealism and pantheism, such as we have found in Germany. Leibnitz has been used both realistically and idealistically in France. He was taken literally by spiritual realists; as, for example, by Paul Janet, whose works on Materialism (1864) and Final Causes (1876) have become well known in England by translations. Their point is that matter and evolution are inexplicable without spirit and final causes, but that, guided by "une volonté prévoyante," evolution could be the means of rising by a continuous process from the monad to humanity. Janet accepted the traditional ontological triplicity—God, souls, and bodies—and, in answer to Ravaisson, who called this realism "demi-spiritualisme," rejoined that he was content to accept the title. At the same time, like Cousin, his works show a tendency to underrate body, tending as they do to the Leibnitzian analysis of the material into the immaterial, and to the supposition that the unity of the body is only given by the soul. His emphasis is on spirit, and he goes so far as to admit that "no spiritualist is engaged to defend the existence of matter." So E. Thouverez says, "Réalisme et rationalisme sont tout un." The strength of Janet's position is his perception that the argument from final causes is in favour of an omnipresent rational will making matter a means to ends, and not in favour of an immanent mind of Nature working out her own ends. "Beaucoups d'esprits aujourd'hui," says he at the end of *Le Matérialisme Contemporain*, "voudraient se dissimuler à eux-mêmes la pente qui les entraîne vers l'athéisme, en prêtant à la nature une vie, un instinct, une âme, et à cette âme une tendance inconsciente vers le bien." Nevertheless, the psychological metaphysics of Cousin and of Janet was too flimsy a realism to withstand its passage into this very idealism of matter which has become the dominant French metaphysics. E. Vacherot deserted Descartes for Hegel. At first in *La Métaphysique et la Science* (1858) he said, in opposition to the Cartesian argument from the perfection to the being of God, that the ideal cannot be real. But, when Janet had rejoined that "to be is worth more after all than not to be," Vacherot reconsidered his position in *Le Nouveau Spiritualisme* (1884). He accepted from Hegel "the real is rational" without the Hegelian method, for which he substituted conscious experience as a revelation of the divine. Matter he held to be mind at the minimum of its action, and evolution the "expansion de l'activité incessante de la cause finale." God, according to his latest view, is the absolute being as first cause and final end. "Let us leave," says he in deference to Janet, "the category of the ideal, which applies to nothing real or living." But the most noticeable passage in *Le Nouveau Spiritualisme* is its contrast between the old and the new; where he says that the old spiritualism opposed spirit to matter, God to Nature, the new spiritualism places matter in spirit, Nature in God (p. 377). F. Ravaisson, by his *Rapport* (prepared for the Exhibition of 1867) on philosophy in France, gave a fresh impulse to the transition from spiritual realism to idealism, by developing the Aristotelian ἔφεσις of matter and the Leibnitzian appetition of monads into "l'amour" as the very being of things. J. Lachelier agreed with Ravaisson that beauty is the last word of things, but, under the influence of Kant and his successors, put his idealism rather in the form that all is thought. A. Fouillée rightly objects that we must not thus impute thought and intention to nature, and yet does not scruple to impute to it life, sensation, and want. Starting from consciousness, he argues that all known things are phenomena of consciousness. Then, agreeing with evolutionism, that things are necessarily determined by forces, but with Leibnitz that body is merely passive, he infers that force, being active, is psychical—a force, which he describes as "idée-force," and as "vouloir-vivre." In connexion with the "idées directrices et organisatrices," supposed by the French physiologist Claude Bernard, and the universal will supposed by German voluntarists, Fouillée concludes that the world is a society of wills. Meanwhile, more under the influence of Kant, C. Renouvier has worked out an idealism which he calls "Néo-criticisme," rejecting the thing-in-itself, while limiting knowledge to phenomena constituted by *à priori* categories. Phenomena he identifies with "représentations représentatives et représentées." But he takes the usual advantage of this most ambiguous of terms, when he extends it to embrace God, freedom, and immortality required by the moral law. Latterly, he has published *La Nouvelle Monadologie* (1899), in which he maintains that each monad is a simple substance, endowed with representation, which is consciousness in form, phenomenon in matter as represented. In order to explain free-will, he supposes, contrarily to Fouillée, that the laws of phenomena are indeterminate, contingent, and liable to exceptions. Here we trace the influence of Leibnitz and Lotze, which is still more marked in *La Contingence des Lois de la Nature* (1874), by E. Boutroux. Fouillée meets the mechanics of evolution by the argument that will to live determines its necessary laws, Boutroux by denying the necessity. His point is, that the world only appears to be phenomena governed by necessary laws, and is really a spontaneity which makes new beginnings, such as life and consciousness, tending to good. We wish we could have given more space to these French spiritualisms, which, realistic and idealistic alike, spring from a genuine enthusiasm for the spirit of man and his liberty. But we have said enough to show that the psychological metaphysics of spiritual realism has not been able to withstand the rise and progress of spiritual idealism in France.

In England, the land of Bacon and Locke, the realistic tendency has been more active than on the Continent, and is exhibited in Bacon's *Novum Organum* and *De Augmentis Scientiarum*, as well as to a less degree in the Fourth Book of Locke's *Essay*. After the metaphysical idealism, begun by Berkeley, had eventuated in Hume's reduction of the objects of knowledge to sensations, ideas, and associations, the Scottish School, applying the Baconian method to the study of mind, began to inquire once more for the evidences of our knowledge, and produced the natural or intuitive realism of T. Reid (1710–1796), Dugald Stewart (1753–1828), and Sir William Hamilton (1788–1856), who, having been followed by H. L. Mansel (1820–1871), as well as by J. Veitch, H. Calderwood, and J. M'Cosh, prolonged the existence of the school, in which we may venture to place L. T. Hobhouse, and F. W. Bain, author of *The Realization of the Possible* (1899), down to our own time. Its main tenet, that we have an immediate perception of the external world, is roughly expressed in the following words of Reid: "I do perceive matter objectively—that is, something which is extended and solid, which may be measured and weighed, is the immediate object of my touch and sight. And this object I take to be matter, and not an idea. And, though I have been taught by philosophers, that what I immediately touch is an idea, and not matter, yet I have never been able to discover this by the most accurate attention to my own perceptions." No opposition to idealism could be more distinct. Reid, however, did not always express himself so distinctly. Moreover, he and his successors mixed up so many accidents with the essence of their realism that the whole system broke down under its own weight. Their psychology contained valuable points. It also contained much that was doubtful, and much that was ill-adapted to the metaphysics of realism. Yet they thought it the only avenue to metaphysics. It is full of appeals to common sense, and of principles of common sense, which Reid also called intuitive first principles, and self-evident truths. It is spoilt by Locke's hypothesis that we do not perceive things but qualities implying things. While it asserted a realism of individuals, it admitted a conceptualism of universals. Stewart also said that our knowledge of matter and mind is merely relative. Hamilton went still farther than his predecessors; he tried to combine the oil of Reid with the water of Kant; and converting the intuitive into the *à priori*, he found a further reason for the relativity of knowledge. "Our knowledge is relative," said he, "first, because existence is not cognizable absolutely and in itself, but only in special modes; second, because these modes thus relative to our faculties are presented to and known by the mind, only under modification, determined by these faculties themselves." Not only so, but in his review of Cousin ("Philosophy of the Unconditioned," in *Discussions*, pp. 12–15), he made conception the test of knowledge, argued that "the mind can conceive, and consequently can know, only the limited, and the conditionally limited," that "to think is to condition," that all we know either of mind or matter is "the phenomenal," that "we can never in our highest generalizations rise above the finite," and concluded that we cannot conceive or know the unconditioned, yet must believe in its existence. Nevertheless, in spite of all this Kantism, which ought to have driven him to the conclusion that all we know is mental phenomena, he adhered to his natural realism. He vacillated a great deal about our mode of perceiving the external world; but his final view was contained in his edition of Reid's works (note D*), and consisted in supposing that (1) sensation is an apprehension of secondary qualities purely as affections of the organism viewed as ego; (2) perception in general is an apprehension of primary qualities as relations of sensations in the organism viewed as non-ego; while (3) a special perception of a so-called "secundo-primary" quality consists in "the consciousness of a resisting something external to our organism." Hamilton's views both on the absolute and on perception affected Mansel and Spencer. They were not, however, received without question even by his followers. H. Calderwood, in his *Philosophy of the Infinite* (1854), made the pertinent objection that, though thought, conception, and knowledge are finite, the object of thought may be infinite. Hamilton, in fact, made the double mistake of limiting knowledge to what we can conceive, and confusing the determinate with the finite or limited. We never know anything except as determined by its attributes; but that would not prevent us from inferring something determined as unconditioned whether infinite or absolute. J. M'Cosh again, in *The Prevailing Types of Philosophy: Can they logically reach reality?* (1891), rightly protests against Hamilton's combination of Scottish and German schools which will not coalesce, and exhorts the former "to throw away its crutches of impressions, instincts, suggestions, and common sense, and give the mind a power of seeing things directly." He has the merit of presenting natural or intuitive realism in its purity. The common tenet of the whole school is that without inference we immediately perceive the external world, at all events as a resisting something external to our organism. But is it true? There are three reasons against it, and for the view that we perceive a sensible object within, and infer an external object without, the organism. In the first place, there are great differences between the sensible and the external object; they differ in secondary qualities in the case of all the senses; and even in the case of touch, heat felt within is different from the vibrating heat outside. Secondly, there are so-called "subjective sensations," without any external object as stimulus, most commonly in vision, but also in touch, which is liable to formication, or the feeling of creeping in the skin, and to horripilation, or the feeling of bristling in the hair; yet, even in "subjective sensations," we perceive something sensible, which, however, must be within, and not outside, the organism. Thirdly, the external world and the senses always act on one another by cause and effect, and by pressure, although we only feel pressure by touch. Now, when the thing with which touch is in a state of reciprocal pressure is external, *e.g.*, a table, we feel our organism pressed and pressing; we do not feel the table pressing and pressed, but infer it. The Scottish School never realized that every sensation of the five senses is a perception of a sensible object in the bodily organism; and that touch is a perception, not only of single sensible pressure, but also of double sensible pressure, a perception of our bodily members sensibly pressing and pressed by one another, from which, on the recurrence of a single sensible pressure, we infer the pressure of an external thing for the first time. Intuitive Realism is to be replaced by Physical Realism.

(3) *Reaction to Hypothetical Realism.*—The three evidences, which are fatal to intuitive realism, do not prove hypothetical realism, or the hypothesis that we perceive something mental, but infer something bodily. This illogical hypothesis, which consists of incautiously passing from the truth that the sensible object perceived is not external but within the organism to the *non-sequitur* that therefore it is within the mind, derived what little plausibility it ever possessed from three prejudices: the first, the scholastic dogma that the sensible object is a *species sensibilis*, or immaterial sensible form received from the external thing; the second, the Cartesian *à priori* argument that the soul as thinking thing can perceive nothing but its own ideas; the third, the common assumption of a sense of sensations. But notwithstanding its illogicality, its tendency to underrate Nature as inferred from such idealistic premisses, and its certain transition into a consistent idealism, hypothetical realism has, with little excuse, revived among us in the writings of Shadworth Hodgson, J. Martineau, and A. J. Balfour. The cause of this anachronism has been the failure of intuitive realism and the domination of idealism, which makes short-sighted men suppose that at all events they must begin with the psychology and the psychological idealism of the day, in the false hope that on the sands of psychological idealism they may build a house of metaphysical realism.

Shadworth Hodgson, after writing many laborious works, has recently put together his conclusions in *The Metaphysic of Experience*, in four volumes, 1898. Believing that philosophy is an analysis of the contents of consciousness, or experience, and that this is metaphysics, he begins, like Kant, with an analysis of experience. Like Kant, he supposes that experience is concerned with sensations, distinguishes matter and form in sense, identifies time and space, eternal time and infinite space, with the formal element, and substitutes synthesis of sensations of touch and sight for association and inference, as the origin of our knowing such a solid material object as a bell. Although he does not agree with Kant that either the formal element in sense or the synthesis of sensations is *à priori*, yet in very Kantian fashion, through not distinguishing between operation and object, he holds that, in synthetically combining sensations of touch and sight, we not only have a complex perception of a solid body, but also know this "object thought of" as itself the complex of these sensations objectified. Hence he concludes that "*matter* is the name for the sensation-elements derived from both senses, abstracting in thought, so far as possible, from the extension-elements of both" (i. 296). Here you would expect him to stop, as the German Neo-Kantism of Lange stops, with the consistent conclusion that all we know of Nature from such data is these complexes of sensation-elements, or phenomena in the Kantian meaning. Not so; like Kant himself, Hodgson supposes something beyond; not, however, an unknown thing in itself causing sensations, but a condition, or *sine qua non*, of their existence, without being a cause of their nature. In order to make this leap he supposes that we have beyond perceptions a conception of condition. His account of the origin of this conception is puzzling. "Although," says he, "it is neither a Kantian *à priori* concept of the understanding, nor a Scholastic intellectual intuition of causal essences, nor yet, on the other hand, a mere record of *de facto* experience, it is nevertheless an idea which is thoroughly and completely justified as true by *de facto* experience, provided that it is frankly acknowledged to be a conception which needs justification; that is to say, a conception framed by conscious reaction on the part of the subject, whereby he interprets facts of perception, &c." (i. 380). Whatever this origin of the conception of condition may be, it could not, any more than a Kantian category of cause, justify us in concluding anything more than a relation of perceptions as conditions of one another, seeing that they were supposed to be the whole data, and matter itself to be "sensation-elements." But what he proceeds to suppose is that, having the conception, and finding that the complex of perceptions needs accounting for, we infer a real condition, *e.g.*, the solid interior of a bell. What we know, however, of this condition, according to him, has two limits: on the one hand, it is the condition only of the existence of our perceptions; on the other hand, all we know of its nature is our perceptions. Matter thus, which had at first been defined as a complex of perceptions objectified, now turns out to be a condition without which perceptions would not exist, but whose nature is known only as a complex of perceptions. Finally, according to him, having inferred matter as the condition of our perceptions, we are entitled to infer that the condition of the existence of matter is God, whose nature, however, can be inferred only by practical reason from conscience. He avers that this "metaphysic of experience" is not idealism, or the tenet that consciousness is the only reality. It is realism—but inconsequent and inadequate realism, something like that of Spencer; according, indeed, more knowledge of the distinction between nature as condition of sensations and God as condition of Nature; but very like in holding that all we know of natural forces is our perceptions. We know more, however, about a body, such as a bell, than either Spencer or Hodgson allows. We know, from the concomitant variations between its vibrations and our perceptions, that its vibrations are not mere conditions but real causes of our perceptions; and that those vibrations are not our perceptions, because we cannot perceive them, but are real attributes of the bell. It will be objected that they are merely possible perceptions. But as they really produce our real perceptions, they are themselves not merely possible, but real or actual. A possible cause could not actually produce an actual effect.

James Martineau (1805–1900) in *A Study of Religion* (1888), like Shadworth Hodgson, started from Kant, and tried to found on transcendental idealism "a return to dualism." If there is one thing certain in the Kantian philosophy, it is its author's perception that what is contributed by mind must not be extended to things beyond mind. Hegel only extended *à priori* forms to things by resolving things into thoughts. Mill also, in answer to those who would assign an *à priori* origin to the uniformity of Nature, says: "I must protest against adducing, as evidence of the truth of a fact in external nature, the disposition, however strong or however general, of the human mind to believe it." Yet Martineau following Trendelenburg, whose lectures he had attended in Germany forty years before, adopted, as his view of the limits of human intelligence, that Kant was right in making space and time *à priori* forms of sense, but wrong in limiting them to sensations. But in order to make space a form of external things, Martineau had to take the external in space, by which Kant meant one sensation out of another, in the very different meaning of the self here and the not-self there. He facilitated this awkward transition by adding to Kant's *à priori* forms of space and time an "*à priori* form of alternative causality," or, as he also called it, "an intuition of causality involved in the elementary exercise of perception," which is the key to his whole philosophy. He supposed that this intuition of causality arises when will is resisted, and, further supposing that causality requires decision between alternatives, concluded that the intuition of will resisted is an intuition of will against will, mine against other (i. 65). To pass over its confusion of *à priori* and intuitive, there are two fatal objections to this view. In the first place, the intuition of causality does not require will at all, because we often perceive one bodily member pressing another involuntarily; a man suffering from lockjaw neither wills nor can avoid feeling the pressure of his upper and lower jaws against one another. Secondly, though causality requires alternatives in the material cause, *e.g.*, wax may or may not be melted, the determination between them is not always a decision of will, but in physical causation depends on the efficient cause, *e.g.*, the fire: as Aristotle says, when the active and passive powers approach, the one must act and the other suffer, and it is only in rational powers that will decides (*Met.* Θ 5). Martineau's philosophy thus falls to the ground, or rather stumbles at the start. We perceive and infer other causes than will. If allowed, however, to proceed, by combining *à priori* forms of space, time, and causality consisting of will, and holding that they are not only subjective but also objective forms, he arrives at a theory of immediate perception of the external world, involving a knowledge of both phenomena and noumena, and a dualism of ego and non-ego, reciprocally cause and effect, here and there in space, will *vis-à-vis* to will. Founded on this theory of the limits of human intelligence is his theism. If, he said, we consider cause and effect as judged by the observer of nature, we find that, while the cause of a phenomenon is always a noumenon, the relation between phenomena is, as Hume said, not a real causality. He concluded that, in order to arrive at causality, one must throw oneself into the field as agent, and then one finds antagonist agents, other wills, and ultimately the will of God. All causality then is, according to him, our will and God's will. "By *self*," says he, "we mean the will internal; by 'God' we mean the will external; by *cause* we mean either; and as the two former come into our knowledge as terms of a relation under the category of the latter, it is impossible for either extreme to lapse into the other" (ii. 176). This theory reminds us at once of the Panthelism of Schopenhauer and the Panpneumatism of Hartmann. But it is superior to both, because it recognizes intelligence in all will, without confusing either with the unconscious. Martineau also justly claimed to have freed the human will from the Pantheistic absorption which is inherent in the Panlogism of Hegel. But, with all these merits, his own theory that all causality is "will *vis-à-vis* to will" leads to strange consequences. He spoke of the will to shut a door against a furious wind. But this on his theory could only mean will to shut the door against God's will, which is fate knocking at the door with a vengeance. In his eagerness to prove the causality of God's will he had to deny all secondary causes except our wills. He said that "however wide the sweep and durable the continuance of the laws of physical change, they are entrusted with no causality of their own, but are only the modes of the Divine action. The whole external universe then (external, I mean, to self-conscious beings), we unreservedly surrender to the In-dwelling Will, of which it is the organized expression" (ii. 176). What then becomes of Nature? Like Spencer, Martineau used the term "phenomenon" in so many varieties of sense, that we cannot attach any definite meaning to his calling Nature "the assemblage of *phenomena*, *i.e.*, of what comes and goes." But we can understand what he meant when he said that no phenomenon causes any change in any other phenomenon; he meant that no body is a cause, and that God's will and ours are the sole causes. This belittling of Nature, to magnify God and ourselves, deserts truth and defeats its own object. On the one hand, to deny that Nature is a *vera causa*, and resolve it into a sequence of phenomena, is to desert the truth that bodies are real substances and real causes by their interresistant pressure: when, for example, I try to shut the door against the wind, the wind's pressure counteracts the door's pressure directly and mine indirectly. On the other hand, to set God's will *vis-à-vis* to man's will is to make both ridiculous. God is the primary cause of all secondary causes, voluntary and involuntary; and, the greater the involuntary power of Nature, the mightier the voluntary power of the Creator and Governor of the world. *Cœli enarrant Dei gloriam.*

A. J. Balfour in *The Foundations of Belief, being Notes Introductory to the Study of Theology* (1895), begins by maintaining that the evidence of the senses is not a foundation of belief, and then expects us to believe in Nature and in God. Aristotle said that without sense there is no science, because there is no proceeding from universals without induction nor by induction without sense; and, again, that perceiving nothing we could learn and understand nothing. Bacon said, "Nos vero non Acatalepsiam sed Eucatalepsiam meditamur et proponimus: sensui enim non derogamus sed ministramus; et intellectum non contemnimus sed regimus." But Balfour has revived that very "Acatalepsia" of the New Academy. In Part II., chapter i., he makes three assumptions about the senses, and, without stopping to prove them, or even to make them consistent, deduces from them his thesis that the evidence of the senses is not a foundation of belief in Nature. He first assumes an immediate experience of a body, *e.g.*, a green tree; and then deduces that the evidence of the senses proves now and then to be fallacious, because we may have an experience indistinguishable from that of a tree but incorrect; and further, that our perceptions are habitually mendacious, because all visual experiences are erroneous, as colour is a sensation while the thing consists of uncoloured particles. This argument from a pure assumption is a confusion of sense and inference. The sense of vision perceives a sensibly visible picture, *e.g.*, green, which is always really as perceived: inference, usually rightly, though sometimes wrongly, infers a tree, and always is wrong when it infers that a tree is green like sensible green, but right when it infers that a tree is green in reflecting corresponding undulations. In no case is the evidence of the senses fallacious or mendacious; the fallacy is in the inference. He next assumes that we have no immediate experience of independent things such as has been gratuitously supposed, and by himself, but that what is immediately experienced is mental facts; or in other words, that sense perceives sensations, feelings, or ideas; while all else, *e.g.*, a tree, is a matter of inference. On this quite new assumption of a sense of sensations he deduces that, from a perception of these mental facts, we could not infer material facts, *e.g.*, a tree; so that again the evidence of the senses does not afford trustworthy knowledge of the material universe. His deduction is logical; but he has forgotten to prove the assumption, and now confuses sensory operation with sensible object. Vision does not perceive a sensation of colour; it perceives a visible picture, *e.g.*, green, which is in the organism, but has never been proved to be a mental fact, or not to be a material fact. So touch perceives not a sensation of pressure, but a pressure which is a material fact in the organism. From a material pressure within we logically infer a material pressure outside. He thirdly assumes an appendix to the second assumption: he assumes that sense perceives mental sensations with succession but without causality, because no kind of cause is open to observation. On this assumption of a sense of sensations but not of causality he deduces that we could not from such data infer any particular kind of cause, or a bodily cause, *e.g.*, a tree, or indeed any cause at all, or any event beyond perception, without assuming the principle of causation that Nature is uniform in cause and effect over great intervals of time and space, assuming it without experience ready-made, and believing it beforehand. But he gives absolutely no proof of the assumption that there is no sense of causality. There is none in the subsidiary senses, because none of them perceives the pressures exerted on them. But the primary sense of touch perceives one bodily member causing pressure on another, reciprocally, within the organism, from which we infer similar particular pressures caused between the organism and the external world; but without needing the supposed stupendous belief and assumption of the uniformity of Nature, which is altogether ignored in the inferences of the ordinary man. Finally, as touch perceives reciprocal pressure within, and tactile inference infers it without, touch is the primary evidence of the senses which is the foundation and logical ground of our belief in Nature as a system of pressing bodies. Balfour, however, having from unproved assumptions denied the evidence of the senses, and the rational power of using them to infer things beyond oneself, has to look out for other, and non-rational, foundations of belief. He finds them in the needs of man. According to him, we believe in Nature because it satisfies our material needs, and in God because He satisfies our spiritual needs. But bare need, *e.g.*, a pang of hunger, is no cause of belief beyond itself; and desire, or need of something prospective, *e.g.*, a desire of food, is effect, not cause, of a previous belief that there is such a thing, and of a present inference that it may again be realized. Moreover, when the belief or inference is uncertain, need even in the shape of desire is not in itself a foundation of belief in the thing desired: to need a dinner is not to believe in getting it; and, as Aristotle said, "there is a wish for impossibilities." It is fair, however, to add that Balfour has a further foundation for the belief in Nature, the survival of the fittest, by which those only would survive who possessed and could transmit the belief. But here he fails exactly as Darwin himself failed. Darwin said, given that organisms are fit, they will tend to survive; but he failed to show how they become fit. Balfour says, given that men believe in Nature, they will survive; but he fails to show how they come to believe in it. Inference from sense is the one condition of all belief in anything beyond oneself, whether it be Nature, or Authority, or God; and it is the one condition of all needs, which are not mere feelings, but desires of things. The result of undermining this sure foundation emerges in Balfour's attitude to the beliefs themselves. He holds that space, time, matter, motion, force, are all full of the insoluble contradictions supposed by Spencer; and that all our beliefs, in Nature and in God, stand on the same footing of approximations. Hence his really valuable arguments from Nature to God sink to the problematic form—there may be Nature; if so, there is God. Such is the modern "Acatalepsia," which arises from denying the evidence of the senses, and from citing the transfigured realism of Spencer instead of the original realism of Aristotle, about whom Balfour speaks as follows: "It would be difficult, perhaps impossible, to sum up our debts to Aristotle. But assuredly they do not include a tenable theory of the universe."

(4) *The Past and Future of Metaphysics.*—Aristotelian realism is the strong point of Roman Catholic philosophy. As interpreted by Thomas Aquinas, it is now in danger of becoming a dogma. In 1879 Pope Leo XIII. addressed to the bishops the *Encyclica Æterni Patris,* which contained the words, *Sancti Thomæ sapientiam restituatis et quam latissime propagetis.* From the Roman Catholic point of view, this reaction to "Thomism" was a timely protest against modern metaphysics. It was founded upon a feeling of uneasiness at a growing tendency among Roman Catholic writers not only to treat theology freely, but to corrupt it by paradoxes. Thus the French philosophy of Cousin was suspected by the Vatican of pantheism; the German philosophy of Günther, "Cartesius correctus," was condemned at Rome in 1857; and in 1888 the Italian philosophy of Rosmini, which leant towards German idealism, was condemned by Leo XIII. himself. The Jesuits regarded modern philosophy as the pathology of human reason, and they were at the bottom of the movement. Perhaps they were not altogether mistaken. One cannot but feel regret at seeing the Reformed Churches blown about by every wind of doctrine, and catching at straws now from Kant, now from Hegel, and now from Lotze, or at home from Green, Caird, Martineau, Balfour, and Ward in succession, without ever having considered the basis of their faith; while the Roman Catholics are making every effort to ground a Universal Church on a sane system of metaphysics. However this may be, the power of the movement is visible enough from the spread of Thomism over the civilized world, and in England from the difference between the freer treatment of metaphysics by some of our Roman Catholic writers and that which has arisen under the immediate influence of Thomism. J. H. Newman (1801–1890), maintaining the authority of conscience and the probabilism of the understanding, concluded to the necessity of a higher authority in the primitive Church. W. G. Ward was a philosophical critic of Mill. St George Mivart, in *The Ground-work of Science* (1898), maintained the reality of an active causative power underlying Nature, and the dignity of human reason, from an independent point of view. On the other hand, more under the influence of the Thomist reaction Thomas Harper has published *The Metaphysics of the School* (1879, &c.), describing scholasticism, as it appears in the works of Aquinas; and *The Manuals of Catholic Philosophy,* edited by R. F. Clarke, include *General Metaphysics* (1890), by J. Rickaby, who effectively criticizes Hegel by precise distinctions, which, though scholastic, did not deserve to be forgotten.

The Thomist reaction has had a good effect in the way of encouraging the study of Aristotelian philosophy, in itself and as modified by Aquinas. Nevertheless, the world cannot afford to surrender itself to Aristotle, or to Aquinas; the master had too many weak points, and the commentator has corrected too few of them. Aristotle could not know enough, physically, about Nature to understand its matter, or its motions, or its forces; and consequently he fell into the error of supposing a primary matter with four contrary primary qualities, hot and cold, dry and moist, forming by their combinations four simple bodies, earth, water, air, and fire, with natural rectilineal motions to or from the centre of the earth; to which he added a quintessence of ether composing the stars, with a natural circular motion round the earth. Metaphysically, he did not, indeed, as is often supposed, think the nature of substance to be matter and form, because in his view God is a substance, yet with no matter; but he did think that every natural substance, or body, is a concrete whole, composed of matter and form different from matter. He thought that besides proximate matter, or one body as matter of another, there is a primary formless matter beneath all bodies, capable of becoming all in turn, but itself potentially, not actually, substance. He thought not only that a form, or essence, is something different from, and at most conjoined with, matter in a concrete body, but also that in all the bodies of one kind, *e.g.*, in all men, there is one undivided form or essence, *e.g.*, rational animal, communicated from one member to another member of the kind, *e.g.*, from father to son, by what we still call, though without any meaning, the propagation of the species. He thought, in consequence, that the *principium individuationis*, which differentiates two members of the kind, *e.g.*, Socrates and Callias, is their one form or essence only as conjoined with different matters, *e.g.*, different bones and flesh. He thought, moreover, that the one form of a kind is an original essence (τὸ τί ἦν εἶναι), which is uncreate; and, in order to avoid the "separate forms" supposed by Plato, he concluded that the world of Nature must be eternal, in order that each original essence may from eternity always be in some individual or another of its kind. On this assumption of the eternity of the world, God could not be a Creator. Aristotle thought that God is only prime mover, and that too only as the good for the sake of which Nature moves; so that God moves as motive. Psychologically, Aristotle applied his dualism of matter and form to explain the antithesis of body and soul, so that the soul is the form, or entelechy, of an organic body; and he applied the same dualism to explain sensation, which he supposed to be reception of the sensible form or essence, without the matter, of a body, *e.g.*, of the form of white, without the matter, of a white stone. He thought that in the soul (ἐν τῇ ψυχῇ) there is a productive intellect and a passive intellect, and that, when we rise from sense by induction, the productive causes the passive intellect to receive the universal form or essence, *e.g.*, of all white things; and he thought that this productive intellect is our immortal faculty. Lastly, he thought that, while other operations have, intellect (νοῦς) has not, a bodily organ; and hence he became responsible for the fancy that there is a break in bodily continuity between sense and will, while intellect is working out a purely immaterial operation of soul, resulting from the former and tending to the latter. It is evident that a philosophy containing so many questionable opinions is not fit to be made into an authoritative orthodoxy in metaphysics.

Now these, on the whole, are the very opinions of Aquinas (1225–1274), except so far as they were clearly inconsistent with the Christian faith. Aquinas thought, as an article of faith, that the world began, and that God is its Creator. This Christian difference from Aristotle involved a change of detail in the theory of essences and of universals generally. Aquinas thought that before the creation the one eternal essence of any kind was an abstract form, an idea in the intellect of God, like the form of a house in the mind of a builder, *ante rem;* that after the creation of any kind it is *in re*, as Aristotle supposed; and that, as we men think of it, it is *post rem*, as Aristotle also supposed. Of this view the part which was not Aristotle's, the state of "universalia ante rem," was due to the Neo-Platonists, who interpreted the "separate forms" of Plato to be ideas in intellect, and handed down their interpretation through St Augustine to the mediæval Realists like Aquinas, who thus combined Neo-Platonism with Aristotelianism. Hence too Aquinas opposed essence to existence much more than Aristotle did. Lastly, as a Christian, he supposed the whole soul to be immortal, and to form for itself a new body after death. But, with these modifications he accepted the general physics of Aristotle, the metaphysical dualism of matter and form, and the psychology founded upon it. The Thomism, therefore, of our day is wrong, from a metaphysical point of view, so far as it elevates Aristotelianism, as seriously modified but not fundamentally corrected by Aquinas, into an authoritative orthodoxy in metaphysics.

Centuries elapsed after Aquinas before Galileo and his successors reformed natural science, and before Bacon destroyed the metaphysical dualism of matter and form by showing that a form in Nature is only a law of the action of matter, and that, as the action of a body is as individual as the body, the form is eternal only in thought (*ratione*). The psychology of Aristotle and Aquinas thus became impossible; for, if the form of a body is only a mode of matter, to call one's soul the form of one's body is to reduce it to only a mode of matter, and fall into materialism. Hence Descartes began the reform of psychology not only by the appeal to consciousness, "I think," but also by opposing body and soul, no longer as matter and form, but as different substances. These great improvements, due to the genius of Galileo, of Bacon, of Descartes, are the fresh beginnings of modern thought, from which we dare not turn back without falling into obscurantism. What, then, is the future of metaphysics? We must return not to the authority but to the study of Aristotle. The independence of metaphysics as the science of being, the principles of contradiction and excluded middle with their qualifications, the distinction without separation between substance and attributes, the definition of substance as a distinct individual thing, the discovery that the world consists of substances existing apart but related to one another, the distinction between material and efficient causes or matter and force, the recognition both of the natural and of the supernatural—all these and many other half-forgotten truths are the reasons why we must always begin with the study of Aristotle's *Metaphysics*. But their incompleteness shows that we must go forward from Aristotle to Bacon and modern science, and even pass through the anarchy of modern metaphysics, in the hope that in the future we may discover as complete an answer as possible to these two questions:—

1. What is the world of things we know?
2. How do we know it?

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Meteor.—Meteors, or shooting stars, as they are familiarly called, are minute bodies which, moving through space, are raised to incandescence by encountering the atmosphere of the earth. Great swarms of these bodies move in streams along common orbits. The outburst of several meteors belonging to the same stream is called a shower, and every shower has a radiant point from which the paths of all its meteors are directed. During the last quarter of the 19th century a large number of radiant points of meteoric showers have been made out. The number of such points known in 1876 was 850, whereas in 1899 it had risen to 4400, but they do not all represent different systems. The great majority of meteoric streams are very feeble, but the displays arising from a few recur at intervals with brilliant effect. The following is a list of the dates and radiants of some of the principal showers:—

Date	Radiant R.A. Dec.	Date.	Radiant R.A. Dec.
Jan. 2–3	230°+53°	Aug. 30–Sept. 2	47°+43°
Feb. 10–15	74 +43	Sept. 10–15	62 +37
March 1	166 + 5	Sept. 21–22	74 +41
March 28	263 +62	Oct. 2	230 +52
April 19–22	270 +33	Oct. 18–20	92 +15
May 2–6	338 − 2	Oct. 29–Nov. 1	43 +22
May 11–18	231 +27	Nov. 2	55 + 9
May 30	333 +27	Nov. 14–16	151 +22
June 3–7	250 −22	Nov. 20–23	63 +22
July 15–19	314 +48	Nov. 23–24	25 +44
July 28–30	339 −12	Nov. 25	154 +40
Aug. 10–12	45 +57	Dec. 6	80 +23
Aug. 12–15	292 +53	Dec. 10–12	108 +33
Aug. 21–23	291 +60	Dec. 12	119 +29

The August shower of Perseids is annually visible for several weeks (July 11 to August 20), the radiant having a daily motion of 1° to the E.N.E. The October Orionids are to be seen during three weeks from a fixed radiant. Some showers appear to be of short duration, while others continue for several weeks, if not months. Probably more than 100 meteor showers of very feeble character are in action on every night of the year. The Lyrids (April 19–22), Leonids (November 14–16), and Andromedids (November 23–24) are periodical, and sometimes make brilliant displays. The Quadrantids (January 2–3), Perseids (maximum, August 10–12), Orionids (October 18–20), Geminids (December 10–12), and other systems recur annually without any great variation of strength. Bright returns of the Leonids will probably be witnessed in November 1933, 1934, 1966, &c. The Andromedids should reappear in November 1905, in 1912–13, and 1918–19.

In the spectroscope most bright meteors show the green line of magnesium as a principal constituent. In a large meteor of 26th July 1873, Professor Konkoly remarked the lines of magnesium and sodium. Other lines in the red and green have been seen, and found by comparison identical with the lines of marsh gas. Bright meteors often emit the bluish white light suggestive of burning magnesium. In addition to magnesium and sodium, the lines of potassium, lithium, and also the carbon flutings exhibited in cometary spectra have been seen.

The movements of those meteorites which have actually been seen to fall upon the earth have been investigated by Professor Newton with a view to ascertaining the character of their orbits. In the great majority of cases he found that they had moved in direct orbits, inclined less than 90°, and that their perihelion distances were between 0·5 and 1·0, the earth's distance from the sun being unity. His opinion was therefore that the large meteorites moving in our solar system are allied much more closely with the group of short-period comets than with parabolic comets. This is true also of the large, slow-moving fireballs which are consumed in our atmosphere and do not reach the ground. The writer, comparing a large number of observations of these objects which appeared during the 19th century, finds that the majority travelled slowly from radiant points near the horizon, and from directions in which they must necessarily have overtaken the earth in her orbit. This suggests a community of origin between stony meteorites which have been seen to fall, fireballs which are burnt up and dissipated in the air, and comets of short period.

Meteoric observation has depended upon rough and hurried eye-estimates in past years, but the importance of ensuring greater accuracy by means of photography has recently been recognized. At Yale, Harvard, and Northfield observatories and at Vienna, photographic determinations were made of the radiant of the inconspicuous Leonid meteor-shower of 1898. They give a mean of R.A. 151° 33′, Dec. +22° 12′. This is probably much more correct than the average place of 109 various eye-determinations of the same radiant, which put it at R.A. 149° 40′, Dec. +22° 42′. In 1899 elaborate preparations were made in various places to observe the shower and to obtain photographic trails of as many meteors as possible, but the expected display failed to assume a striking character, and the photographic method resulted in practical failure. Calculations indicate that the group of meteors has been disturbed by the powerful attraction of Jupiter and Saturn, and that probably the swarm passed more than a million of miles inside the earth's orbit instead of nearly intersecting it as formerly. But as we do not know the exact width of the stream or the amount of the perturbations it has suffered, the display may yet recur with some of its former brilliancy.

About 1866 the orbit elements of four well-observed comets were found to present a great affinity to, if not actual identity with, the orbits of four of the best-known and most brilliant meteoric streams. More recent years have added few, if any, well-defined correspondences of similar character, though the orbit of a shower of Aquarids, occurring early in May, offers a suggestive resemblance to the path of Halley's comet. It may be thought surprising, when the large number of cometary and meteoric systems are considered, that so few accordances have been detected, but the explanation is that really very few comets pass near enough to the earth to give rise to showers of meteors. Of eighty comets observed during the twenty years ending 1893, Professor Herschel found that only two, viz., Denning's comet of 1881 and Finlay's of 1886, approached comparatively near to the earth's path, the former within 3,000,000 miles and the latter to within 4,600,000. (See Comets.)

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(W. F. D.)

METEOROLOGY.

PROPERLY speaking, meteorology is the study of all the phenomena of the gaseous atmosphere that surrounds the earth and extends to some unknown outer surface that marks the beginning of the so-called interstellar space. These phenomena may be studied either individually or collectively. The collective study has to do with statistics and general average conditions, sometimes called normal values, and is known as *Climatology*. The study of the individual items may be either descriptive, explanatory, physical, or theoretical. Physical meteorology is again subdivided according as we consider either the changes that depend upon the motions of masses of air or those that depend upon the motions of the gaseous molecules; the former belong to hydrodynamics, and the latter are mostly comprised under thermodynamics, optics, and electrics.

The general problems of climatology are best presented in the *Lehrbuch* of Dr Julius Hann (second edition, Strasburg, 1896). The general distribution of temperature, winds, and pressure over the whole globe was first given by Buchan in charts published by the Royal Society of Edinburgh in 1868, and again greatly revised and improved in the volume of the *Challenger* reports devoted to meteorology. The most complete atlas of meteorology is Buchan and Herbertson's edition of Bartholomew's *Atlas*, published in London in 1899. Extensive works of a more general character have been published by the London Meteorological Office, and the Deutsche Seewarte for the Atlantic, Pacific, and Indian Oceans. Daily charts of atmospheric conditions of the whole northern hemisphere were published by the U.S. Weather Bureau from 1875 to 1883 inclusive, with monthly charts for succeeding years. The physical problems of meteorology were discussed in Ferrel's *Recent Advances in Meteorology*, Washington, 1885. Mathematical papers on this subject will be found in the author's collection known as *The Mechanics of the Earth's Atmosphere*, second edition, Washington, 1893; the memoirs by Helmholtz and Von Bezold contained in this collection have been made the basis of a most important work by Brillouin, Paris, 1898, entitled *Vents Contigus et Nuages.* A general summary of our knowledge of the mechanics and physics of the atmosphere is contained in the Report on the International Cloud Work by F. H. Bigelow, Washington, 1900. The extensive treatise on meteorology by Dr Julius Hann (1901) is an authoritative work. The optical phenomena of the atmosphere are well treated by Mascart in his *Traité d'Optique*, Paris, 1891–98. Of minor treatises especially adapted to popular reading, or to school use, or collegiate courses of study, we may mention those by Sprung, Berlin, 1885; Ferrel, New York, 1890; Angot, Paris, 1898; Davis, Boston, 1893; Waldo, New York, 1898; Van Bebber, Stuttgart, 1890; Moore, London, 1893; Russell, New York, 1895.

I. FUNDAMENTAL PHYSICAL DATA.

Atmospheric air is a mixture of nitrogen, oxygen, aqueous vapour, carbonic acid gas, ammonia, argon, neon, helium, and possibly traces of free hydrogen and hydrocarbons. The proportions in which these gases are present are quite constant, except that the percentage of aqueous vapour is subject to large variations. In an atmosphere that is saturated at the temperature of 90° F., as may occur in such a climate as that of Calcutta, the water may be $2\frac{1}{2}$ per cent. of the whole weight of any given volume of air. When this aqueous vapour is entirely abstracted, the remaining dry gas is found to have a very uniform constitution in all regions and at all altitudes where examination has been carried out. In the so-called dry atmosphere the relative weights are about as follows:—Oxygen, 23·16; nitrogen and argon, 76·77; carbonic acid, 0·04; ammonia and all other gases, less than 0·01 in the lower half of the atmosphere, but probably in larger percentages at great altitudes. The two constituents, argon and neon, were discovered by Rayleigh and Ramsay in January, 1895; in 1898 Ramsay and Travers announced the presence of krypton. The density of argon is about 19·9, that of oxygen 16, and that of nitrogen 14, when hydrogen is unity. Dewar has so perfected the process of reaching low temperatures that liquid hydrogen has been produced, and by its means all the more easily condensed gases contained in atmospheric air have been removed, so that there is left in the experimental tube a minute quantity of less condensible gases, such as helium. These exceedingly volatile components of the atmosphere cannot apparently be held down to the earth by the attraction of gravitation, but are continually diffusing through the atmosphere outwards into interstellar space, and possibly also from that region back into the atmosphere. There are doubtless other volatile gases filling interstellar space and occasionally entering into the atmosphere of the various planets as well as of the sun itself; even the hydrogen and hydrocarbons that escape from the earth into the lower atmosphere undoubtedly ascend to regions inaccessible to man and slowly diffuse into the outer space. The laws of diffusion show that for each gas there is an altitude at which as many molecules diffuse inwards as outwards in a unit of time. This condition defines the outer limit of each particular gaseous atmosphere, so that we must not imagine the atmosphere of the earth to have any general boundary. The only intimation we have as to the presence of gases far above the surface of the globe comes from the phenomena of the refraction of starlight, the morning and evening twilight, and especially from the shooting stars which suddenly become luminous when they pass into what we call our atmosphere. Such observations are supposed to show that there is an appreciable quantity of gas at the height of one hundred miles, where it may have a density of a millionth part of that which prevails at the earth's surface.

According to Professor E. W. Morley, of Cleveland, Ohio, the relative proportions of oxygen and nitrogen vary slightly at the surface of the earth according as the areas of high pressure and low pressure alternately pass over the point of observation; his remarkably exact work seems to show a possible variation of a small fraction of 1 per cent., and he suggests that the air descending within the areas of high pressure is probably slightly poorer in oxygen. The proportion of carbonic acid gas varies appreciably with the exposure of the region to the wind, increasing in proportion to the amount of the shelter; it is greater over the land than over the sea, and it also slightly increases by night-time as compared with day, and in the summer and winter as compared with the spring and autumn months. During the year 1896 Professor Arrhenius in the *L. E. D. Philosophical Magazine*, and in 1899 Professor Chamberlin in the *American Geological Journal*, published memoirs in which they argue that a variation of several per cent. in the proportion of carbonic acid gas is quite consistent with the existence of animal and vegetable life, and plausibly explains the cold climate of any glacial period. The question whether free ozone exists in the atmosphere is still debated, but there seems to be no satisfactory evidence of its presence, except possibly for a few minutes in the neighbourhood of, and immediately after, a discharge of lightning. In the case of still air the general proportions of the principal gases up to considerable altitudes can be calculated with close approximation by the laws of diffusion and elastic pressure; on the other hand, actual observations show that the rapid convection going on in the atmosphere changes these proportions and brings about a fairly uniform percentage of oxygen, nitrogen, and carbonic acid gas up to a height of ten miles. The quantity of aqueous vapour is controlled by temperature quite as much as by convection, and has very little to do with diffusion; the law of its distribution in altitude has been well expressed by Hann by the simple formula: $\log e = \log e_0 - h/6517$ where h is the height expressed in metres and e and e_0 are the vapour tensions at the upper station and sea-level respectively. Thus, if the vapour tension is 10 millimetres at sea-level corresponding to saturation at a temperature of about 11° C. or 52° F., then the pressure and the dew-point at other altitudes should be about as follows:—

Altitude.	Vapour Pressure.	Dew-Point.
Kil.	Mm.	° C.
0	10·00	+11·4
5	6·87	+ 5·8
10	4·59	+ 0·1
15	2·98	− 5·0
20	1·86	−10·6
30	0·64	−22·0
40	0·18	−34·2
50	0·04	−48·0
60	0·00	?

In addition to the gases and vapours in the atmosphere, both meteorology and hygiene have come to consider the motes of dust as very important constituents. The aqueous particles that constitute cloud, fog, and haze are also important. As all these float in the air, slowly descending, but resisted by the viscosity of the atmosphere, their whole weight is added to the atmosphere and becomes a part of the barometric record. When the air is cooled to the dew-point and condensation of the vapour begins, it takes place first upon the atoms of dust as nuclei; consequently, air that is free from dust is scarcely to be found except within a mass of cloud or fog.

According to a calculation published in the *U.S. Monthly Weather Review* for February 1899, the total mass of the atmosphere is 1/1,125,000 of the mass of the earth itself, but, according to Professor R. S. Woodward (see *Science* for January 1900), celestial dynamics shows that there may possibly be a gaseous envelope whose weight is not felt at the earth's surface, since it is held in dynamic equilibrium above the atmosphere; the mass of this outer atmosphere cannot exceed $\frac{1}{1200}$th of the mass of the earth, and is probably far less, if indeed it be at all appreciable.

Physical properties.

There can be no proper study of meteorology without a consideration of the various physical properties of the atmosphere's gases and vapours, each of which plays an independent part, and yet also reacts upon its neighbours.

Conductivity.—Dry air is a poor conductor of heat, its coefficient of conduction being expressed by the formula: $0{\cdot}000\,0568\,(1+0{\cdot}00190t)$ where the temperature (t) is expressed in centigrade degrees. This formula states the fact that a plate of air 1 centimetre thick can conduct through its substance for every square centimetre of its area, in one second of time, when the difference of temperature between two faces of the plate is 1° C., enough heat to warm 1 gram of water 0·000 0568° C., or 1 gram of air 0·000 239° C., or a cubic centimetre of air 0.1850° C., if that air is at the standard density for 760 millimetres of pressure and 0 degrees of temperature centigrade.

Diathermancy.—The air is extremely diathermanous or transparent to the general transmission of radiant heat. In general the coefficient of transmission increases as the heat waves become longer, but certain wave-lengths or kinds of heat are specifically absorbed. The general coefficient of transmission for a zenithal sun is 0·4 at the violet and 0·8 at the red end of the spectrum. By the specific absorption certain long wave-lengths are entirely cut off by aqueous vapour and others by the carbonic acid gas, so that in general the atmosphere appears to be more transparent to the short wave-lengths. When the zenithal sun's rays fall upon a station whose barometric pressure is 760 millimetres, then only from 50 to 80 per cent. of the total heat reaches the earth's surface, and thus the general coefficient of transmission for the thickness of one atmosphere is usually estimated at about 60 per cent. Of course when the rays are more oblique, or when haze, dust, or cloud interfere, the transmission is still further diminished. In general one-half of the heat received by the illuminated atmosphere is absorbed by it, leaving the other half to reach the surface of the ground, provided there be no intercepting clouds. The thermal conditions actually observed at the immediate surface of the globe may therefore be of minor importance in the mechanism of the atmosphere.

Specific Heat.—The capacity of the air for heat varies according as the heat increases the volume of the air expanding under constant pressure, or the pressure of the air confined in constant volume. The specific heat under constant pressure is about 1·406 times the specific heat under constant volume. The numerical value of the specific heat under constant pressure is about 0·2377; that is to say, that number of calories, or units of heat, is required to change the temperature of 1 gram of air by 1° C. This coefficient holds good, strictly speaking, between the temperatures minus 30° and plus 10° C., and there is a very slight diminution for higher temperatures up to 200°.

Radiating Power.—The radiating power of dry air is so small that it cannot be measured quantitatively, but the spectroscope and bolometer demonstrate its existence. The coefficient of radiation of the moisture diffused in the atmosphere is undoubtedly much larger than that of the particles of dust and cloud, and is nearly equal to that of a lamp-black surface, or unity. From the normal diurnal change in temperature at high and low stations, it should be possible to determine the general coefficient of atmospheric radiation for the average condition of the air in so far as this is not obscured by the influence of the winds. This was first done by Maurer in 1885, who obtained a result in calories that may be expressed as follows:—The total radiation in twenty-four hours of a unit mass of average dusty and moist air towards an enclosure whose temperature is 1° lower is sufficient to lower the temperature of the radiating air by 3·31° C. in twenty-four hours. This very small quantity was confirmed by the studies of Trabert, published in 1892. The direct observations of Hutchins on dry dusty air, as published in 1890, gave a much larger value—evidently too large. The investigation of this subject prosecuted by Professor F. W. Very at the Allegheny Observatory, and published as "Bulletin G" of the U.S. Weather Bureau, shows the character and amount of the radiation of several gases, and especially the details of the process going on under normal conditions in the atmosphere.

Density.—The absolute density or weight of a cubic centimetre of dry air at the standard pressure, 760 millimetres, and temperature 0° C., is 0·001 29305 grams; that of a cubic metre is 1·29305 kilograms; that of a cubic foot is 0·08071 pounds avoirdupois.

Expansion.—The air expands with heat, and the expansion of aqueous vapour is so nearly the same as that of dry air that the same coefficient may be used for the complex atmosphere itself as a whole. The change of volume may be expressed in centigrade degrees by the formula $V=V_0\,(1+0.000\,3665t)$, or in Fahrenheit degrees $V=V_0\,(1+0{\cdot}000\,237t)$.

Elasticity.—The air is compressed nearly in proportion to the pressure that confines it. The pressure, temperature, and volume of a true gas are connected by the equation $pv=\mathrm{RT}$, where T is the absolute temperature or 273° plus the centigrade temperature; p is the barometric pressure in millimetres and v the volume of a unit mass of gas, or the reciprocal of the density of the gas. The constant R is 29·272 when the centimetre, the gram, the second, and the centigrade degrees are adopted as units of measure, and differs for each gas. The number just given relates to dry atmospheric air. For aqueous vapour in a gaseous state and not near the point of condensation R has the value 47·061. For ordinary air in which x is the mass of the aqueous vapour that is mixed with the unit mass of dry air, the above equation becomes $pv=(29{\cdot}272+x47{\cdot}061)\,\mathrm{T}$. This equation is sometimes known as the equation of condition peculiar to the gaseous state. It may also be properly called the equation of elasticity or the elastic equation for gases, as expressing the fact that the elastic pressure p depends upon the temperature and the volume. The more exact equation demonstrated by Van der Waals, *i.e.*, $\left(p+\frac{a}{v^2}\right)(v-b)=\mathrm{RT}$, is not needed for the low pressures that occur in meteorology.

Diffusion.—In comparison with the winds, it may be said that it is difficult for aqueous vapour to diffuse in the air. In fact, the distribution of moisture is carried on principally by the horizontal convection due to the wind and the vertical convection due to ascending and descending currents. Diffusion proper, however, comes into play in the first moments of the process of evaporation. The coefficient of diffusion for aqueous vapour from a pure water surface into the atmosphere is 0·18 according to Stefan, or 0·1980 according to Winkelmann; that is to say, for a unit surface of one square centimetre, and a unit gradient of vapour pressure of one atmosphere per centimetre, as we proceed from the water surface into the still dry air, at the standard pressure and temperature, the quantity of moisture diffused is 0·1980 gram per second. This coefficient rises or increases with the temperature, and is 0·2827 at 49·5° C. But this rate of diffusion diminishes very rapidly at a small distance from the free surface of the water, so that the most important condition facilitating evaporation is the action of the wind.

Viscosity.—When the atmosphere is in motion each layer is a drag upon the adjacent one that moves a little faster than it does. This drag is the so-called molecular or internal friction or viscosity. The coefficient of viscosity in gases increases nearly in proportion to the absolute temperature, and its value is given by an equation like the following: $0{\cdot}000\,248\,(1+0{\cdot}003\,665t)^{2/3}$, which is the value given by Carl Barus (*Ann. Phys.* 1889, xxxvi.). This expression implies that for air whose temperature is the absolute zero there is no viscosity, but that at a temperature of 0° C., or 273° on the absolute scale, a force of 0·000 248 gram is required in order to push or pull a layer of air 1 centimetre square past another layer distant from it by 1 centimetre at a uniform rate of 1 centimetre per second. In treating of the general motions of the atmosphere it is quite common to consider the viscosity of the air as a resisting force, but the above figures show that it exerts an exceedingly feeble resistance as compared with the obstacles encountered on the earth's surface and the inertia of the rising and falling masses of warm and cold air. The coefficient of friction usually deduced from the observations of the winds results essentially not from viscosity, but from the resistances of all kinds to which the motion of the atmosphere is subjected. The greater part of these resistances consists essentially in a dissipation of the energy of the moving masses by their division into smaller masses which penetrate the quiet air in all directions. The loss of energy due to this process, if it must be called friction, should perhaps be called convective friction, or, more properly, convective loss of energy.

Gravity.—The weight of the atmosphere depends primarily upon the action of gravity, which gives a downward pressure to every particle. Owing to the elastic compressibility of the air, this downward pressure is converted at once into an elastic pressure in all directions. The force of gravity varies with the latitude and the altitude, and in any exact work its variations must be taken into account. Its value is well represented by the formula due to Helmert, $g=980{\cdot}6\,(1-0{\cdot}0026\cos 2\mathrm{L})\times(1-fh)$, where L represents the latitude of the station and h the altitude. The coefficient f is small and has a different value according as the station is raised above the earth's surface by a continent, as, for instance, on a mountain top, or by the ocean, as on a ship sailing over the sea, or in the free air, as in a balloon. Its different values are sufficiently well known for meteorological uses, and are utilized most discreetly in the elaborate discussion of the hypsometric formula published by Angot in 1899 in the memoirs of the Central Meteorological Bureau of France.

Distribution of temperature.

The temperature of the air, at the surfaces of both the earth and ocean and throughout the atmosphere, is the fundamental element of both climatology and dynamic meteorology. As far as it is known from direct observation, it is best exhibited by means of isotherms or lines of equal temperature drawn on charts of the globe. It can also be expressed analytically by harmonic spherical functions, as was first done by Schoch. The normal distribution of temperature for each month of the year over the whole globe has been given by Buchan in his charts of 1868 and of 1888, also by the U.S. Weather Bureau "Bulletin A" of 1893, and again by Buchan in his new edition of Bartholomew's *Physical Atlas*, London, 1899. The temperatures, as thus charted, first receive a slight correction, called a reduction to sea-level, in order to reduce them to a homogeneous system. The actual temperature near the ground at any altitude on a continent or island may be obtained from these charts by subtracting 0·5° C. for each 100 metres of elevation of the ground above sea-level, or 1° F. for 350 feet. This reduction, however, applies specifically to temperatures observed near the surface of the ground, and cannot be used with any confidence to determine the temperature of points in the free air at any distance above the land or ocean. On all such charts the reader will notice the high temperatures near the ground in the interior of each of the continents in the summer season and the low temperatures in the winter season. In February the average temperatures in the northern hemisphere are not lowest near the North Pole, but in the interiors of Siberia and North America; in the southern hemisphere they are at the same time highest in Australia, and Africa, and South America. In August the average temperatures are unexpectedly high in the interior of Asia and North America, but low in Australia and Africa. The vertical distribution in the free air must also be studied in detail, in order to understand both the general circulation and the special systems that characterize the earth's atmosphere. Many observations on mountains and by aëronauts in balloons were made during the 19th century in order to ascertain the facts with regard to the decrease of temperature as we ascend in the atmosphere, but it is now recognized that both these classes of observations were largely affected by local influences due to the presence of the ground and the balloon. Later efforts have been directed to the elimination of these disturbing elements, and the determination of the temperature of the free air by means of delicate thermographs carried up to great heights by small free "sounding balloons," and to lesser heights by means of kites. Many international balloon ascents have been made since 1890, and a large amount of information has been secured. Reports upon these results have been published by Dr H. Hergesell for Europe in general, and by L. Teisserenc de Bort relative to that done at his private observatory for dynamic meteorology at Trappes, near Paris. Valuable work has also been done with kites, both at Trappes and by Mr A. Lawrence Rotch at his private meteorological observatory on Blue Hill, near Boston; but the principal work with kites has been that accomplished in 1898 at the seventeen kite stations of the U.S. Weather Bureau. The first results of all this latter work are published in a memoir, "Bulletin F," by Dr H. C. Frankenfield, of which a summary is given in the *U.S. Monthly Weather Review* for September 1899. Some of the more general results are given in the following table:—

Stations.	Altitude.	Temperature.	
	Feet.	Gradient.	Reduction.
		Fahr. °	Fahr. °
Washington	210	−3·00	−15·2
Cairo	315	−4·30	−25·6
Cincinnati	940	−5·15	−27·5
Fort Smith	527	?	?
Knoxville	990	−5·00	−21·5
Memphis	319	−3·50	−17·3
Springfield	684	−3·85	−17·7
Cleveland	705	−4·10	−18·8
Duluth	1197	−4·30	−17·6
Lansing	869	−3·85	−17·0
Sault Ste Marie	722	−3·45	−15·7
Dodge	2473	−4·10	−11·6
Dubuque	894	−3·30	−14·5
North Platte	2811	−5·40	−13·3
Omaha	1241	−3·20	−12·9
Pierre	1595	−3·90	−14·4
Topeka	972	−3·83	−16·5

In this table the second column gives the altitude of the ground at the reel on which the kite wire was wound. The third column shows the average gradient in degrees Fahrenheit per 1000 feet above the reel at the respective stations, up to a uniform surface 5280 feet above sea-level. The fourth column shows the total reduction to be applied to the temperature at the reel in order to obtain the temperature at the one-mile level above sea. These gradients and reductions are based upon observations made only during the six warm months from May to October 1898. At the observatory of Trappes free balloons and kites were used during eighteen months, in 1898 and 1899, with sufficient frequency to give us some knowledge of the monthly gradients of temperature in a vertical direction and a fair average for a whole year. The following results are taken from the *U.S. Monthly Weather Review*, September 1899:—

Decrease of Temperature in Free Air.

Altitude above ground.	Annual.	May–Oct.	Nov.–Apr.
	Cent. °	Cent. °	Cent. °
Kil. 10	−60·1	−63·7	−56·5
9	−51·4	−54·5	−48·3
8	−44·7	−47·2	−42·2
7	−37·7	−39·5	−35·8
6	−30·2	−31·1	−29·2
5	−24·2	−25·3	−23·2
4	−18·3	−19·9	−16·7
3	−13·2	−15·3	−11·0
2	− 8·6	−10·3	− 6·8
1	− 4·0	− 5·7	− 2·3
0	0·0	0·0	0·0

It is evident that the annual average vertical gradient of temperature is between 4° and 6° C. per thousand metres of ascent in the free air. In the summer months —May–October—the gradient up to 6000 kilometres agrees closely with the value 5° per thousand metres, which has come into extensive use since the year 1890 on the recommendation and authority of Hann. The winter gradients are apparently less than those for summer, possibly owing to the influence of the condensation into cloud and rain during the winter season in France; the same value may not result from the kite work in the United States, where the clouds and precipitation of winter do not so greatly exceed those of summer. The work at Trappes is therefore not necessarily representative of the general average of the northern hemisphere, but belongs to a region in which during the summer time, at great heights, the air is cooler than in the winter time, since during the latter season there is an extensive flow of warm air from the ocean over the cold air from the land. The isotherms at 5000 and 10,000 metres altitude over all Europe, on three special days when many ascensions were made, are published by Hergesell in the *Met. Zeit.* for January 1900, and show unexpectedly great diversities at those altitudes.

Distribution of aqueous vapour.

The distribution of aqueous vapour is best shown by lines of equal dew-point or vapour tension, though for some purposes lines of equal relative humidity are convenient. The dew-point lines are not usually shown on charts, partly because the lines of vapour pressure are approximately parallel to the lines of mean temperature of the air, and partly because the observations are of very unequal accuracy in different portions of the globe. In general we may consider any isotherm as agreeing with the dew-point line for dew-points a few degrees lower than the temperature of the air. The distribution of moisture is quite irregular both in a horizontal and in a vertical direction. On charts of the world we may draw lines based on actual observations to represent equal degrees of relative humidity, or equal dew-points and vapour pressures; but as regards the distribution of moisture in a vertical direction we are, in the absence of specific observations, generally forced to assume that the vapour pressure at any altitude h follows the average law first deduced from a limited number of observations by Hann, and expressed by the logarithmic equation, $\log. e = \log. e_0 - h/6517$, which is quite analogous to the elementary hypsometric formula, $\log. p = \log. p_0 - h/18400$. Therefore, in general, the ratio between the pressure of the vapour and the pressure of the atmosphere at any altitude is represented by the approximate formula, $\log. e/p = \log. e_0/p_0 - h/10091$. Of course these relations can only represent average or normal conditions, which may be departed from very widely at any moment. They have, however, been found to agree remarkably with all observations which have as yet been published. The average results are given in the following table, which is abbreviated from one published by Hann, but with the addition of the work done by the U.S. Weather Bureau, as reduced by Dr Frankenfield in 1899.

It is therefore evident that the formula first published by Hann in 1874 as the result of observations on fifteen balloon ascents and six mountains, by means of which the last line in the table was computed, is abundantly confirmed by the Weather Bureau work in the United States with kites and balloons. The distribution of vapour it indicates is wholly different from that assumed by Dalton and the physicists who followed him. It is not the law of diffusion, but it agrees so closely with actual observations up to altitudes of five miles that we may safely assert that the vapour constituent of the atmosphere is not distributed according to the law of gaseous diffusion, but, like temperature and the ratio between oxygen and nitrogen, is controlled by other laws prescribed by the winds and currents, namely—convection.

Diminution of the Relative Vapor Pressure with Altitude.

Authority.	1500 feet.	2000 feet.	3000 feet.	4000 feet.	5000 feet.	6000 feet.	7000 feet.	8000 feet.	No. Obs.
Kites.	0·82	0·78	0·70	0·61	0·52	0·49	0·39	0·44	1123
U.S. W.B. Balloons.	0·97	0·96	0·87	0·68	0·44	0·59	—	—	4
Hammon. Balloons.	0·89	0·83	0·80	0·78	0·67	0·46	0·44	—	2
Hazen. Balloons.	0·84	0·80	0·66	0·61	0·50	0·54	0·41	0·37	15
Hann. Mountains.	0·83	0·81	0·80	0·66	0·61	0·58	0·55	0·47	[illegible]
Hann. Computed by Hann.	0·85	0·81	0·72	0·65	0·58	0·52	0·47	0·42	—

Note.—The vapour pressure at any altitude is supposed to be expressed as a fraction of that observed at the ground. When the altitudes are given in feet Hann's formula becomes $\log e/e_0 = -h/29539$.

The total amount of vapour in the atmosphere is between one-fourth and one-fifth of the amount required by Dalton's hypothesis, as is illustrated by the following table taken from an article by the writer in the Smithsonian Report for 1888, page 410:—

Total Vapour in a Vertical Column.

Altitude. Feet.	Relative Tension $=e/e_0$.	Actual Weight Gr. per Cubic Foot.				Total Vapour in the Columns expressed as Inches of Rain.			
		80° F.	70° F.	60° F.	50° F.	80° F.	70° F.	60° F.	50° F.
0	1·000	10·95	7·99	5·76	4·09	0·0	0·0	0·0	0·0
6,000	0·524	5·75	4·19	3·02	2·14	1·3	1·0	0·7	0·5
12,000	0·275	3·01	2·20	1·58	1·12	2·1	1·5	1·1	0·8
18,000	0·144	1·58	1·15	0·83	0·59	2·5	1·8	1·3	0·9
24,000	0·075	0·82	0·62	0·43	0·31	2·7	2·0	1·4	1·0
30,000	0·040	0·43	0·32	0·23	0·16	2·8	2·1	1·5	1·1

We see that a heavy rainfall may result from the precipitation of only a small percentage of the water contained in the fresh supplies of air brought by the wind, and that consequently, if all moisture were abstracted from the atmosphere throughout the equatorial regions, it could only affect the barometer by 2·8/13·6 inches, or about two-tenths of an inch, while at the polar regions the diminution would be much less than one-tenth. Evidently, therefore, it is idle to argue that the fall of pressure in an extensive storm is to be considered as the simple result of the condensation of the vapour into rain.

Barometric pressure.

The horizontal distribution of barometric pressure over the earth's surface is shown by the isobars, or lines of equal pressure; it can also be expressed by a system of complex spherical harmonics. As the indications of the mercurial barometer must vary with the variation of gravity, whereas those of the aneroid barometer do not, it has been agreed by the International Meteorological Conventions that for scientific purposes all atmospheric pressures, when expressed in barometric inches, must be reduced to one standard value of gravity, namely, its force at sea-level and at 45° of latitude. In this locality its value is such as to give an acceleration of 980·8 centimetres, or 32·2 English feet, per second. The effect of the variation of gravity with latitude is therefore to make the mercurial barometer read too high, between 45° and the equator; and too low, between 45° and the pole. The correction to be applied to any mercurial barometric reading at or near sea-level, in order to get the atmospheric pressure in standard units, should be given on the edge of a meteorological chart, unless the isobars shown thereon already contain this correction. On such charts it will be perceived that the barometric pressure at sea-level is by no means uniform over the earth's surface, and daily weather charts show very great fluctuations in this respect, the lowest pressures being storm centres and the highest ones areas of clear cold weather. But even the normal average charts show high pressures over the continents in the winter and low pressures over the oceans, these conditions being reversed in the summer time. Schouff (*Pogg. Ann.*, 1832) first demonstrated that the average pressure in the neighbourhood of the equator is slightly less than under either tropic, and that there is a still more remarkable diminution of pressure from either tropic towards its pole. The exact statement of these variations of pressure with latitude was subsequently worked out very precisely by Ferrel, and forms the basis of his explanation of the general circulation of the earth's atmosphere and its influence on the barometer. The series of monthly charts for the whole globe, compiled by Buchan and published by the Royal Society of Edinburgh in 1868, as well as Buchan's later and more perfect charts in the meteorology of the *Challenger* Expedition, Edinburgh, 1889, first revealed clearly the fact that the distinct areas of high and low pressure which are located over the continents and the oceans vary during the year in a fairly regular manner, so that the pressure is higher over the continents in the winter season and lower in the summer season, the amount of the change depending principally upon the size of the continent. A part of this annual variation in pressure is undoubtedly introduced by the methods of reduction to sea-level; indeed, if the data of the lower stations are reduced up to the level of 10,000 or 15,000 feet, we sometimes find the barometric conditions quite reversed. These annual changes are intimately connected as cause and effect with the annual changes of temperature, moisture, and wind, but it is quite erroneous to imagine that the observed pressures control the winds; there is a reaction going on between the wind and the barometric pressure, and the resistance of the earth's surface is such that the true relation between these factors is a complex but fundamental problem of theoretical meteorology.

The vertical distribution of pressure as deduced from observation shows a rate of diminution with increasing altitude very closely but not entirely accordant with the laws of static equilibrium, as first elaborated by Laplace in his hypsometric formula. The departures from the law of static equilibrium are sufficient to show that, if our atmosphere is really in a state of equilibrium, it must be a matter of dynamics and not of statics. The relation of the density of the air to the altitude and temperature, and the total pressure of the superincumbent atmosphere, are shown in the accompanying diagram (Fig. 1), which is taken from a paper by the late Joseph Cottier, published in the *U.S. Monthly Weather Review* for July 1897. The diminution of pressure with altitude, as shown in this diagram for average conditions, but not for the temporary conditions that continually occur, follows a logarithmic law, and can undoubtedly be extended upwards for the normal atmosphere to a height of 20 or 30 miles, but not much farther, owing to our uncertainty as to the actual temperature and pressure in the upper portions of the atmosphere. This diagram is based upon the assumption that the atmosphere is in a state of convective equilibrium; the ascending and descending masses expand and cool as they ascend, or contract and warm up as they descend, nearly but not quite in accordance with the adiabatic law of the change of temperature in pure gases. The limiting height of the atmosphere must be at some known elevation above 20 or 30 miles, where the temperature would become absolute zero, according to the adopted law of diminution. But the uncertainty of the various hypotheses as to the physical properties of the upper atmosphere forbids us to entertain any positive ideas on this subject at the present time. If we define the outer limit as that point at which the diffusion of gases inwards just balances the diffusion outwards, then this limit must be determined not by the hypsometric formula, but by the properties of gases at low temperatures and pressures under conditions as yet uninvestigated by physicists.

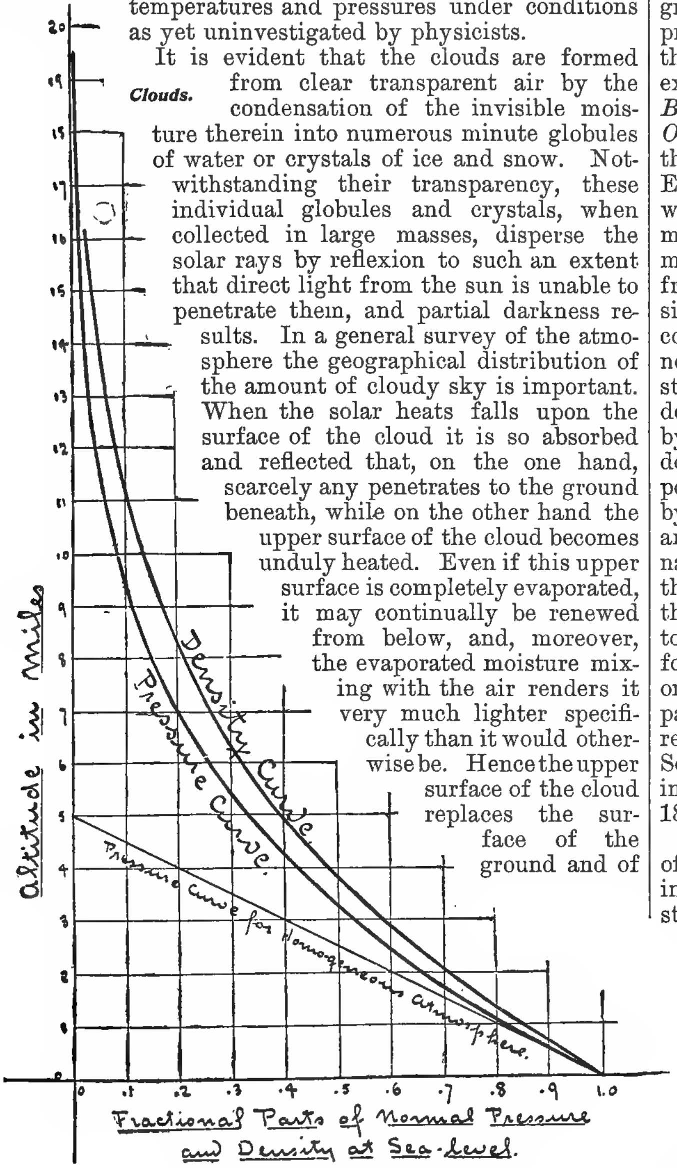


Fig. 1.

It is evident that the clouds are formed from clear transparent air by the condensation of the invisible moisture therein into numerous minute globules of water or crystals of ice and snow. Notwithstanding their transparency, these individual globules and crystals, when collected in large masses, disperse the solar rays by reflexion to such an extent that direct light from the sun is unable to penetrate them, and partial darkness results. In a general survey of the atmosphere the geographical distribution of the amount of cloudy sky is important. When the solar heats falls upon the surface of the cloud it is so absorbed and reflected that, on the one hand, scarcely any penetrates to the ground beneath, while on the other hand the upper surface of the cloud becomes unduly heated. Even if this upper surface is completely evaporated, it may continually be renewed from below, and, moreover, the evaporated moisture mixing with the air renders it very much lighter specifically than it would otherwise be. Hence the upper surface of the cloud replaces the surface of the ground and of the ocean; the air in contact with it acquires a higher temperature and greater buoyancy, while the ground and air beneath it remain colder than they would be in sunshine. The average annual cloudiness over the globe is therefore intimately related to the density and circulation of the atmosphere; it was first charted in general terms by L. Teisserenc de Bort of Paris about 1886. The manifold modifications of the clouds impress one with the conviction that, when properly understood and interpreted, they will reveal to us the most important features of the processes going on in the atmosphere. If the farmer and sailor can correctly judge of the weather several hours in advance by a casual glance at the clouds, what may not the professional meteorologist hope to do by a more careful study? Acting on this idea, the author in 1868 asked from all of his correspondent observers full details as to the quantity, kind, and direction of motion of each layer of clouds; these were telegraphed daily for publication in the bulletin of the Cincinnati Observatory, and for use in the weather predictions made at that time. Since January 1872 similar data have been regularly telegraphed for the use of the U.S. Weather Bureau in preparing forecasts, although the special cloud maps that are compiled have not been published, owing to the expense. These data were also published in full in the *Bulletin of the International Simultaneous Meteorological Observations* for the whole northern hemisphere during the years 1875–84. The writer's work on the U.S. Eclipse Expedition to the West Coast of Africa in 1889–90 was wholly devoted to the determination of the height and motions of the clouds by the use of a special form of the marine nephoscope, whose use can easily be understood from an examination of Figs. 2, 3, and 4. It consists simply of a framework and mirror fitting upon the standard compass of the navigator, and removable at a moment's notice if necessary. The use of this instrument is to be strongly recommended, as it gives the navigator a means of determining exactly the bearing of a storm centre at sea by studying the lower clouds better than he can possibly do by the observations of the winds alone. The importance of cloud study has been especially emphasized by the International Meteorological Committee, which arranged for a complete year of systematic cloud-work by national weather bureaus and individual observatories throughout the world from May 1896 to June 1897. In this connexion Mr H. C. Clayton of Blue Hill Observatory has published a very comprehensive report on cloud forms. The complete report by Professor F. H. Bigelow on the work done by the U.S. Weather Bureau forms a part of the annual report for 1899, and constitutes a remarkable addition to our knowledge of the subject. Some preliminary account of this work was published in the *American Journal of Science* for December 1899.

In order to obtain the greatest benefit from the study of the clouds, we must understand the laws and processes involved in their formation; but as these constitute a study in mechanics and physics of great complexity, the results already obtained will be stated in a subsequent section of this article as a part of theoretical physical meteorology. Meanwhile the following brief remarks relative to the kinds of clouds will serve as an introduction to the subject. The name *stratus* implies a horizontal sheet of cloud having no special structure, except that it is a thin layer. It was first applied by Howard specifically to the thin layers that form within a short distance of the earth's surface in quiet places on a still evening, preliminary to the general formation of low fog at night; therefore it is sometimes called high or lifted fog. It is also applicable to thicker layers that form at considerable heights above the ground, and by cutting off radiation effectually prevent the formation of fog at the earth's surface. Again, the term is applied to layers of haze that may form even at the highest altitude. Near the observer's zenith such a layer usually appears as haze, but when seen in the distant horizon it appears as a horizontal layer of stratus. Finally the term is applied in various combinations to indicate, for instance, that the main cloud has a broad thin base, like a stratus, attached to its lower part or broad horizontal sheets overflowing at the top.

The presence of a stratus cloud indicates that there is no rapid or great vertical motion going on, such as would throw a thin layer of stratus into great rolls or heaps. *Cumulus* may be described as the direct result of rapidly ascending currents that have been started either by the buoyancy of the warm air at the surface of the earth or at the surface of a stratus cloud. But it is also formed by the direct action of moist winds, which, blowing against mountains or other obstacles, are forced to rise rapidly. In either case the ascending air must expand as it comes under the low pressure of greater altitudes, and as it does work in expanding, it must cool by an amount that is determined by the laws of thermodynamics. This cooling is distinctly not due to any great extent to mixture with cold air, the radiation of heat, or the so-called cold of altitude, but, as Espy first maintained in 1826, is a simple thermodynamic operation, by which heat is converted into work, or work that is done makes a draft upon the available heat that is contained in the air. At a certain point of its ascent the air thus cools sufficiently to form haze and cloud. Espy showed that the latent heat evolved in the formation of the cloud may become again apparent if the cloudy air is forced to descend, so that, except for a small loss by radiation, the air will return to the same temperature as that with which it started. If, however, rain or snow should fall from the clouds leaving the evolved latent heat behind, then when the cloudy air returns to the ground it is drier and warmer than in its initial condition, and thus gives rise to the hot waves known as chinooks and foehns; or if the process goes on over a large area of the earth, it causes regions of drought and even deserts. *Alto-cumulus* is a comparatively thin layer of clouds of the cumulus type, occurring in cases where the ascending currents are not strong enough, or do not continue long enough, to stimulate the formation of very high or thick cumuli. Sometimes these clouds represent the upper portions of a series of waves in the atmosphere. At other times they are formed between two layers of air, of which the upper one has a different velocity and direction of motion from the lower one; consequently, at the boundary surface a series of rolls or horizontal cylindrical vortices are produced, and the cloudiness is due partly to mixture and partly to the expansion of the air in the rising portion of the clouds. Systems of alto-cumulus rolls sometimes extend for several hundred miles in all directions, or in a straight line for a hundred miles to leeward of a mountain top. *Cirro-cumulus* is much smaller than the alto-cumulus, of a more delicate texture, purer white, and almost invariably arranged in rank and file or other very regular patterns. It is formed, like the alto-cumulus, in the mixing regions between two layers of air moving in different directions, but its typical peculiarities apparently arise from the fact that it is formed at such high altitudes and low temperatures that it can only consist of the finest crystals of ice and snow. It is so thin or contains so little water that it scarcely ever presents a dark side having an appreciable contrast to the bright side; in other words, the sunlight seems to illuminate it through and through. *Cirrus* clouds appear both singly and in large groups—generally of a pure white—sometimes in belts or bands, which converge by perspective in opposite points of the horizon, and whose actual length is therefore to be measured by several hundred miles. They are the highest and whitest of all the clouds; they may be formed by mixture, or even sometimes by mere contact and the conduction of their own heat to neighbouring cold air. More frequently they must be due to cooling of moist streaks in the upper atmosphere by expansion and radiation. As soon as these clouds are formed in daylight, the heat of the sunshine begins to dissipate them, and they soon disappear if they are surrounded by very dry air; but, if the air be moist, the same process that formed the first cirrus will continue until the whole layer of air becomes filled with a thick haze which indicates the presence of conditions favourable to a storm.

II. Apparatus and Methods.

The observational basis of meteorology is the frequent, and, if possible, continuous record of the temperature, moisture, and barometric pressure in the free atmosphere, the direction and velocity of the wind, the rain and snow fall, and the kind, amount, and motion of the clouds. For Europe these data have been furnished with more or less accuracy and continuity by thousands of observers ever since 1553, when Ferdinand II., grand duke of Tuscany, organized a system of daily observations in Italy under the general supervision of Luigi Antinori. During the 19th century great efforts were made to obtain equally full records from all parts of the land and ocean, and thousands of navigators were added to the great corps of observers. Other matters have also been investigated, the most important being the intensity of radiation from the earth at night-time and from the sun by day-time, the optical phenomena of the sky, the amount of dust in the air, the electrical condition and the chemical constitution of the atmosphere. Although all the instruments used belong to the category of physical apparatus, yet certain points must be considered as peculiar to their use in connexion with meteorology.

Thermometer.

In using the thermometer to determine the temperature of the free air it is necessary to consider not merely its intrinsic accuracy as compared with the standard gas thermometer of the International Bureau of Weights and Measures at Paris, but especially its sluggishness, the influence of noxious radiations, the gradual change of its zero point with time, and the influence of atmospheric pressure.

Sensitiveness.—The thermometer indicates the temperature of the outside surface of its own bulb only when the whole mass of the instrument has a uniform temperature. Assuming that by appropriate convection we can keep the surface of the thermometer at the temperature of the air, we have still to remember that ordinarily this itself is perpetually changing both in rapid oscillations of several degrees and in diurnal periods of many degrees, while the thermometer, on account of its own mass or thermal inertia, always lags behind the changes in the temperature of its own surface. On the other hand, radiant heat passes easily through the air, strikes the thermometer, and raises its temperature quite independently of the influence of the air whose temperature we wish to measure. The internal sluggishness or the sensitiveness of the thermometer is usually different for rising and for falling temperature, and is measured by a coefficient which must be determined experimentally for each instrument by observing the rate at which its indications change when it is plunged into a well-stirred bath of water whose temperature is either higher or lower than its own. This coefficient indicates the rate per minute at which the readings change when the temperature of the surface of the bulb is one degree warmer or colder than the temperature of the bath. Such coefficients usually vary between $\frac{1}{20}$th of a degree centigrade for sluggish thermometers, and one or two degrees for very sensitive thermometers. Suppose, for instance, that the coefficient is one-half degree, then when the rate of change in the temperature of the air is one degree per minute it is exactly the same as that which the thermometer itself undergoes when its own temperature is two degrees different from that of the air; consequently, the thermometer will lag behind the air temperature to that extent and by that amount of time, assuming that the air itself flows fast enough to keep the surface of the bulb at the air temperature. When the air temperature ceases to rise or fall, and begins to change at the same rate in the opposite direction, the thermometer will fail to record the true maximum or minimum temperature by an appreciable error depending upon the rapidity of the change, and will follow the new temperature changes with the same lag. For example, in the case just quoted, if a rising temperature suddenly changes to a falling temperature, the error of the thermometer at the maximum temperature will be two degrees, and yet the thermometer may be absolutely correct as compared with the standard when it is allowed five or ten minutes' time to overcome the sluggishness. It is very difficult to obtain the temperature of the free air at any moment within $\frac{1}{10}$ of a degree centigrade, owing to the sluggishness of all ordinary thermometers and the perpetual variations in the temperatures of the atmospheric currents.

Radiation.—When a thermometer bulb is immersed in a bath of liquid all radiant heat is cut off, but when hung in the open air it is subject to a perpetual interchange of radiations between itself and all its surroundings; consequently its own temperature has only an indirect connexion with that of the air adjacent to it. One of the most difficult problems of meteorology is so to expose a thermometer as to cut off noxious radiations and get the true temperature of the atmosphere at that spot. The following are a few of the many methods that have been adopted to secure this end:—Melloni put the naked glass bulbs within open sheltering caps of perforated silver paper. Flaugergues used a protection consisting of a simple vertical cylinder of two sheets of silver paper enclosing a thin layer of non-conducting substance, like cotton or wool. The influence of radiation upon a thermometer depends upon the radiating and absorbing powers of its own surface; a roughened surface of lamp-black radiates and absorbs perfectly; one of chalk powder does nearly as well; glass much more imperfectly; while a polished silver surface reflects with ease, but radiates and absorbs with the greatest difficulty. Fourier proposed to use two thermometers side by side, one of plain glass and the other of blackened glass; the difference of these would indicate the effect of radiation at any moment; but instead of plain glass he should have used polished silver. His method was quite independently devised and used by the writer in 1865 and 1866 at Pulkowa, where the thermometers were placed within a very light shelter of oiled paper. In order to use this method successfully, both the black and the silvered thermometers should be whirled side by side inside the thermometer shelters (see *Bulletin of the Philosophical Society of Washington* for 1883). Various forms of open lattice work and louvre screens have been devised and used by Glaisher, Kupffer, Stevenson, Stowe, Dove, Renou, Joseph Henry, and others, in all of which the wind is supposed to blow freely through the screens, while the latter cut off the greater part of the direct sunshine and other obnoxious radiations by day, and also prevent obnoxious radiation from the thermometer to the sky by night. The Italian physicist Belli first proposed a special artificial ventilation drawing the fresh air from the outside and making it flow rapidly over the thermometer. Even before his day de Saussure, Espy, Arago, and Bravais whirled the thermometer rapidly either by a small whirling machine, or by attaching it to a string and swivel and whirling it like a sling. When this whirling is done in a shady place excellent results are obtained. Renou and Craig placed the thermometer in a thin metallic enclosure or shelter, and whirled the latter. Wild established the thermometer in a fixed louvre shelter, but by means of a ventilating apparatus drew currents of fresh air from below into the shelter, where they circulated rapidly and passed out. In Germany, since 1885, Dr Assmann has developed the apparatus known as the ventilated psychrometer, in which the dry-bulb thermometer is placed within a double shelter of thin metallic tubing, and the air is drawn in rapidly by means of a small ventilating fan. In the observations made by the writer on the cruise of the *Pensacola* to the west coast of Africa, the dry- and wet-bulb thermometers were enclosed within bamboo tubes and rapidly whirled. The inside of the wet-bulb tube was kept wet, so that its surface being cooled by evaporation could not radiate injuriously to the thermometer. In the system of exposure adopted by the U.S. Weather Bureau the dry and wet bulbs are whirled by a special apparatus fixed within the louvred shelter, which is about 3½ feet cube, and is placed far enough above the ground or building to ensure free exposure to the wind. In using the whirling and ventilating methods it is customary to take a reading after whirling one minute, and a second reading at the end of the second minute, and so on until no appreciable changes are shown in the thermometer. Of course in perfectly calm weather these methods can only give the temperature of the air for the exact locality of the thermometer. On the other hand, when a strong wind is blowing the indicated temperature is an average that represents the long narrow stream of air that has blown past the thermometer during the few minutes that are necessary in order that the bulb may obtain approximately the temperature of the air.

Change of Zero.—All thermometers having glass bulbs, especially those of cylindrical shape, are sensitive to changes of atmospheric pressure. The freezing-point, determined under a barometric pressure of 30 inches, or at sea-level, stands higher on the glass tube than if it had been determined under a lower pressure on a mountain top. Therefore delicate thermometers, when transported to great heights, or even during the very low pressure of a storm centre, read too low and need correction. The zero-point also changes with time and with the method of treatment that the bulb has received, owing to the slow adjustment of the molecules of the glass bulb to the state of stable equilibrium. Their relations among themselves are disturbed whenever the bulb is freshly heated. At this time the freezing-point is depressed to an amount nearly proportional to the heating. The normal method of treatment consists in first determining the boiling-point of the thermometer, and, after a few minutes, the freezing-point. If this method is uniformly followed the two fiducial points will stay in permanent relation to each other. A thermometer that has been used for many years by a faithful meteorological observer has almost inevitably been going through a steady series of changes; in the course of ten years its freezing-point may have risen by 2° or 3° F., and, moreover, it changes by fully a tenth of a degree between summer and winter. The only way completely to eliminate this source of error from meteorological work is to discard the mercurial thermometer altogether; but, instead of adopting that course, the use is generally recommended of thermometers whose bulbs are made of a special glass, upon which heating and cooling have comparatively very little influence. Any argument as to secular changes in the temperature of the atmosphere is likely to be greatly weakened by the unknown influence of this source of error, as well as by changes in the methods of exposure and in the hours of observation.

Barometer.

The barometer indicates the elastic pressure prevailing in gas or liquid at the surface of the mercury in the open tube or cistern, provided that the fluid at that point is in a state of quiet relative to the mercury. Any motion of the air will have an influence upon the reading quite independently of the prevailing elastic pressure. The pressure within a mass of gas at any point is the summation of the effects due to the motions of the myriad molecules of the gas at that point; it is the kinetic energy of the molecules striking against each other and the sides of the enclosure, which in this case is the surface of the mercury in the cistern of the instrument. If the barometer moves with respect to the general mass of the gas there is a change in the pressure on the mercurial surface, although there may be none in the general mass of the free gas, and a barometer giving correctly the pressure of the air at rest within a room will give a different indication if the instrument or the air is set in rapid motion so that the air strikes violently against it. If the barometer moves with the air it will indicate the elastic pressure within the air. When the wind blows against an obstacle the air pressure is increased slightly on the windward side and diminished on the leeward side. It is thus obvious that in determining the pressure within the free atmosphere the exposure of the barometer must be carefully considered. The other sources of error that give rise to discrepancies in meteorological work relate to the temperature of the instrument, the sluggishness of the movement of the mercury, and the secular changes in the correction for capillarity, due principally to the changes in the condition of the surfaces of the glass and the mercury, especially those that are exposed to the open air. The international comparisons of barometers show that discrepancies exist between the best normals or standards, and that ordinary barometers must always be compared with such standards at the temperatures and pressures for which they are to be used. The influence of a gale of wind is to raise the elastic pressure within a room whose window faces to the windward, but to lower the pressure if the window faces to the leeward. The influence of the draught up chimney, produced by the wind blowing over its summit, is to lower the pressure within the room. The maximum effect of the wind in raising the pressure is given by the formula, $P-P_0=0{\cdot}000\,038\,3\times V^2$, where the pressure is given in inches and the velocity in miles per hour. This amounts to about one-tenth of an inch in a 50-mile wind, and to nearly four-tenths in a 100-mile wind. The diminution by a leeward window or a draught up chimney is usually less than this amount. This alteration in pressure, due to the local effect of wind, does not belong to the free atmosphere but to the method of exposure of the barometer, and can be eliminated only by methods first described by the author in 1882: it is a very different matter from the general diminution of pressure in the atmosphere produced by the movement of the wind over a rotating earth and by the centrifugal force within a vortex. The latter is an atmospheric phenomenon independent of instruments and locality in hurricanes and tornadoes which may amount to several inches of the mercurial column. It is, however, quite common to find in the continuous records of pressure during a hurricane evidence of the fact that the low pressure due to the hurricane and the special diminution due to the exposure of the barometer are combined together, so that when the calm centre of a hurricane passes over a station the pressure temporarily rises by the amount due to the sudden stoppage of the local exposure effect.

Anemometer.

The wind is measured either by means of its pressure against any obstacle or by revolving apparatus that gives some idea of the velocity of its movement. The pressure is supposed to interest the engineer and navigator, but the velocity is the fundamental meteorological datum; in fact, the pressure varies so much with the nature of the obstacle and method of exposure, and the density of the air, that it has no real importance in the study of the movements of the atmosphere. Pressure anemometers date from the pendulous tablet devised by Sir Christopher Wren about 1667, and such pressure plates continue to be used in an improved form by Russian observers. Normal pressure plates are used at a few English and Continental stations. The windmill anemometers devised by Schober and Woltmann were modified by Combes and Casella so as to make an exceedingly delicate instrument for laboratory use; another modification by Richard is extensively used by French observers. In the early part of the 19th century Edgeworth devised and Robinson perfected a windmill system in which hemispherical cups revolved around a vertical axis, and these have come into general use in both Europe and America. Many studies have been made of the exact ratio between the velocity of the wind and the rotations of the Robinson anemometer. The factor 3 is usually adopted and incorporated into the mechanism of the apparatus, but in ordinary circumstances this factor is entirely too large, and the recorded velocities are therefore too large. The whirling cups do not revolve with any simple relation to the velocity of the wind, even when this is perfectly steady. The relation varies with the dimensions of the cups and arms and the speed of the wind, but especially with the steadiness or gustiness of the wind. The exact ratio must always be determined experimentally for each specific type of instrument; in most instruments in actual use the factor for steady wind varies between 2·4 and 2·6. When the wind is gusty the inertia of the moving parts of the instrument necessitates an appreciable correction; thus, when the gust is at its height the revolving parts receive an impetus that lasts after the gust has gone down, so that the actual velocity of the cups is too high. For this reason, also, comparisons and studies of anemometers made in the irregular natural winds of a free air are unsatisfactory. For the average winds at Washington, D.C., and on Mount Washington, N.H., and the standard instruments used in the U.S. Weather Bureau service, Professor C. F. Marvin, however, deduced the following table for reduction from recorded to true velocity. This table involves the moment of inertia of the revolving parts of the instrument and the gustiness of the winds at Washington, and will therefore of course not apply strictly to other types of instruments or winds, for which special studies must be made.

Marvin's Table for the Reduction to True Velocities of the Data given by Robinson's Anemometer.

Indicated Velocity.	True Velocity.									
Miles.	0	1	2	3	4	5	6	7	8	9
0	..	..	..	..	..	5·1	6·0	6·9	7·8	8·7
10	9·6	10·4	11·3	12·1	12·9	13·8	14·6	15·4	16·2	17·0
20	17·8	18·6	19·4	20·22	21·0	21·8	22·6	23·4	24·2	24·9
30	25·7	20·5	27·5	28·0	28·8	29·6	30·3	31·1	31·8	32·6
40	33·3	34·1	34·8	35·6	36·3	37·1	37·8	38·5	39·3	40·0
50	40·8	41·5	42·2	43·0	43·7	44·4	45·1	45·9	46·6	47·3
60	48·0	48·7	49·4	50·2	50·9	51·6	52·3	53·0	53·8	54·5
70	55·2	55·9	56·6	57·3	58·0	58·7	59·4	60·1	60·8	61·5
80	62·2	62·9	63·6	64·3	65·0	65·8	66·4	67·1	67·8	68·5
90	69·2	..	.	..	.	..	..	..	..	..

About 1842 a committee of the American Academy of Arts and Sciences experimentally determined, for a large variety of chimney caps, or cowls, or hoods, the amount of suction that produces the draught up a chimney, and shortly afterwards a similar committee made a similar investigation at Philadelphia (see *Proc. Amer. Acad.* vol. i. p. 307, and *Journal of Franklin Institute*, vol. iv. p. 101). These investigations showed that the open end of the chimney, acting as an obstacle in the wind, is covered by a layer of air moving more rapidly than the free air at a little distance, and that therefore between this layer and the aperture of the chimney there is a space within which barometric pressure is less than in the neighbouring free air. The draught up the chimney is due to the pressure of the air at the lower end or fireplace pushing up the flue into this region of low pressure, quite as much as to the buoyancy of the heated air within the flue. From such experiments as these there has been developed the vertical suction-tube anemometer, as devised by Fletcher in 1867 and re-invented by Hagemann in 1876, and introduced into England by Dines. Two vertical tubes whose apertures are respectively directed to the windward and the leeward, and within which are two independent barometers, give the means of determining the barometric pressure plus the wind pressure and minus the wind pressure respectively, so that both the velocity of the wind and the true barometric pressure can be determined. If instead of a simple opening at the top of the tube we place there horizontally the contracted Venturi's tube, we obtain a maximum wind effect, which gives an accurate measure of the wind velocity, and is the form recommended by Bourdon as an improvement on that of Arson. In all anemometers of this class the inertia of the moving parts is reduced to a minimum, and the measurement of rapid changes in velocity and of the maximum intensity of gusts becomes feasible. On the other hand, these researches have shown how to expose a barometer so that it shall be free from the dynamic or wind effect even in a gale. It has only to be placed within a room or box that is connected with the free air by a tube that ends in a pair of parallel plane plates. When the wind blows past the end of this tube it flows between these plates in steady linear motion, and can produce no disturbance of pressure at the mouth of the tube if the plates are at a suitable distance apart. This condition of stable flow, as contrasted with permanent flow, was first defined by Sir William Thomson (Lord Kelvin) (see *Phil. Mag.*, September 1887). Such a pair of small circular plates can easily be applied to a tube screwed into the air-hole at the back of any aneroid barometer, and thus render it independent of the influence of the wind.

As to the exposure of the anemometer, no uniform rules have as yet been adopted. Since the wind is subject to exceedingly great disturbances by the obstacles near the ground, an observer who estimates the force of the wind by noticing all that goes on over a large region, or about him, has some advantage over an instrument that can only record the wind prevailing at one spot. The practice of the U.S. Weather Bureau has been to insist upon the perfectly free exposure of the anemometer as high as can possibly be attained above buildings, trees, and hills; but of course, in such cases, the instruments give records for an elevated point, and not for the ground. They are therefore not precisely appropriate for use in hygienic and agricultural studies, but they yield the records needed for general dynamic meteorology and proper for comparison with the isobars and the movements of the clouds shown on the daily weather map.

Hygrometer.

Moisture floats in the atmosphere either as invisible vapour or as visible haze, mist, and cloud. The presence of the latter generally assures us that the air is fully saturated. The total amount of both visible and invisible vapour contained in a unit volume of cloud or mist is directly determined by the Schwackhofer or Svenson hygrometer, or it may be ascertained by warming a definite portion of the air and fog and measuring the tension of the vapour by Edelmann's apparatus. Both these methods, however, are in practice open to many practical sources of error. If only invisible aqueous vapour is present we may determine its amount by several methods—(*a*) the chemical method, by absorbing and weighing it; (*b*) the dew-point method, by cooling the air down to the temperature where condensation begins; (*c*) Edelmann's method, by absorbing the moisture chemically and measuring the change in vapour tension; (*d*) by adding vapour until the air is saturated and measuring either the increased tension or the quantity of evaporation; (*e*) the psychrometric method, by determining the temperature of evaporation. The wet-bulb thermometer, which is the essential feature of the last method, was used by Baumé in 1758 and de Saussure in 1787, but merely as giving an index of the dryness of the air. The correct theory of its action has been elaborated by many investigators—Ivory, 1822; August, 1825; Apjohn, 1834; Belli, 1838; Regnault, 1845. From the last date until recent years no important progress was made in our knowledge of the subject, and it was supposed that the psychrometer was necessarily crude and unsatisfactory, but in its modern form it has become an instrument of much greater precision, probably quite as trustworthy as the dew-point apparatus or other method of determining atmospheric moisture. In order to attain this accuracy the two bulbs must be of the same size, style, and sensitiveness; the wet bulb must be covered with thin muslin saturated with pure water; both thermometers must be whirled or ventilated rapidly, but at the definite prearranged rate for which the tables of reduction have been computed; and, finally, both thermometers must be carefully sheltered against obnoxious radiations. In order to attain these conditions European observers tend to adopt Assmann's ventilated psychrometer, but American observers adopt Arago's whirled psychrometer, set up within an ordinary thermometer shelter. By either method an accuracy of one-tenth degree C. or two-tenths Fahrenheit should be attained. As a crude approximation, we may assume that the temperature of the dew-point is below the temperature of the wet bulb as far as that is below the dry bulb. A greater accuracy can be attained by the use of Ferrel's or Marvin's psychrometric tables. Glaisher deduced empirically from a large mass of observations certain factors for computing the dew-point, but these do not represent the accuracy that can be attained with the whirled psychrometer, nor are they thoroughly satisfactory when used with Regnault's tables and the stationary psychrometer. Especially should their use be discarded when the wet bulb is greatly depressed below the dry bulb and the atmosphere correspondingly dry. For occasional use at stations, and especially for daily use by travellers and explorers, nothing can exceed the convenience and accuracy of the sling psychrometer, especially if the bulbs are protected from radiation by a slight covering of non-conducting material or even metal, as was done by Craig in 1866–69 for the stations of the U.S. Army Surgeon-General. The hair hygrometer gives directly the relative humidity or the ratio between the moisture in the air and that which it would contain if saturated. The very best forms perform very well for a time, but in general the instrument is not considered so trustworthy as the ventilated psychrometer.

Rain- and snow-gauge.

The simple instrument for catching and measuring the quantity of rain, snow, or hail that falls upon a definite horizontal area consists essentially of a vertical cylinder and the measuring apparatus. The receiving mouth of the cylinder is usually terminated by a cone or funnel, so that the water running down through the funnel and stored in the cylinder is protected from evaporation or other loss. The cylinder is firmly attached to the ground or building, so that the mouth is held permanently at a definite altitude. The sources of error in its use are the spattering into it from the ground or neighbouring objects, and the loss due to the fact that, when the wind blows against the side of the cylinder, it produces eddies and currents that carry away drops that would otherwise fall into the mouth, and even carries out of the cylinder drops that have fallen into it. As a consequence all the ordinary rain-gauges catch and measure too little rainfall. The deficit increases with the strength of the wind, and the smallness or lightness of the raindrops and snowflakes. If we assume that the correct rainfall is given by a gauge whose mouth is flush with the level of the ground, and is surrounded by a trench wide enough to prevent any spatter, then, on the average of many years and numerous observations with ordinary rain-gauges in western Europe, and for the average character of the rain in that region and the average strength of the attending winds, the deficit of rain caught by a rain-gauge whose mouth is 1 metre above the ground is 6 per cent. of the proper amount; if its elevation is 1 foot above ground, the deficit will be 3½ per cent. This deficit increases as the gauges are higher above the ground in proportion to the square root of the altitude, provided that they are fully exposed to the increase of wind that prevails at those altitudes. It is evident that even for altitudes of 5 or 10 feet the records become appreciably discrepant from those obtained at the surface of the ground. The following table shows in the last column the observed ratio between the catch of a gauge at any altitude and that of the standard at the level of the ground. Unfortunately, there is no record of the force of the wind to go with these measurements; but we know that in general, and on the average of many years corresponding with those here tabulated, the velocity of the wind increases very nearly as the square root of the altitude. Although this deficit with increasing altitude has been fully recognized for a century, yet no effort has been made until recent years to make a proper correction, or to eliminate this influence of the wind at the mouth of the gauge. Professor Joseph Henry, about 1850, recommended to the observers of the Smithsonian Institution the use of the "pit-gauge." About 1858 he recommended a so-called shielded gauge, namely—a simple cylindrical gauge 2 inches in diameter, having a wide horizontal sheet of metal like the rim of an inverted hat soldered to it. This would undoubtedly diminish the obnoxious currents of air around the mouth of the gauge, but the suggestion seems to have been overlooked by meteorologists. In 1878 Professor Nipher of St Louis, Missouri, constructed a much more efficient shield, consisting of an umbelliform screen of wire-cloth having about sixty-four meshes to the square inch. This shield seems to have completely annulled the splashing, and to have broken up the eddies and currents of wind. With Nipher's shielded gauges at different altitudes, or in different situations at the same altitude, the rain catch becomes very nearly uniform; but the shield is not especially good for snow, which piles up on the wire screen. Since 1885 numerous comparative observations have been made in Europe with the Nipher gauge, and with the "protected gauge" devised by Boernstein, who sought to prevent injurious eddies about the mouth of the gauge by erecting around it at a distance of 2 or 3 feet an open board fence with its top a little higher than the mouth of the gauge. The boards or slats are not close together, but apparently afford as good a protection as the shield of Professor Nipher.

Altitude and Relative Catch of Rain.

Situation and Size of Gauge.	Years of Record.	Altitude.	Relative Catch.
		Metres.	Per Cent.
		0	100
Calne, 5-inch and 8-inch	4	1	90
Castleton, 5-inch and 8-inch	3	2	88
Rotherham, 5-inch	8	3	86
St Petersburg: Central Physical Observatory, 10-inch	10	4	85
		5	85
		6	84
London: Westminster Abbey	1	9·1	77
Emden	2	11	72
St Petersburg: Central Physical Observatory	1	13	68
York: Museum	3	13	80
Calcutta: Alipore Observatory	7	15	87
Woodside: Walton-on-Thames	1	15	73
Philadelphia: Frankford Arsenal	3	16	95
Sheerness: Waterworks	3	21	52
Whitehaven: St James's Church	10	24	66
St Petersburg: Central Physical Observatory	10	25	59
Paris: Astronomical Observatory	40	27	81
Dublin: Monkstown	6	27	64
Oxford: Radcliffe Observatory	8	34	59
Copenhagen: Observatory	4	36	67
London: Westminster Abbey	1	46	52
Chester: Leadworks	2	49	61
Wolverhampton: Waterworks	3	55	69
York Minster	3	65	60
Boston: St Botolph's Church	2	79	47

In general it is now conceded by several high authorities that the measured rainfall must be corrected for the influence of the wind at the gauge, if the latter is not annulled by Nipher's or Boernstein's methods. A practicable method of measuring and allowing for the influence of the wind was explained by the writer in 1888 (see *Symons's Meteorological Magazine* for 1889, or the *U.S. Monthly Weather Review* for 1899). This method consists simply in establishing near each other several similar gauges at different heights above the ground, but in otherwise similar circumstances. On the assumption that for small elevations the diminution of the wind, like that of the rainfall, is very nearly in proportion to the square root of the altitude, the difference between the records for two different altitudes may be made the basis of a calculation which gives the correction to be applied to the record of the lower gauge, in order to obtain the rainfall that would have been caught if there were no wind. It is only when the rainfall has been properly corrected for the effect of the wind on the gauge that we obtain numbers that are proper to serve for the purpose of determining the variation of the rainfall with altitude, locality, or time.

It has been common to consider that the rain-gauge cannot be properly used on ships at sea, owing to the rolling and pitching of the vessel, and the interference of masts and rigging; but if gauges are mounted on gimbals, so as to be as steady as the ordinary mariner's compass, their records will be of great importance. Experimental work of this sort was done by Mohn, and afterwards in 1882 by Professor Frank Waldo; but the most extensive inquiry has been that of Mr W. G. Black (see *Journal Manchester Geographical Society*, 1898, vol. xiv.), which satisfactorily demonstrates the practicability and importance of the marine rain-gauge.

Evaporometer.

The moisture in the atmosphere comes from the surface of the earth or ocean by evaporation, a process which goes on continually, replacing the moisture that is precipitated as rain, hail, snow, and dew, and maintaining the total quantity of the moisture in the atmosphere at a very uniform figure. The rate of evaporation depends on the temperature, the dryness, and the velocity of the wind. It is not so important to meteorologists to know where the moisture comes from as to know its amount in the atmosphere, and in fact no method has yet been devised for determining how much moisture is given up by any specific portion of the earth, or ocean, or forest. Our evaporometers measure the quantity of moisture given off by a specific surface of water, but it is so difficult to maintain this water under the same conditions as obtain in nature that no conclusions can be safely deduced as to the actual evaporation from natural surfaces. The proper use of these evaporometers is as integrating hygrometers, to give the average humidity of the air, the psychrometer giving the conditions prevailing at any moment. Among the many forms of evaporometer the most convenient is that devised by Piche, which may be so constructed as to be exceedingly accurate. Careful comparisons between the Piche and the various forms of absolute evaporometers were made by Professor Thomas Russell, and the results were published in the *U.S. Monthly Weather Review* for September 1888, pp. 235–239. By placing the Piche apparatus upon a large whirling machine he was able to show the effect of the wind upon the amount of evaporation. This important datum enabled him to explain the great differences recorded by the apparatus established at eighteen Weather Bureau stations; based upon these results, he prepared a table of relative evaporation within thermometer shelters at all stations. The actual evaporations from ground and water in the sunshine may run parallel to these, but cannot be accurately computed. It is probable that Professor Russell's computations are smaller than the evaporations from shallow bodies of water in the sunshine, but larger than for deep bodies, like the great lakes and for running rivers. The Piche evaporometer consists essentially of a glass tube, whose upper end is closed hermetically, whereas the lower end is covered by a horizontal disc of bibulous paper, which is kept wet by absorption from the water in the tube. As the water evaporates its descent in the tube is observed, whence the volume evaporated in a unit of time becomes known. So long as the paper remains clean, and the water is pure, the records of the instrument depend entirely upon the evaporating surface, the dryness of the air, and the velocity of the wind.

The direction and apparent velocity of the motion of the clouds, or other objects floating above us, are best observed by means of the nephoscope, which has now become a necessary item in the outfit of any first-class

Nephoscope.

meteorological station. Among the various forms of this instrument are the so-called nephodoscope of Fornioni, the marine nephoscope of Fineman, the simple mirror with attachments used by Clayton, the cloud camera of Vettin, and the alt-azimuths of Mohn and Lettry. The most perfect form for use on land is that devised by Professor Marvin in 1896 for the U.S. Weather Bureau stations (see Fig. 2); while the most convenient for use at sea is that used in 1889 by the author on the cruise of the *Pensacola*, and first described in the report of the International Meteorological Congress held at Chicago in August 1893. The construction of this instrument is shown in Figs. 3, 4, 5. In using it the observer looks down upon a horizontal mirror and observes the reflection of the cloud. By moving his eye he brings any cloudy point into coincidence with the reflection of a small fixed spherical knob above the mirror, and keeps the images of the knob and the cloud coincident as they pass from the centre of the mirror to its edge. This line of motion shows the azimuth of the horizontal component of the cloud's motion. The apparent angular velocity of the cloud, as it would be if the cloud started from the zenith, is obtained by counting the seconds that elapse between its passage from the centre to the edge, or to a small circle inscribed within the edge. With this instrument two observers a short distance apart may easily determine the apparent altitude, and azimuth, and motion of any cloud, whence its true altitude and velocity may be computed. When the observer uses the marine nephoscope on a vessel which is itself in motion, he observes the resultant of his own and the cloud's motions. If his vessel is under his own control, so that he may change its velocity or direction at will, he easily determines this resultant for two cases, and obtains data by which he is enabled to calculate the real altitude and velocity of the cloud in terms of his own velocity. As the nephoscope can be used on a waggon moving rapidly over a smooth road, or in a small boat on a smooth pond, almost as well as on a larger sea-going vessel, it becomes an instrument of universal application for cloud study. It is also equally convenient for observing the positions of auroras, halos, meteors, and other special phenomena. For the international work undertaken during the year 1898, the photographic camera established upon an alt-azimuth mounting, or the so-called photogram-meter, was especially developed. In this apparatus photographs of the clouds are taken simultaneously at two or more stations, and in each case the centre of the photographic plate has its altitude and azimuth determined. From this centre one can measure on the plate the additional angles required in order to fix the altitude and azimuth of any point that is photographed, and thus the dimensions of the whole visible cloud and its internal or differential motions can be determined, as well as its general motion. During the year 1898 about twenty stations were occupied throughout the world for the purpose of determining accurately the altitudes and motions of every layer of cloud.

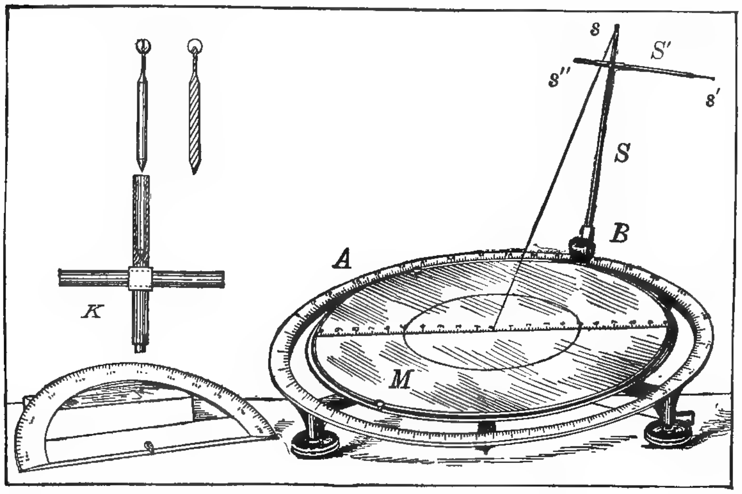


Fig. 2.—Marvin's Nephoscope.

Sunshine recorder.

The ordinary meteorological record specifies the proportion of sky that appears to be covered with cloud, or the so-called cloudiness, usually expressed in tenths. The observer generally confines his attention to that portion of the sky within sixty degrees of the zenith, and ignores the lower zone, since the clouds that are found therein are often at so great a distance from him that their record is not supposed to belong to his locality. As the cloudiness—or its reciprocal, the sunshine—is supposed to be the most important item in agricultural climatology, and is certainly also important for dynamic meteorology, it is usually considered desirable to obtain more complete records than are given by only one or two specified hours of observation. To this end apparatus for recording sunshine, or, rather, the effect of cloudiness,

Horizontal Projection of Nephoscope.

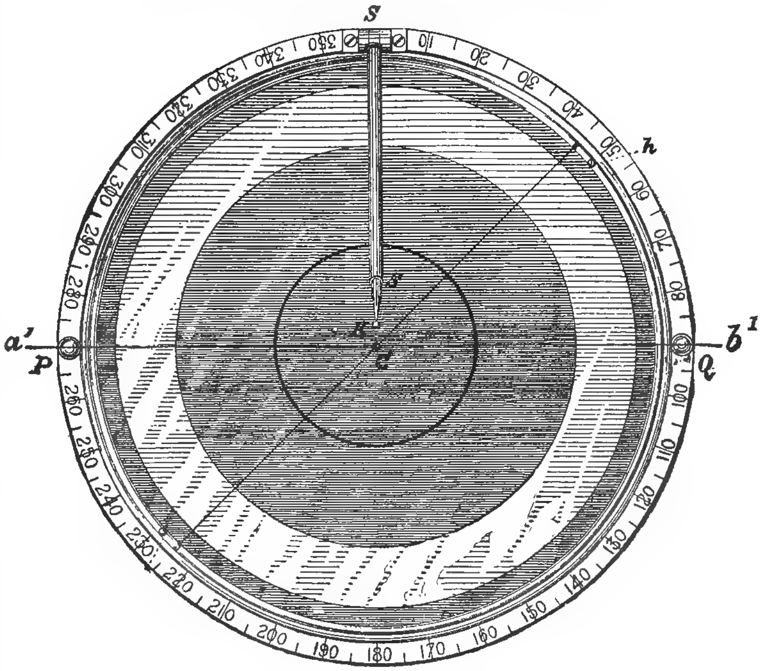


Fig. 3.—Marvin's Nephoscope.

is widely adopted. At least three forms are worth describing.

Horizontal Projection of Compass.

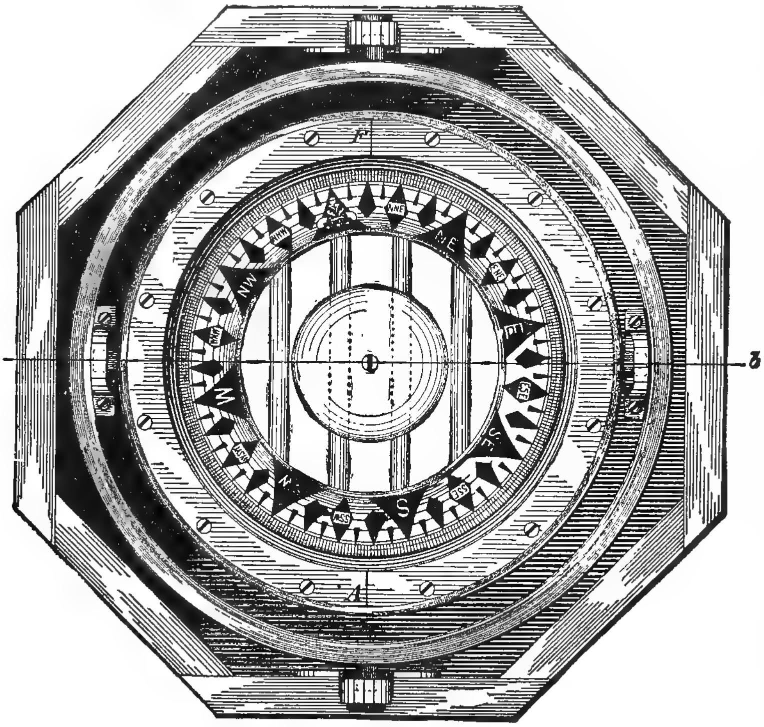
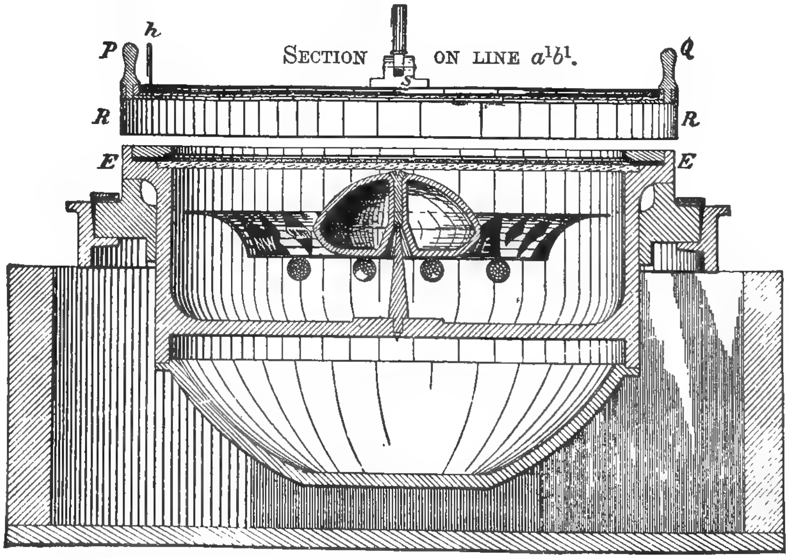


Fig. 4.—Marvin's Nephoscope.

The *Jordan photographic sunshine recorder* consists of a cylinder enclosing a sheet of sensitive paper; the sun's rays penetrate through a small aperture, and describe a path from sunrise to sunset, which appears on this sheet after it has been properly washed with the fixing solution. Any interruption in this path, due to cloudiness or haze, is of course clearly shown, and gives at once the means of estimating what percentage of the day was clear and what cloudy. The form of the instrument constructed by Professor Marvin has been used for many years at about forty Weather Bureau stations, and the original construction is still employed by other observers throughout the world. The *Stokes-Campbell recorder* consists of a globe of glass acting as a burning-glass. A sheet of pasteboard or a block of wood at the rear receives the record, and the extent of the charring gives a crude measure of the percentage of full or strong sunshine. Many of these instruments are used at stations in Great Britain and the British colonies. The *Marvin thermometric sunshine recorder* consists of a thermometer tube, having a black bulb at the lower end and a bright bulb at the other. The excess of temperature in the black bulb causes a thread of mercury to move upwards, and for a certain standard difference of temperature of about 5° F., such as would be produced by the sun shining through a very thin cloud or haze, a record is made by an electric current. The record simply shows that during the day sunshine of a certain intensity prevails, or was prevented by cloudiness. Mr D. T. Maring, in the *U.S. Monthly Weather Review* for 1897, described an ingenious combination of the thermometer and the photographic register of cloudiness, which is worthy of further development. It gives both the quantity of cloudiness and intensity of the sunshine on some arbitrary relative scale.



Section on line *ab*.

Fig. 5.—Marvin's Nephoscope.

The intensity of the sunshine, as sometimes employed in general agricultural studies, is also shown by Violle's conjugate bulbs, which are thin copper balls about 3 inches in diameter, one of them being blackened on the outside and the other gilded. When exposed to the sunshine the difference in temperature of the two bulbs increases with the intensity of the sunshine, but as the difference is dependent to a considerable extent on the wind, the Violle bulbs have not found wide application. The Arago-Davy actinometer, or bright and black bulbs *in vacuo*, constitutes a decided improvement upon the Violle bulbs, in that the vacuous space surrounding the thermometers diminishes the effect of the wind. The physical theory involved in the use of this instrument was fully developed by Ferrel, and he was able to determine the coefficient of absorption of the earth's atmosphere and other data, thereby showing that this apparatus has considerable pretensions to accuracy. In using it as contemplated by the inventor and by Professor Ferrel, we read simply the stationary temperature recorded by the bright and black thermometers at any moment, whereas the best method in actinometry consists in alternately shading and exposing the apparatus so as to determine the total effect of the solar radiation in one minute, or some shorter unit of time. This so-called dynamic, as distinguished from the static, method was first applied by Pouillet in 1838 in his use of his pyrheliometer, which was the first apparatus and method that gave approximate measures of the radiation of heat from the sun. In order to improve upon Pouillet's work more delicate apparatus has been constructed, but the fundamental methods remain the same. Thus Ångström has applied both Langley's bolometer and his own still more sensitive thermoelectric couples and balance method, and Violle his absolute actinometer, consisting of a most delicate thermometer within a polished metal sphere, whose temperature is kept uniform by the flow of water, while Crova, with a thermometer within an enclosure of uniform temperature, claims to have attained an accuracy of one part in a thousand. Chwolson reviewed the whole subject of actinometry, and has shown the value of his own apparatus, consisting of two thin plates alternately exposed to and shielded from sunshine, whose differences of temperature are measured by electric methods.

As none of the absolute methods for determining the solar radiation in units of heat lend themselves to continuous registration, it is important to call attention to the possibility of accomplishing this by chemical methods. The best of these appears to be that devised by Marchand by the use of a device which he calls the Phot-antitupimeter. In this the action of the sunlight upon a solution of ferric-oxalate and chloride of iron liberates carbonic acid gas, the amount of which can be measured either continuously or every hour; but in its present form the apparatus is affected by several serious sources of error.

The electric compensation pyrheliometer, as invented by Knut Ångström (*Ann. Phys.*, 1899), offers a simple method of determining accurately the quantity of heat received by radiation. He employs two blackened platinum surfaces, one of which receives the radiations to be measured, while the other is heated by electric current. The difference of temperature between the two discs is determined by a thermocouple, and they are supposed to receive the same amount of energy when their temperatures are the same. A Hefner lamp is used as an intermediate standard of radiation, and alternate observations on any other two sources of radiant heat give the means of determining their own relations to each other. By means of two such instruments observations were made simultaneously on the intensity of the solar radiation at two points, respectively 360 and 3352 metres above sea-level, to determine the amount of heat absorbed by the intermediate atmosphere. An accuracy of 1-1000 appears to be attainable.

Meteorograph.

The numerous forms of apparatus designed to keep frequent or continuous register of the prevailing pressure, temperature, moisture, wind, rainfall, sunshine, evaporation, and other phenomena are instruments that belong peculiarly to meteorology as distinguished from laboratory physics. The apparatus may be broadly divided into several classes according as the records are obtained by the help of photography, or electricity, or by direct mechanical action. The prevailing tendency at present is in favour of apparatus in which the work of the recording pen is done by a falling weight, whose action is timed and limited by the making and breaking of electric currents by the meteorological apparatus proper. The most serious defect in such instruments, even when kept in good working order, is a want of sensitiveness commensurate with the desired openness of scale. It is very important that a fraction of a minute of time should be recognizable, as also one-tenth of a degree of temperature; and one-thousandth of an inch of barometric pressure, and velocities of one hundred miles per hour, as well as rapid changes in all these elements, must be measurable. But instruments whose scales are large enough to record all these quantities are usually so sluggish that the comparison of the records is very unsatisfactory. In order to study the relationships between temporary and fleeting phenomena, it is necessary that all instruments should record upon the same sheet of paper, so that the same time-scale will answer for all. The instruments that respond most nearly to the general needs of meteorology are the various forms of meteorographs devised by Wild for use at St Petersburg, by Sprung and Fuess for use at Hamburg and Berlin, and by Marvin for Washington. The photographic systems for pressure and temperature introduced many years ago at stations in Great Britain and the British colonies are not quite adequate to present needs. The portable apparatus manufactured by Richard Frères at Paris is in use at a very large number of land stations and on the ocean, and by giving special care to regular control-observations of time, pressure, and temperature, important results may be obtained; but in general the time-scales are too small, and the unknown sources of error too uncertain, to warrant implicit reliance upon the records.

Photometer.

The brightness of the sky light, and especially the amount of polarization, have been observed with increasing interest, as it seems possible from these two elements to ascertain something with regard to the condition and amount of the moisture of the air. With a simple Nicol's prism held in the hand and turned slowly about the axis of vision one can quickly recognize the fact that the sky light is polarized, and that the polarization is largely due to the air or dust lying between us and the clouds in the distant horizon. Arago with a more delicate form of polariscope determined the existence of a so-called neutral zone. Babinet located a neutral point or zone about as far from the anti-sun as was Arago's from the sun itself. Brewster discovered a neutral point near the sun and horizon, disappearing when the sun is more than 15° above the horizon. Finally, Brewster explored the sky sufficiently to draw lines of equal polarization, which he published in Johnston's *Physical Atlas*, and which were confirmed by Zantedeschi in 1849. Since those days far more delicate work has been done—first by Bosanquet of Oxford, afterwards by Professor Pickering of Harvard University and Professor Wright of Yale University. A later contribution to the subject is by Jensen (see *Met. Zeit.* for Oct.–Dec. 1899), who has observed the brightness as well as the polarization, and thus completed the data necessary for testing the various physical theories that have been proposed for the explanation of this phenomenon. We owe to Tyndall the capital discovery that when a beam of white light penetrates a mass of fine aqueous mist the latter sends off at right angles a delicate blue light, which is almost wholly polarized in a plane at right angles to the plane of reflection. As the particles of mist grow larger, the blue light becomes whiter and the polarization disappears. The original vapour particles are undoubtedly so small as to be comparable in size with a fraction of the wave-length of ordinary light, and Rayleigh was able to show that such minute particles must have a power of selection, and that the diffused sky light comes to us by selective reflection. On this basis we should expect that in the driest air at great heights, where the temperature is low and condensation has but just begun, and the dust particles are rare, there would occur the smallest aqueous particles, the feeblest intensity, and the largest amount of polarization. In his work on this subject (see *Phil. Mag.*, May 1899) Rayleigh has shown that it is quite possible that the atoms of oxygen and nitrogen constituting the atmosphere may themselves also exercise a diffuse selective reflection, and contribute to the brightness and polarization that are mainly due to aqueous vapour.

With these theoretical points in mind, we see the importance of adding photometry and polarimetry to the work of a meteorological observatory. The apparatus to be used in this connexion will vary somewhat with the exact character of the observations to be made. The most extensive researches that have yet been carried out in this line with a meteorological application in view are those of Jensen, Crova, Cornu, Pickering, and especially Rubenson, who in fact recommended that polarimetry and photometry should go hand in hand. In order to measure the position of the plane of polarization the Arago polariscope may be used, but, in order to measure the percentage of polarized light, Mascart's modification of the Savart is better. In order to measure the general brightness of a spot in the sky, Jensen has used a slight modification of the Weber photometer, and in fact Weber himself has applied the same method to the measurement of the daylight. The complete work of Jensen was published in the *Schriften* of the Scientific Association of Schleswig-Holstein in 1899, and, like the memoir published by Rubenson in 1863, it gives the meteorological conditions in full as a basis for the investigation of the connexion between sky light and the moisture in the atmosphere.

The cyanometer devised by Arago to measure the blueness of the sky consisted of an arbitrary scale of blues on a strip of porcelain, with which one could compare the blue of the sky. This comparison, however, is open to many subjective errors. A more satisfactory apparatus is Zollner's photometer or some equivalent, in which a patch of white surface is illuminated by any particular tint or combination that may be desired. In fact, Maxwell's colour-box admits of ready application to the analysis of sky light, and reveals at once the proportions of red, yellow, and blue that may be contained therein.

Dust-counter.

The importance of observing the dustiness of the atmosphere has been especially realized since the invention and use of various forms of apparatus for counting the number of particles of dust in a small volume of air. These inventions are due to Mr John Aitken, of Edinburgh, and a short description of his results was presented by him to the Meteorological Congress in 1893 at Chicago. The latest form of his apparatus is very convenient, and is called the pocket dust-counter. In this the air contained in a small receiver is rendered dustless by repeated expansions, in each of which the cooling due to expansion forces the vapour to condense upon the dust, which, becoming heavy, falls to the bottom, so that in a short time all is removed. A small stop-cock is now turned, so as to allow a definite small quantity of air to enter and mix with the dustless air in the receiver. The natural and pure airs are now thoroughly mixed, and again the whole quantity within the receiver is expanded, and the dust nuclei fall down by the condensation of vapour upon them. Assuming that every particle of dust is represented by a minute droplet of water, we have but to count the latter; this is easily done by causing all the drops to fall upon a polished plate of black glass, which is divided into small squares by fine lines ruled with a diamond point. Usually each of these squares represents a small fraction of a cubic centimetre of air; thus in one case the number of fog particles averaged 2·6 per square millimetre of the glass plate, and, as the multiplying factor was 100, this corresponded to 260 particles of dust in a cubic centimetre of air. The purest air has been found in the West Highlands of Scotland, where 16 particles per cubic centimetre was once recorded as the minimum, while 7600 was the maximum. On the Rigi Kulm, in Switzerland, the purest air gave 210, and the dustiest 16,500. On comparing the records of the dust-counter with the record of the apparent state of the air, Mr Aitken found that 500 particles per cubic centimetre corresponded to clear air, and 1900 to a thick haze in which distant mountain tops were hidden. In the cities the particles of soot and effluvia of all kinds act as dust, and both in London and Paris the numbers ran as high as 80, 116, 150, and 210 thousand per cubic centimetre.

Electrical apparatus.

The electrical phenomena of the atmosphere undoubtedly belong to meteorology, and yet the methods of observation have been so unsatisfactory and the difficulty of interpreting the results has been so baffling that regular observations in electricity are only carried out at a very few meteorological institutions. A general summary of our knowledge of the subject was prepared by J. Elster and H. Geitel for the International Congress held at Chicago in 1893, but the methods and apparatus of observation have not received any remarkable modifications. In general the water-dropping collector of Lord Kelvin, arranged for continuous record by Mascart, continues to be the best apparatus for continuous observation at any locality, and a portable form of this same apparatus is used by explorers and in special series of local observations. In order to explore the upper air the kite continues to be used, as was done by McAdie for the Weather Bureau in 1885 and by Weber at Kiel in 1889. The difference of potential between the upper and lower end of a long vertical wire hanging from a balloon has been measured up to considerable altitudes by Elster and Tuma. In general it is known that negative electricity must be present in the upper strata just as it is in the earth, while the intervening layer of air is positively electrified. The explanation of the origin of this condition of affairs is given in the recent researches of Professor J. J. Thomson (*Phil. Mag.*, December 1899), and his interpretation is almost identical with that now recognized by Elster (see *Terrestrial Magnetism*, January 1900, vol. iv. p. 213). According to these results, if positive and negative ions exist in the upper strata and are carried up with the ascending masses of moist air, then the condensation of the moisture must begin first on the negative ions, which are brought down eventually to the earth's surface; thus the earth receives its negative charge from the atmosphere, leaving a positive charge or an excess of positive ions in the middle air. The observations of atmospheric electricity consist essentially in determining the amount and character of the difference of potential between two points not very far distant from each other, as, for instance, the end of the pipe from which the water-drops are discharged, and the nearest point of the earth or buildings resting on the earth. The record has only an extremely local value, and the investigations of Professor Trowbridge, made in conjunction with the U.S. Weather Bureau in 1882–85, show that the differences vary so much with the winds, the time of day, and the situation of the water-dropper, that the mere comparison of records gives no correct idea of the general electrical relationships. It had been suggested that possibly daily telegrams of electric conditions and daily maps of equipotential curves over the North American continent would be of help in the forecasting of storms, but it was shown to be useless to attempt any such system until some uniform normal exposure could be devised. (See Atmospheric Electricity and Electricity, V.)

Kites.

The exploration of the upper atmosphere is to be regarded as the most important field of research at the present time, and the kite and the balloon enable observers and apparatus to be carried to considerable heights, though by no means so far as is desirable. The kite was first used by Alexander Wilson at or near Glasgow in 1749, and has since then been frequently used by English observers. The later revival of interest in the subject dates principally at least

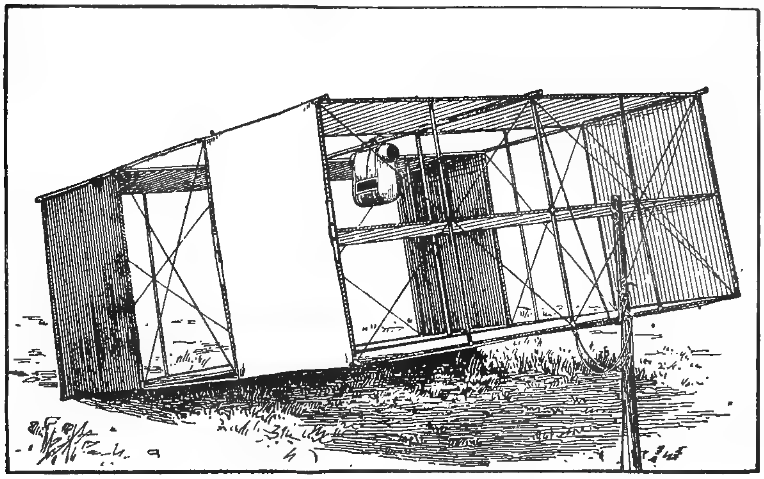


Fig. 6.—Marvin-Hargrave Kite, with Meteorograph in position.

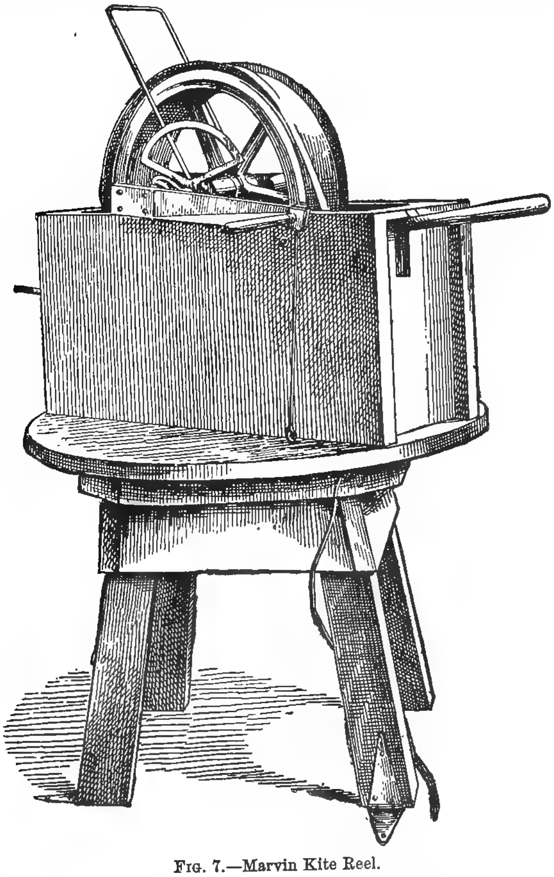


Fig. 7.—Marvin Kite Reel.

from the work done in England in 1882 by Archibald, who used the kite to carry up anemometers to very considerable heights, and thereby determined the relative movement of the air in the free atmosphere. In 1883 Mr Alexander McAdie used the kite in his studies of atmospheric electricity, and the present writer proposed to use it for a complete exploration as to temperature, moisture, and wind; but Mr W. A. Eddy of New York first forced it upon public attention, and accepted the suggestion of the present writer to employ it for meteorological work. Having flown his kites at Blue Hill, with the permission of Mr Rotch, and having carried up with them the self-registering apparatus devised by Mr Ferguson, he left the further prosecution of this work to Mr Rotch, who has made this a prominent feature of the work at his observatory, having carried up meteorographs to the height of 12,000 feet by means of a series of kites flying in tandem. The officials of the U.S. Weather Bureau have developed an admirable cellular kite, invented by Hargrave of Australia, and Professor Marvin's works on the theory and construction of this form are well known. The general appearance of the Marvin or Weather Bureau kite, the reel and other apparatus that go with it, and the meteorograph it carries up, are shown in Figs. 6, 7, 8. The size ordinarily used carries about 68 square feet of supporting surface of muslin tightly stretched on a light wooden frame. The line, made of the best steel piano-wire, is wound and unwound from a reel which keeps an automatic record of the intensity and direction of the pull. The reeling in and out may be done either by hand or by a small gas-engine. The observer at the reel makes frequent records of the temperature, pressure, and wind, the apparent angular elevation of the kite, and the length of wire that is played out. At the kite itself the Marvin meteorograph keeps a continuous record of the pressure, temperature, humidity, and velocity of the wind. The meteorograph with its aluminium case weighs about two pounds, and is so securely lashed behind the front cell of the kite that no accident has ever happened to one, although the kites sometimes break loose and settle to the ground in a broken country many miles away from the reel. On four occasions the line has been completely destroyed by slight discharges of lightning; but in no case has the kite, the observer, or the reel been injured thereby. Of course, such flashes are preceded by numerous rapidly-increasing sparks of electricity from the lower end of the wire, which warn the observer of danger. During the six months from May to October 1898, seventeen kite stations were maintained by the U.S. Weather Bureau in the region of the lakes, the Upper Mississippi and the Lower Missouri valleys, in order to obtain data for the more thorough study of atmospheric conditions over this particular part of the country. During these months 1217 ascents were made, and as no

On account of its great interest and importance, we quote the following from Dr Frankenfield's bulletin and the summary in the *U.S. Monthly Weather Review* for September 1899:—

Mean Temperature Gradients in degrees Fahrenheit per 1000 feet from the ground up to the respective altitudes.

Stations.	1000 feet.	1500 feet.	2000 feet.	3000 feet.	4000 feet.	5000 feet.	6000 feet.
	°	°	°	°	°	°	°
Washington, D.C.	5·6	4·4	4·0	3·5	3·2	3·0	3·1
Cairo, Ill.	9·7	6·6	6·0	4·9	4·7	4·3	...
Cincinnati, O.	13·0	6·3	6·9	5·8	5·6	4·7	4·2
Fort Smith, Ark.	7·2	7·0	6·7	5·8	3·8	...	...
Knoxville, Tenn.	8·4	6·2	6·6	5·4	5·0	...	...
Memphis, Tenn.	7·8	6·8	5·0	3·8	3·7	3·5	...
Springfield, Ill.	7·6	5·7	5·1	4·4	4·0	3·7	3·6
Cleveland, O.	5·7	4·1	3·6	3·5	4·1	4·1	4·3
Duluth, Minn.	5·2	4·8	4·6	4·6	4·3	3·8	4·6
Lansing, Mich.	7·5	6·0	4·7	4·1	3·9	3·8	...
Sault Ste Marie, Mich.	6·6	6·2	5·2	4·5	3·9	3·0	...
Dodge, Kans.	6·3	5·2	4·8	3·7	3·1	3·2	3·2
Dubuque, Iowa	6·9	5·9	4·6	3·5	3·2	3·3	...
North Platte, Neb.	6·8	6·5	5·9	5·2	4·4	4·7	5·4
Omaha, Neb.	...	5·4	4·9	3·6	3·2	3·5	3·8
Pierre, S. Dak.	5·9	5·1	4·8	4·3	3·7	4·4	4·0
Topeka, Kans.	7·4	6·2	4·9	4·0	3·8	3·9	4·5
Average	7·4	5·8	5·2	4·4	4·0	3·8	4·1

great height was attempted they were mostly under 7000 or 8000 feet. There was thus obtained a large amount of information relating to the air within a mile of the earth's surface. The general gradients of temperature, which were promptly deduced and published by H. C. Frankenfield in 1899 in a bulletin of the Weather Bureau, gave for the first time in the history of meteorology trustworthy actual observations of air temperatures in the free atmosphere in numbers sufficient to indicate the normal condition of the air.

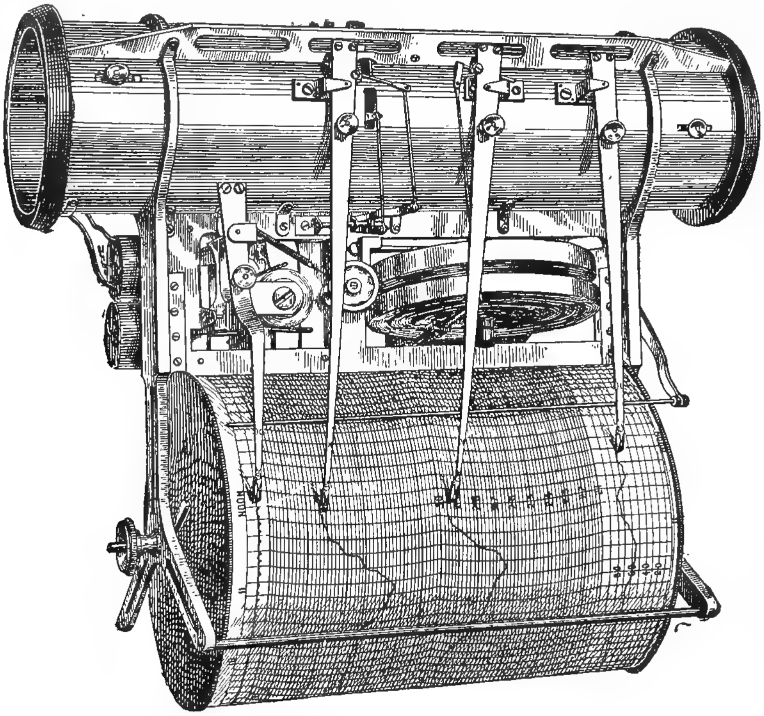


Fig. 8.—Marvin Kite Meteorograph.

The kite and meteorograph have already been adopted for use by European meteorologists at Trappes, Hamburg, Brussels, Berlin, and Strasburg. Especially successful has been the work of Mr A. L. Rotch, the proprietor of the Blue Hill Observatory; and of Mons. Leon Teisserenc de Bort, the proprietor of the observatory for dynamic meteorology at Trappes.

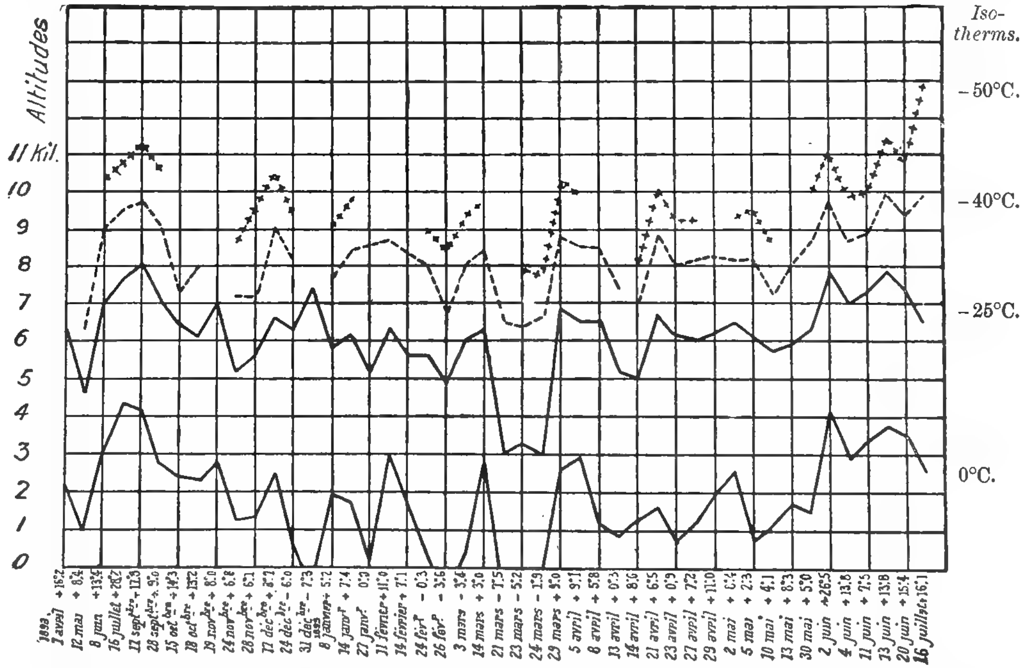


Fig. 9.—Chart of Isotherms in Free Air above Trappes.

This diagram shows the height at which the isotherms of 0°, −25°, −40°, −50° C. were encountered on the respective dates. Below the ground-line are given both the dates and the temperatures of the air observed at the ground when the balloon started on each ascent. The isotherms of −40° and −50° are not given for certain ascents, because in these the balloon did not rise high enough to encounter those temperatures.

Balloons.

The balloon was used for the scientific exploration of the atmosphere quite freely during the 19th century. The first important voyages were those of Gay-Lussac and Biot at Paris in August and September of 1804. The next important ascent was that of Bixio and Barral in 1850 at Paris. The most remarkable high ascents have been those of James Glaisher, 2nd September 1862, and Berson at Berlin in 1889; on both of these occasions the aëronauts attained altitudes of from 30,000 to 35,000 feet. Similar systematic ascents at many points in Europe simultaneously on pre-arranged dates have been made during the years 1895–99, and promise to be an important feature in the future study of the atmosphere. Owing to the great risk to human life in these high ascents, and especially to the fact that we desire records from still greater heights, efforts have been made to devise self-recording apparatus that may be sent up alone to the greatest heights attainable by free hydrogen balloons carrying the least possible amount of ballast. As these ascensions are made with great velocity, and therefore as nearly vertical as possible, they are called "soundings," because of their analogy to the mariner's usage at sea, and the balloon is called a "sounding balloon." Such balloon soundings have been made not only individually, but by pre-arranged system simultaneously in combination with the ascent of free-manned balloons above referred to; and at some places kites have been simultaneously used in order to obtain records for the lower atmosphere. The first experiments in simultaneous work were made in 1896 and in 1897, when ascents were made at eight or more points in France, Germany, and Russia. These experiments and the discussions to which they gave rise have emphasized the importance of increasing the sensitiveness of the self-recording apparatus, and as far as practicable the rapidity of the ventilation of the thermometers, and of providing more perfect protection against radiation from the sun or to the sky. It is believed that accurate records may be attained up to at least 30,000 metres, but as yet 20,000 has not been attained, and the records brought back are still under considerable criticism on account of instrumental defects. In general the wind that supports the kite also furnishes sufficient ventilation for the thermometer; but in the case of the sounding balloon, which as soon as it attains its summit-level (and its rapid rate of ascent diminishes) floats along horizontally in the full sunshine, a strong artificial ventilation must be provided. Moreover, the sluggishness of the best thermometers is such that during the rapid rise the records of temperature that are being made at any moment really belong to some altitude considerably below the balloon, and a most critical interpretation of the records is required.

The most enthusiastic work both with balloons and kites has been steadily pushed forward by Tiesserenc de Bort at Trappes; and from the results of about one hundred ascents during 1898–99, published by him in the *Comptes Rendus*, we quote the accompanying diagram (Fig. 9), showing the height at which the isotherms of 0° C., minus 25° C., minus 40° C., and minus 50° C. were encountered by the kites or balloons on the respective dates. As this diagram gives a fair picture of the conditions during the whole year—from April 1898 to July 1899—the present writer has deduced the average diminution with altitude, and the following table of results is quoted from the *U.S. Monthly Weather Review* for September 1899, p. 417:—

Average Diminution of Temperature in the Free Air above Trappes during 1898–99.

Altitude (Kilometres).	Total Diminution of Temperature.	Successive Gradients, per Kilometre.
10	−60° C.	9° C.
9	−51	6
8	−45	7
7	−38	8
6	−30	6
5	−24	6
4	−18	5
3	−13	4
2	− 9	5
1	− 4	4
0	0	...

III. CLIMATOLOGY.

The climate of any locality is generally defined as the average condition in respect of atmospheric phenomena, meaning thereby not merely the general average of all values of the temperature, winds, rainfall, &c., but the extreme values and the averages of the extreme values for long periods of time. If we confined ourselves wholly to meteorology proper, we should necessarily define a climate by numbers and diagrams relating to these meteorological elements; but from time immemorial it has also been the custom to illustrate and even investigate climatic conditions by enumerating the plants and animals that flourish in different localities, and by tabulating the dates of sprouting, budding, leafing, fruiting, ripening, harvesting, and the dropping of the leaves. The study of plants from this point of view is called *phenology;* and in so far as plants depend upon the meteorological climate, it gives us a comprehensive view of both the present and the past climates of every portion of the earth since the ancient geological periods. But as the relations between plant life and meteorology are complex, and but little understood, we leave this field of study to the botanists and palæontologists, and confine ourselves to the atmosphere proper. The most remarkable collection of data relative to phenology in its relation to meteorology is to be found in two essays by Dr Karl Linsser, published in 1864 and 1866 by the Imperial Academy of Sciences at St Petersburg. In these essays he has shown the nature of the dependence of the growth of the plant upon temperature, rainfall, the length and character of the growing season, and the latitude, and has given some important clues as to the natural process of the evolution of various species and varieties.

As to climatology proper, there are two classes of memoirs—those that confine themselves to numerical data, charts, and diagrams, and those that attempt by general descriptions to give a popular and vivid picture of the conditions that prevail in various localities. Of the latter we find an admirable illustration in Henry S. Blanford's work, *A Practical Guide to the Climates and Weather of India, Ceylon, and Burma, and the Storms of Indian Seas*, London, 1889. Of the works that combine both numerical tables and descriptive text, with a predilection in favour of the former, there is nothing to compare with the *Lehrbuch der Klimatologie* of Professor Hann, of which a second edition was published in 1897 in three volumes. But, in general, the climatological elements for any country, and especially for the whole world, can be well presented and comprehended by means of a few charts, and this is undoubtedly well done in Hann's *Atlas* of 1887, but most thoroughly in the third volume of Bartholomew's *Physical Atlas* (Constable and Company, London, 1899). This atlas of meteorology contains over four hundred maps illustrating the prominent features in the distribution of temperature, pressure, winds, clouds, sunshine, and rainfall, followed by a series illustrating storms and weather, which forms an admirable supplement to any textual presentation of the subject of meteorology. In the present article we shall only attempt some description of the general distribution and peculiarity of rainfall throughout the globe, taking advantage of the important memoir on this subject published by Supan in 1898, as "Supplementary volume No. 124 to *Petermann's Mitteilungen.*"

The average condition of the atmosphere as to temperature and pressure over the whole globe is the climatological feature of fundamental interest for the student of theoretical meteorology. Professor Forbes was the first to attempt to define the relation between the mean temperature of any latitudinal zone and the mean ratio between the areas of land and water within that zone. His numerical determination of these ratios has been slightly changed by later authorities; but on account of the historical interest of the subject the following table is given, showing the temperatures, pressures, and ratios of land to water that served as the basis of important researches. The reader will perceive that the average temperature is decidedly affected by the presence of land; and the column of prevailing winds shows that these, as well as the barometric pressure, depend upon the temperature gradient, and therefore upon the presence of the land. In fact, in the study of the climate of a continent, the latter is considered as essentially the centre of a large area of disturbance in the midst of the ocean that covers four-fifths of the earth's surface. As we proceed from the shores of a continent inward we depart from the oceanic and approach the truly continental conditions. Ferrel has expressed these influences of land and water in a general formula, from which may be determined what the temperature and pressure would be if the earth were all land or water.

This subject has also been discussed by Forbes, Sartorious von Waltershausen, as well as Hann and Ferrel, and

Climatological Table.

Latitude.	Mean Annual,			Ratio of Land to Water (Forbes).	Mean Annual Insolation.			Relative Area of Zones.	Annual Rainfall (Loomis-Murray).
	Temperature.	Pressure.	Wind.		Outer Atmosphere.	Earth's Surface.			
						Cloudiness 0·0.	Cloudiness 0·4.		
Degrees.	° Cent.	mm.		Per Cent.					mm.
North 90	−17·0	...	...	...	0·42	0·08	0·03	0·000	
,, 85	...	...	...	...	...	...	...	...	360
,, 80	−15·8	760·5	E.N.E.	...	0·43	0·16	0·06	0·174	
,, 75	...	760·0	E.N.E.	...	...	...	...	...	380
,, 70	−10·2	758·6	E.N.E.	48·3	0·47	0·26	0·10	0·342	
,, 65	...	758·2	N.E.	...	...	...	...	...	400
,, 60	− 2·2	758·7	N.E. & S.W.	56·8	0·57	0·57	0·15	0·500	
,, 55	...	759·7	W.	...	...	...	...	...	590
,, 50	+ 6·5	750·7	W.	56·3	0·68	0·49	0·20	0·643	
,, 45	...	761·5	W.	...	...	...	...	...	610
,, 40	14·4	762·0	W. & E.	44·5	0·79	0·55	0·22	0·766	
,, 35	...	762·4	S.W. & S.E.	...	...	...	...	...	590
,, 30	20·4	761·7	E.	43·4	0·88	0·64	0·26	0·866	
,, 25	...	760·4	E.	...	...	...	...	...	730
,, 20	24·3	759·2	N.E.	30·8	0·94	0·71	0·28	0·940	
,, 15	...	758·3	N.E.	...	...	...	...	...	1020
,, 10	26·4	757·9	N.E. & S.E.	23·4	0·99	0·74	0·29	0·985	
,, 5	...	...	N.E. & S.E.	...	...	...	...	...	2120
Equator 0	26·8	758·0	S.E.	21·6	1·00	0·75	0·30	1·000	
South 5	...	758·3	S.E.	22·6	..	...	...	...	2030
,, 10	25·9	759·1	S.E.	22·6	0·99	0·74	0·29	0·985	
,, 15	...	760·2	S.E.	22·6	...	...	...	...	1320
,, 20	20·5	761·7	E. & S.E.	22·6	0·94	0·71	0·28	0·940	
,, 25	...	763·2	S.E.	22·6	...	...	...	...	710
,, 30	19·2	763·5	N.E. & S.E.	20·5	0·88	0·64	0·26	0·866	
,, 35	15·6	762·4	Var.	9·7	...	...	...	...	750
,, 40	12·9	760·5	W.N.W. & W.S.W.	4·1	0·79	0·55	0·22	0·766	
,, 45	10·1	757·3	W.N.W.	3·1	...	...	...	...	1130
,, 50	6·7	753·2	W.N.W.	1·9	0·68	0·49	0·20	0·643	
,, 55	3·8	748·2	N.W.	1·3	...	...	...	...	1120
,, 60	+0·3	743·4	W.N.W.	...	0·57	0·57	0·15	0·500	
,, 65	...	739·7	S.E.	...	...	...	...	...	
,, 70	− 4·8	738·0	S.E.	...	0·47	0·26	0·10	0·342	
,, 75	...	734	...	...	...	...	...	...	1070
,, 80	− 8·2	736	...	...	0·43	0·16	0·06	0·174	
,, 85	...	...	...	...	...	...	...	...	
,, 90	− 9·3	...	...	...	0·42	0·08	0·03	0·000	

the latest advance is found in the works of Zenker on "the distribution of heat and the fundamentals of climate." Formulæ representing the numerical relation between latitude and temperature or pressure on the one hand, and the ratio of land to water on the other, have been deduced. In the *Met. Zeit.* for January 1900 J. Liznar gives a slightly different treatment, somewhat as follows, of the questions discussed by Zenker and those who preceded him :—

The distribution of temperature on a hemisphere which is wholly land and wholly water can be deduced from a knowledge of the relative quantities of heat that fall upon the outer boundary of the atmosphere in different latitudes. Let this latter be indicated by I in arbitrary units; let the temperature of the surface of a land hemisphere be L, and that of a water hemisphere, W. Liznar gives the following formulæ connecting these qualities: $L = (I - 49) / 3395$ and $W = (I + 1208) / 5355$, and the temperatures computed by these formulæ are as follows :—

Lat.	I.	L.	W.	L – W.
0	3053	+33·7° C.	+27·7° C.	+ 8·0° C.
10	3011	32·6	24·9	+ 7·7
20	2886	29·3	22·7	+ 6·6
30	2683	23·8	19·0	+ 4·8
40	2412	15·8	13·7	+ 2·1
50	2088	+ 5·4	+ 7·1	− 1·7
60	1737	− 7·5	− 0·7	− 6·8
70	1446	−19·7	− 7·6	−12·1
80	1310	−26·1	−11·1	−15·0
90	1267	−28·3	−12·2	−16·1

From these figures for L and W we may compute the temperature of each zone of the earth's surface by taking into account the actual relation between land and water. The amount of land in any zone may be expressed as N, a fraction of the area of the zone, and the amount of water will therefore be (I – N). Using the value of N, as measured by Dove, we obtain the computed temperatures (C) of the following table, and for comparison we add the observed mean annual temperatures (O), as deduced by Liznar from the measurements previously published by Spitaler and Batchelder, as shown in the following table :—

Latitude.	N. Land Area.	C. Temperature computed.	O. Temperature observed.
N. 70	0·543	−14·1° C.	−10·0° C.
60	·609	− 4·8	− 1·0
50	·587	+ 6·0	+ 5·6
40	·372	+14·4	14·0
30	·452	21·1	20·3
20	·315	24·8	25·2
10	·242	26·8	26·7
0	·216	27·4	26·2
−10	·215	26·6	25·3
−20	·235	24·3	23·0
−30	·205	20·0	18·4
−40	·041	13·8	+12·0
−50	·019	+ 7·1	+ 5·6

Such studies, however, relate to an ideal earth and atmosphere, and have too little to do with the actual distribution of land and water, winds, temperature, and pressure in longitude, to justify their application to the real earth. Their results belong more properly to a globe whose surface is dotted with land and water, so uniformly intermixed that there can be no chance for the existence of distinct areas of continental and oceanic climates. We therefore hesitate to apply them to the elucidation of such climatic questions as that of the Glacial epoch and other problems suggested by geology.

The Distribution of Rain.—From a purely chronological point of view we have to consider the mean annual, seasonal, and monthly distribution of rain, and as a matter of less importance the diurnal distribution; we have also to consider the liability on the one hand to floods or excessive rains, and, on the other hand, to long periods of drought. From a geographical point of view we have to consider the rainfall both on the land and on the ocean, the increase or decrease of rainfall with altitude above the ocean, and the average variation of rainfall with the latitude of the place.

It has not been customary for observers on the ocean to keep records of the quantity of rain and snow, owing to the difficulty of finding a proper situation on the vessel for the rain-gauge, and also because of the supposed uncertainty of the observations themselves in adverse circumstances. Therefore, instead of the quantity of the rainfall, navigators have recorded only the time and duration of its occurrence and its general character as light or heavy, showery or steady. But even from these records it is possible to derive a rough approximation to the quantity, which is certainly more important than the mere duration, though both items serve scientific purposes. The depth of snowfall in inches is very important, as indicating the extent to which the soil and the roots of plants are kept warm during the winter season; but in the present text we consider only the equivalent depth of melted snow expressed in inches or millimetres of rainfall. Although twenty thousand stations are recording rainfall, only the records of perhaps five thousand are available for our study, because of the length of the individual series of observations; and these would not suffice as the basis of satisfactory general rainfall charts unless their indications were supplemented by a careful study of the shorter series, and especially of the general statements of explorers, agriculturists, and geographers as to the relation between wind and rainfall, and the results of general experience. The quantity of rain during the respective seasons of the year is very important from an agricultural point of view.

Up to a certain point the terms "wet" and "dry" as applied to a climate are entirely relative, and generally concern the influence of rainfall upon plant life. But the development of plants depends largely upon the character of the soil and its power to retain moisture during drought; it also depends upon the dryness of the air and the strength of the wind, and the consequent evaporation, and also upon the character of the precipitation, whether rain or snow, and therefore in part upon the temperature. However, we shall not go far wrong if we consider an annual rainfall of 250 millimetres as a dry climate, and one of 1000 millimetres or more, namely, 40 inches, as a wet one.

The isohyetal of 250 millimetres is the boundary of the Arctic basin on the north and the Antarctic on the south. Within these regions the undoubted deficiency in rain, added to the low temperature, forbids almost any form of vegetation. The greater part of Europe between latitudes north 35° and 65° has at least a moderate rainfall, namely, between 250 and 1000 mm.; the coast of Norway has two rainy regions, but the region east of the Scandinavian mountains shows a great falling-off. The British islands are more rainy and warmer than Scandinavia, and the contrast between the east and west sides of them is strongly marked, the contrast being due to the fact that the south-west winds laden with moisture from the Atlantic necessarily deposit more rain when they first strike the land and are driven upwards by its disturbing action. In the Bay of Biscay we find an increase of rainfall, which is heaviest along the north-western slope of the Serra da Estrella in central Portugal, though almost equally heavy rain falls on the higher mountain slopes in the interior of France. Throughout the region of the Mediterranean the western coasts have more rain than the eastern.

In general the heaviest precipitation occurs when the mountains are so disposed that moist air is rapidly forced up to a great height. The two regions having an average annual rainfall of over 4000 millimetres, or 160 inches, are located on the Dalmatian and Albanian coasts of the Mediterranean and in the north-eastern corner of India, where damp south-west winds are forced up over steep mountain gradients. It is quite possible that an equally heavy rain occurs on the north-east coast near the summits of the mountainous islands of the East Indies, as also on the mountain-tops of the lake region of Central Africa. Almost as heavy rains are found in the island of Jamaica, and especially in the upper portions of the valleys of the Orinoco and Amazon. In the interior of Europe, the higher portions of mountain slopes are rainy, although the low land near by may be relatively dry. In mountainous countries like Switzerland the greatest variety exists in the distribution of rain, and regions having the most opposite qualities in this respect often lie contiguous to each other. In northern Asia there is great uniformity in the quantity of rain, unless indeed our rainfall records are defective. From the Volga eastwards to the Lena the annual quantity averages between 500 and 750 millimetres, which may be called a moderate rainfall. In Manchuria and northern China the quantity is but little larger, and a decided increase is found only as we move south-eastwards along the coast of China, Korea, and Siam, between latitudes N. 40° and N. 10°. Japan also belongs to this region of moderate rainfall; but Supan points out the fact that the island stations on the southern coast of China, on which lighthouses are stationed, report decidedly less rain than the adjacent coast stations. He thinks that this is in agreement with the general principle that horizontal currents of air, such as the sea breezes, give no rain until they meet obstacles of considerable extent, such as the precipitous coast, when they begin to rise rapidly and cool, as in the ordinary process of rain-making. But the present writer would say that the study of rain-gauges exposed to severe winds on the east coast of the United States demonstrates that they catch less rain than they should, owing to the action of the wind at the mouth of the gauge. This effect of the wind at the gauge has undoubtedly influenced all records of rainfall in exposed situations, and plausibly explains the deficit just referred to. In the East Indian region British, and especially Dutch, meteorologists have made excellent rainfall records. In this region not only do land and water intermingle in fairly equivalent proportions, but the annual movement of the sun northwards and southwards, the annual changes of the monsoon, and the migration of the equatorial belt of calms, all combine to produce most decided seasonal variations in this rainy region. Thus, on the island of Luzon the easterly trade-winds cause an annual rainfall of 3000 millimetres on the eastward slope of the mountains, but the western side has only 1800. On the island of Sumatra, where the rain principally falls during the south-western monsoon, the south-western side has 4160 millimetres, but the north-eastern side 2700 millimetres; in the northern or peninsular part of the island of Celebes, which trends east and west, the northern slope has an annual rainfall of 2540, but the southern slope 1390 millimetres. In Hindustan the great south-west monsoon of the summer season is the rainy wind; hence the west or south-west coasts are generally rainier than the east coasts. This summer monsoon, when it reaches the head of the Bay of Bengal, divides into two branches; the main branch continues on to Burma and Siam, while the other turns to the north-west over the Ganges and along the south face of the Himalaya mountains. The rainiest station on the globe, Cherrapungi, lies in the midst of the main branch, and is also on the side of a moderate mountain; it is so situated that it seems to be exactly under the summit of the standing wave in the atmosphere due to the enforced flow of the monsoon over this mountain, like the waves on the surface of a stream of water flowing over a rocky bed. Doubtless the heavy rainfall at Cherrapungi is not experienced over a region of more than 10 square miles.

Among the regions that receive but little rain are some that are generally known as deserts, although there may be plenty of water stored away deep down in the soil. Thus on the western side of the Rocky Mountains and in the so-called plateau region, as also on the eastern slope farther southwards, and among the Andes in South America, are narrow zones containing many regions of small rainfalls. In Europe and Asia there are several such regions. Thus on the northern border of the Tian Shan is a large area whose annual rainfall is from 400 to 600 millimetres; but as we pass inwards to the desert of Gobi we come to small regions of less than 200 millimetres, such as we also find when we go far northwards over the Kirghiz Steppes. In general the regions of small rainfall are on the leeward sides of mountain ranges or in valleys and plateaux between such ranges. The great south-western monsoon that brings so much rain to southern India brings dryness to the interior of Asia; thus, at Leh in the valley of the Upper Indus the annual rainfall is less than 80 millimetres, and the snow-line is at a level of about 19,000 feet. Similar dry valleys occur in the Rocky Mountain region and the Andes, and several are known in Switzerland.

In both Africa and South America the interesting feature of the rainfall is the great extent and importance of the region of equatorial rains. In Africa this is bounded on the north by the light rain of the Sahara Desert and on the south by the almost equally light rains of the various South African states and colonies. Between these—namely, between latitudes N. 15° and S. 15°—is the region of heavy rain that supports such rivers as the Zambezi, the Congo, the Niger, and the Nile. Over the basins of each of these rivers the general average rainfall is about 1500 millimetres. The heaviest rains of Africa occur on the west coast, especially on the Gulf of Guinea, and from Sierra Leone to the Gold Coast. On the oceanic side of Cameroon mountains there appears to be a remarkable rainfall, but the report of over 9000 millimetres per year at Debundji (latitude N. 4°, longitude E. 9°) has every appearance of being a numerical error on the part of the observer. The rainfall at all points on the coast of Africa is of the monsoon type—that is to say, it has a regular annual period; but of course the periods vary for the regions within and beyond the equatorial zone. Even the rainfall in the great African lake region has a monsoon character, being largely dependent upon the south-eastern monsoon from the South Indian Ocean, which, after striking the African coast, is during the northern summer deflected northwards, and not only crosses the equator, but becomes the south-western monsoon of India and China.

In Australia the distribution of rain is very sharply marked. The whole interior of this continent lies under the influence of the tropical belt of light rain, and is subject to severe droughts. On the south-western coast the south-eastern trade-winds penetrate sufficiently to give a considerable region a rainfall of 1000 millimetres annually, mostly in June, July, and August. At the opposite season of the year the north and north-eastern sides of the continent receive rather a large amount coming from the equatorial belt of rains, which then extend south of the equator. The eastern side of Australia receives a moderate amount, but over a larger area, from the south-eastern trades which in the summer season blow with increased force against this coast and cause abundant rain on the higher mountains. The western coast and interior of Australia receive on the average less than 250 millimetres, and are classed as desert, although artesian wells frequently bring up a copious supply of water from the reservoirs below.

In North America certain very dry regions known as the Rio Grande and Colorado deserts in the United States, and in South America the drier portions of Argentina and Peru, probably have about the same annual rainfall, viz., 100 to 200 millimetres. As we depart from these regions, either towards the equator or towards the Atlantic and Pacific Oceans, we come upon others that have more rain, the maximum being over 2000 millimetres on the southern and western coast of Alaska, and the western coast of Chile and Patagonia, and over a large region drained by the Amazon and Madeira rivers in Brazil. In the United States, those states bordering on the Atlantic and the Gulf of Mexico, from Louisiana to Newfoundland, have about the same rainfall as the interior of Siam and southern China.

Seasonal Rainfall.—The distribution of rain according to months and seasons, including periods of drought and flood, is quite as important as the amount of rainfall. In order to express in a few words the seasonal changes at all places on the globe, which have such great variety as to seem purely local in their character, we may perhaps deduce them all from a few general rules which should enable one to anticipate what the character of the rain must be at any place. In general, any cause that makes the air near the ground or ocean ascend rather rapidly will produce rain in proportion to the quantity of air that ascends, the quantity of moisture in the air, and the quickness with which the moisture condenses into cloud and rain. The last element, quickness, is approximately inverse to the height to which the air must ascend before becoming cloudy, and therefore inverse to the altitude of the lowest cloud surface. In general the north-eastern and south-eastern trade-winds of the northern and southern hemispheres, blowing towards the equator, combine with the intense action of the sun's heat to favour the formation of ascending currents and an equatorial rainy belt on the ocean without the special assistance of mountains or precipitous coasts. These oceanic equatorial rainy belts are very much displaced and distorted by the action of the continents and the larger islands. In this way is brought about the heavy rain over a wide area in Brazil, Central Africa, and the East Indian archipelago. Whatever causes the currents of air to descend retards or prevents the formation of cloud and rain, except in so far as the descent and dryness in one place must be accompanied by a corresponding ascent and rain in some other locality; thus the great south-western monsoon of India ascends and deposits rain on the southern side of the Himalaya, but, in so far as it descends on the northern side, it brings extremely dry weather to Tibet, Turkestan, and Mongolia. Similarly, the strong westerly winds that ascend and form rain on the Alaskan and Patagonian coasts descend as dry air on the eastern slope of the Rocky Mountains and the Andes respectively.

Wherever great irregularities are absent from the earth's surface, as over the oceans and the plains, the ascending currents needed to form rain may be produced by the heating of the atmosphere near the soil under the influence of direct sunshine; but in some cases the same result is apparently produced by changes in barometric pressure going on in the upper layers of the atmosphere. These changes have been likened to great waves or billows in the atmosphere extending over large areas, and producing different effects according to the nature of the surface beneath them. When the trough by relieving the pressure over a large region of the lower air allows it to expand and cool, clouds may form and develop into a storm; the ascending air occurs primarily on the eastern side of the lowest pressure, and the rainfall accompanies it. In great contrast to the south-eastern trades of the southern hemisphere and the north-eastern trades of the northern are the anti-trades that prevail in the atmosphere a short distance above them, and that blow from the north-west and south-west respectively. These anti-trades may possibly have a slight descending tendency, and would therefore not form cloud and rain; but they are boisterous winds full of eddies, and therefore affect the trade-winds below them in such a way as to give rise to innumerable local rains and gusts. Moreover, when they eventually reach the surface of the ocean they strike the first coast that they meet, such as that of Great Britain or the Scandinavian peninsula, or Alaska, or southern Chile, and with great force are pushed upwards, giving plenty of cloud and rain. In the interior of Russia, Siberia, Australia, and North America the principal sources of local rains are the local eddies caused either by the heating of the ground in the sunshine or by the action of the strong winds overhead.

Over the ocean the regular migration of the trade-winds and equatorial zone northwards and southwards annually with the sun produces a regularity in the seasonal distribution of rain, according to the zones of latitude, which is expressed by Supan in the following table :—

Zone.		Limiting Latitudes.	
I.	Little rain in summer . . .	40° N.	27° N.
II.	,, ,, at all seasons . .	27° N.	19° N.
III.	,, ,, in winter . . .	19° N.	7° N.
IV.	Abundant rain at all seasons .	7° N.	1° N.
V.	Little rain in winter . . .	1° N.	17° S.
VI.	,, ,, at all seasons . .	17° S.	30° S.
VII.	,, ,, in summer . . .	30° S.	35° S.

These belts of dryness and rain are strongly marked on the windward coasts of the continents; they do not extend far inland, and are not clearly defined on the leeward coasts. As the winds are from either the north-east or south-east, the rainy regions must be on the easterly coasts. The changes in these belts depend on the changes of the wind, or what is frequently called the general circulation of the atmosphere; this latter is associated with the sub-tropical areas of high and low pressure, which shift their positions in summer and winter, about as shown by Supan in the following table :—

Maximum Pressure over	Winter Season.			Summer Season.			Semi-annual Movement, Winter to Summer.	
	Date.	Latitude.	Longitude.	Date.	Latitude.	Longitude.	Latitude.	Longitude.
North Atlantic .	Jan. 15	28° N.	44° W.	July 15	36° N.	34° W.	8° N.	1° E.
North Pacific .	Jan. 15	30° N.	138° W.	July 15	39° N.	147° W.	9° N.	9° W.
South Atlantic .	July 15	27½° S.	16° W.	Jan. 15	30° S.	4° W.	2½° S.	12° E.
South Indian .	July 15	31° S.	67° E.	Jan. 15	37° S.	91° E.	6° S.	24° E.
South Pacific .	July 15	34° S.	94° W.	Jan. 15	35° S.	104° W.	1° S.	10° W.

The general systematic movement of these areas northwards and southwards with the sun is better marked in the northern hemisphere than in the southern, undoubtedly owing to the larger percentage of land in the northern hemisphere, and the resulting contrasts between the temperatures and the resistances to motion over the land and water. In general, during the days and seasons when the barometric pressure is above the average for any region or season little or no rain falls therein.

The fundamental principle that rain falls only when there is a rapidly ascending moist current usually explains in a simple manner all the peculiarities of its geographical and chronological distribution. On the borders of areas of high pressure and within the areas of low pressure the air is ascending, but within the high areas it is descending. Hence the latter are dry and have a clear sky, but the former have cloudy skies and rain. As the sun moves north or south, returning to his first position within a year, so do the systems of winds and the regions of rain. Notwithstanding the irregularities of local rainfall, the average of the rain on the land areas in any whole zone around the globe gives fairly homogeneous results. Such zones were first calculated by Murray (see *Scottish Geographical Magazine*, 1887, page 65) on the basis of the charts and data published by Loomis in 1882, and such zonal averages are embodied in the last column of the climatological table already given, where they can be compared with the mean annual temperature and pressure, but especially with the cloudiness and the ratio of the land and water. The large precipitation between 60° S. and 90° S., as compared with that between 60° N. and 90° N., is undoubtedly due to the presence of the Antarctic Ocean, which furnishes the moisture, and especially to the rapid westerly winds, which, by their action on the waves, and ice, and occasional islands, cause a sufficient vertical circulation to determine the formation of cloud, and rain, or snow. In general, the excessive precipitation in the equatorial regions both north and south must be ascribed to the abundant moisture in the air, and to the rapid vertical circulation in the daytime, due to the action of the sunshine at the surface of the land and water, and especially to the character of the prevailing winds, which, by blowing from the north-east and south-east, must generally produce ascending currents in that region, except, possibly, in a few districts where they may glide past each other horizontally. In the Indian Ocean during the monsoon season the rainfall on the equator is not particularly large, owing to the absence of islands or opposing currents of air, and to the fact that the air of the south-western monsoon, having come rapidly from cooler regions to the south, has become warmed without being saturated, and has not yet attained the condition to form abundant rain. The hypothesis that any considerable quantity of air from either trade-wind region ever crosses the equator to the opposite region was considered untenable until John Eliot, director of the Meteorological Service for India, by means of his monsoon charts of the Indian Ocean, demonstrated that in the northern summer season the heated air over the eastern continent produces such a great disturbance of the ideal symmetrical system of trade-winds that the south-easterly trades of the southern Indian Ocean are drawn northwards, becoming southerly winds at the equator and south-westerly winds over the Persian Gulf, Hindustan, and the Bay of Bengal, while the feebler south-easterly trades north of Australia become the south-westerly winds of Siam and China. On the western continent, by a similar but feebler action, the north-eastern trades of the Gulf of Mexico become the south-eastern winds of a mild monsoon on the northern coast of the gulf; but owing to the small extent of the heated and elevated portion of the North American continent, this produces only monsoon rains in the valley of the Rio Grande, and has but slight influence apparently in disturbing the condition of affairs south of the equator in Brazil and Venezuela. In general, in both hemispheres, the amount of rain in the respective summers exceeds that in the winters; the summer rains are also more uniformly distributed over the general surface of the country, being, in fact, due to a special local action of the solar radiation, and not to the general action that produces the trade-winds and the monsoons. Rapidly ascending currents, and therefore cumulus clouds, may be formed either by the direct action of the solar heat or by the action of the wind upon obstacles at the earth's surface; the solar action produces the local summer rains, but both solar action and the obstacles to the wind contribute to produce the rains that attend the general monsoon winds. Condensation within a cloud, and especially that due to radiation from its upper surface, may be wholly counteracted by strong sunshine during the daytime if there be no supply of moist air to maintain the cloud, and, on the other hand, be greatly favoured by the absence of sunshine and by unobstructed radiation during night-time; in this way are explained the maxima of rain and cloud at 3 or 4 P.M., and about the same time in the early morning. On hot days, and within the tropics, one may see a growing cumulus cloud with its flat lower surface suddenly begin to expand at the top and rise so rapidly as to show that there is not a sufficient supply of moisture from below to maintain the flat base, whereupon the cloud assumes a balloon shape, larger at the top and tapering toward the bottom, and, becoming thinner and whiter, rises until it enters a stratum of overflow, where it is at once drawn out into a thin horizontal sheet of alto-cumulus or alto-stratus. This process may be again repeated, converting the alto-cumulus into cirrus, so that the same particles of moisture may appear successively as cumulus, alto-cumulus, and cirro-cumulus, and finally attain to the level of the most delicate cirrus cloud within a horizontal distance of one or two hundred miles. When this process is going on the rain falls from cumulus, if at all, and the cirri floating far in advance announce the presence of the distant storm.

The supply of moisture for rain comes ultimately from the oceans; but the evaporation of this rain after it has fallen to the ground, and the repetition of precipitation and evaporation farther inland, form important steps in the distribution of this oceanic moisture. The wind that blows steadily until it has penetrated to the interior of the continent becomes drier because of its loss of moisture and its increase of temperature. It can only deposit rain when additions are made to its vapour by evaporation from the land or by mixture with moister air, but even then it must be cooled still further by higher ascensions and stronger radiations. In general the winter rains are due to a lower layer of moist air flowing from surfaces of warmer water inwards, sometimes to great distances over the continent, and at the same time rising slowly. The moisture for the summer rains comes from local evaporation and more rapidly rising currents, produced by the heat of the warmer part of the day. Therefore the diminution of rainfall as we pass from the coast to the interior is, relatively speaking, more decided in the winter season than in the summer. Supan gives a formula for this relation between the rainfall over the ocean and the land at different seasons and in different zones of latitude. Let L represent the aqueous vapour added to the atmosphere over the land, M the aqueous vapour carried by the winds from the ocean to the land, and K the efficiency of the conditions that favour condensation and rain; then in general we may have the rainfall upon the land represented by the formula $(L+M)K$. This formula applies, for instance, to the west coasts of Europe and Canada, to the Asiatic and Australian monsoon regions. The various types of rainfall over the globe can be fairly represented by varying the three terms; for instance, in Egypt, especially in the delta of the Nile, the evaporation during the season of inundation is very large and the ocean breeze is also very strong, so that both L and M are large, but the conditions that favour the production of rain are so slight that K is practically zero, and therefore the rainfall is zero. In the polar zone L is nearly zero. In the temperate zone, as, for instance, over the continent of Europe and Asia, these conditions vary with the seasons. Thus in winter L is zero, but in summer L and M are both appreciable; in fact, L may be greater than M on the coast and M may be zero in the interior. In the sub-tropical rain zone L is small in winter, but in summer both L and M become large, while K becomes small and the rainfall may become zero. In the tropical zone L is always appreciable, and probably larger in summer than in winter. In the equatorial zone, on account of the light winds, M is inappreciable; but for coasts on which the trade-winds blow, L, M, and K are all appreciable.

Among the rainfall types are the following, in which it will be noticed that the distinguishing feature is not the geographical distribution, but the seasonal features or chronological distribution:—

(*a*) Permanently rainy regions, where 60 millimetres or 2·4 inches of rain or more falls during each season of the year. Such regions are found in general on the windward coasts of the continents, on the east coasts within the trade-wind region; also in the equatorial zone.

(*b*) Permanently dry regions, where less than 60 millimetres falls during each season of the year. Such regions may be found in the Arctic zones, the central portions of the continents of Asia and North America, the sub-tropical region on the west coasts of Africa and South America, the Sahara in northern Africa, and the Mohave Desert in Arizona.

(*c*) The variable rainy regions, where over 60 millimetres falls in certain special seasons.

(*d*) The variable dry regions, where less than 60 millimetres falls in special seasons.

Distribution of Rainfall with Altitude.—In the interior of an island or continent the increasing height of the land usually brings an increasing disturbance of the general currents of air that produce rain in mountainous regions; and although the wind may be too dry to produce rain over the low lands, yet it falls upon the high lands. We may thus, as we ascend within a continent, attain an elevation of nearly uniform rainfall throughout winter and summer, while the low land receives local summer rain, but little or no winter rain. On the island of Ascension the steady north-easterly trade-winds bring to the summit of Green Mountain uniform temperature, moisture, and rainfall, with an exquisite flora, while the lower flat portion of the island is almost rainless, subject to great evaporation, and destitute of plants. In Saxony and the Harz Mountains the general rainfall, according to Schreiber's *Klimatographie*, 1893, is distributed in altitude as follows:—

Altitude. Metres.	Absolute Rainfalls.			Relative Rainfalls.	
	Winter.	Summer.	Annual.	Winter.	Summer.
	mm.	mm.	mm.	Per cent.	Per cent.
100	221	351	572	38	62
300	280	398	678	41	59
500	337	444	781	43	57
700	396	490	886	45	55
900	454	536	990	46	54
1200	540	606	1146	47	53

Evidently, at some slightly higher elevation than 1200 metres, the winter and summer rainfalls would become equal. Above this elevation it is quite possible that the rainy and dry seasons would be reversed. Such inversion is known to occur on the summits of some high mountains and over some lofty plateau regions. The winds change with the seasons, but the rainfall depends upon the windward and leeward aspects of the wind relative to the mountains, and also on its dryness and its velocity, so that the altitude of the region of uniform annual distribution of rainfall has not yet been expressed by any simple rule. Not to go into too many details as to the numerous types of rainfall that have been described by Hann, Supan, and other climatologists, we may at least give the following interesting table by Supan, illustrating the features that most affect plant life and animal life, namely, the distribution of rainfall through the year according to three types:—(1) where the mean variability of rainfall is less than 10 per cent., so that the rainfall is uniform throughout the year; (2) where the mean variability lies between 10 and 19 per cent. inclusive, so that the rainfall may be said to have a very moderate periodicity; (3) where the rainfall has a mean variability of over 20 per cent. and shows a decided periodicity.

Distribution of Rainfall during the Year.

	Type I.			Type II.			Type III.		
	Philadelphia.	Copenhagen.	Singapore.	Baku.	Barnaul.	Hong-Kong.	Jerusalem.	Nerchinsk.	Peking.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
January	7·7	7·0	8·8	10·2	3·3	1·1	24·8	0·4	0·5
February	7·0	5·9	8·0	9·0	2·3	1·4	23·1	0·5	0·8
March	8·0	6·1	7·1	6·8	2·7	3·6	14·2	1·3	1·0
April	7·7	6·0	7·4	9·1	3·7	6·0	6·8	3·1	2·6
May	8·5	7·1	8·3	5·1	9·8	13·8	1·1	6·8	6·3
June	9·1	9·5	7·6	3·5	13·9	18·0	0·03	15·3	13·7
July	9·2	10·8	5·6	2·3	17·3	17·6	0·0	26·1	34·1
August	10·3	11·3	8·8	2·2	16·2	16·4	0·0	28·2	26·3
September	8·0	9·9	7·6	11·0	9·5	13·9	0·1	12·3	10·8
October	8·5	10·6	8·7	13·8	8·5	5·8	1·7	3·4	2·5
November	7·9	8·6	11·7	15·8	7·2	1·3	7·9	1·7	1·1
December	8·1	7·2	10·4	11·2	5·5	1·1	20·3	0·9	0·3
Year	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

In general the annual quantity of rainfall increases with the frequency with which rain falls; and we may also add that the annual quantity is in the inverse ratio to the annual variability, other conditions remaining the same, especially the geographical latitude.

Secular Change of Climate.—Geological study shows that the present distribution of rain, both geographical and chronological, did not prevail throughout the past history of the earth, but that the rainfall, snowfall, and fog or cloudiness have varied greatly as to place and time. The preceding tables and the text connected therewith show that these changes may easily have depended solely on corresponding great changes in the elevation of the continents, on the variations in their extent, and the distribution of land in latitude. On the other hand, the changes that have taken place within the past 3000 years—that is to say, since we have any historical or observational data—have been so small as to elude demonstration. A most careful comparison of the present climate with that prevailing during the earliest times in Greece and Asia Minor was published in 1898 by Eginitis, director of the observatory at Athens, from which we can only infer that there is no apparent difference in the climate, properly so called; and that if there be any difference in the flora and fauna, it must be due to a change in the latter produced by human interference or natural evolutions, but not by any change in climate.

Artificial Production or Prevention of Rain.—From time immemorial there have been those who believed that in some way or other man can influence the weather so as to avert disaster from droughts or storms. Even now this idea has a strong hold upon some who have not properly studied the advance of our knowledge in regard to the laws of nature. The matter would hardly be worthy of serious mention in this place were it not that there is abundant evidence that many are deceived and much money wasted by the so-called rain-makers and others. It is perfectly safe to maintain the general proposition that man cannot make any important change in the weather by means of noises, explosions, liberation of gases, erection of lightning rods, or any other device that has yet been suggested. We may learn to take advantage of the rain and the wind, or to defend ourselves from the lightning, the flood, and the storm, but we cannot alter them. Even in the case of the destruction of extensive forests and equally extensive reafforestations, it has been satisfactorily shown that the measured quantity of rainfall is the same both with and without the forest, and both before and after its destruction; the numbers of local storms of wind are also the same, but the temperature near the ground and the evaporation from the surface of the ground are changed, so that the so-called climate within a forest is slightly different from that prevailing in an adjacent clearing. This is also true if we cover a piece of land with a house—the climate within the house is different from that outside; but these are plays upon the word climate and not meteorological changes properly so called. In Italy, Austria, and France a widespread delusion prevails as to the possibility of preventing hail by the bombardment of the clouds, analogous to the short-lived delusion promoted by Dyrenforth in the United States, to the effect that rain could be brought down by bombarding the clouds.

IV. Physical and Theoretical Meteorology.

The ultimate aim of those who are devoted to any branch of science is to penetrate beyond the phenomena observed on the surface to their ultimate causes, and to reduce the whole complex of observations and empirical rules based upon limited experiences to a simple deductive system in which the phenomena observed shall be shown to flow naturally from the few simple laws that underlie the structure of the universe. A correct "theoria" or physical and logical argumentation deducing from primary laws all the phenomena constitutes the noblest achievement of man in science. It is by such works that Newton and Laplace distinguished themselves in astronomy. The development of the true physical and mechanical theories of atmospheric phenomena has made great progress, but is still inferior in completeness to astronomical work, owing to the great complexity of the meteorological problems. The optical and the thermal phenomena have been very satisfactorily elucidated, but the phenomena of motion or aërodynamics have only been elucidated to a limited extent, while the electrical phenomena have as yet no firm basis of explanation. We must, however, introduce the reader to some of the works that have been published on the subject, in the hope that thereby he will himself be persuaded to further study and induced to contribute to our knowledge.

Between the years 1853 and 1861 Professor William Ferrel published in *Gould's Astronomical Journal*, *Runkle's Mathematical Monthly*, and the *American Journal of Science* several treatises on the motions of solids and fluids relative to the earth's surface. His work resulted in the elucidation of the problems of the atmosphere, and in ingenious ways, applicable approximately to such complex cases, and analytically equivalent to the arithmetical method of quadratures or the graphic methods of geometry, he deduced important relations between the density of the air, the barometric pressure, and the attending winds. His essays seemed to show that it might be possible to treat the complex problems of meteorology logically and deductively by analytical, numerical, and graphic processes, and his memoirs were the first in which observed average meteorological conditions were properly coordinated with the fundamental formulæ of mechanics. Ferrel's ideas were made the basis of the system of daily weather predictions published by the present writer in 1869 in the *Bulletin* of the Cincinnati Observatory. This work was taken up by the Government, and greatly enlarged during 1871–91 by the chief signal officers of the army, and during subsequent years by the chiefs of the U.S. Weather Bureau. His works appear to have first attracted the attention of European mathematicians in consequence of reviews published by Hann in the *Zeitschrift* of the Austrian Meteorological Society in January 1875, but especially after they had been reprinted in a convenient form by the U.S. Signal Office as "Bulletin No. VIII." In 1881 Ferrel, after finishing his works on the tides for the U.S. Coast and Geodetic Survey, began a new and extensive series of meteorological contributions, three of which were published by the U.S. Coast Survey and the rest by the Signal Office. Stimulated by Ferrel's work, by the urgent needs of the modern weather bureaux throughout the world, and by the beauty of the mathematical problems presented, numerous mathematicians have lately taken up the study of the earth's atmosphere, so that the literature of the subject is now far more extensive than is generally supposed.

In addition to the purely mechanical problems, the numerous physical problems have also been carefully treated, both experimentally and mathematically. The problems of radiation have been elucidated by Langley, Hutchins, Ångström, Paschen, Violle, Maurer, Crova, Chwolson, and Very. The problems of thermodynamics have been especially developed by Kelvin, Hertz, von Bezold, Ferrel, and Brillouin. The physical problems involved in the formation of rain-drops have been studied by an optical method by Carl Barus; and with brilliant success, from an electrical point of view, by C. T. R. Wilson and J. J. Thomson at the Cavendish Laboratory, Cambridge, England.

In a complete study of the mechanics of the earth's atmosphere we naturally begin by expressing in simple analytic formulæ all the various conditions and laws according to which every particle of the air must move. Some of these are local matters, depending upon the resistances at various points of the earth's surface; others are of the nature of discontinuous functions, as, for instance, when the ascent of moist air above a certain level suddenly gives rise to condensation and clouds, to the evolution of latent heat, to the precipitation of rain, to the shading of the air and the ground below the clouds, and to the sudden interception of all the solar heat at the upper surface of the cloud. It seems, therefore, incredible that the problems of the atmosphere can ever be resolved by purely analytical methods; there must be devised combinations of numerical and graphical, and possibly even mechanical, methods to reproduce the problems and give us special solutions adapted to particular cases. But even these special methods can only be perfected in proportion as we attain approximate solutions of the simpler problems, and it is in this preliminary work that a good beginning has already been made, thanks to the homologies between the mathematics of hydrodynamics and of electricity.

The present state of theoretical meteorology, in which are included both physical and mechanical, cannot be fully presented in non-technical English text. It is imperatively necessary to employ algebraic formulæ, or numerical tables, or graphic diagrams, the former being certainly the least cumbersome and the most generally available. The uniform system of notation devised by Professor F. H. Bigelow, of the U.S. Weather Bureau, is presented in the following lines taken from the *U.S. Monthly Weather Review* for May 1897 :—

Professor Bigelow's notation is: R, radius of earth; r, any distance from the centre of the earth; θ, north polar distance; ϕ, north latitude; λ, east longitude; and $V=+\frac{m}{r}$, the potential; the positive normal is drawn from the surface outwards and the rotation is positive when right-handed, with translation along the positive direction. It is held by Professor Bigelow that terrestrial magnetism and meteorology must conform to these three last conventions, which have been uniformly adopted in modern physics. Developing the angle θ from the north pole and the angle λ towards the east, and the radius r towards the zenith, the system of co-ordinate becomes x positive towards the south, y positive towards the east, and z positive towards zenith. The corresponding velocities are u, v, w; the corresponding accelerations, du/dt, dv/dt, dw/dt. Further details as to his notation and a very complete summary of the formulæ of physical meteorology expressing the results of nearly all recent students will be found in chapters x. and xi. of Professor Bigelow's Report on the International Cloud Observations, published as vol. ii. of the annual report of the chief of the U.S. Weather Bureau for 1898–99.

The fundamental laws to which the atmosphere is subject are as follows :—

A. The Equation of Elastic Pressure.—The pressure shown and measured by the barometer is an elastic pressure acting in all directions equally at the point where it is measured. By virtue of this elastic pressure a unit volume of air will expand in all directions if not rigidly enclosed, but will cool in so doing. On the other hand, if forcibly compressed within smaller dimensions, it will become warmer. For a given temperature and pressure a unit volume of air of a prescribed chemical constitution will have a prescribed definite weight. The general relations between absolute temperature, pressure, and volume are expressed by the formula

$$pv=\mathrm{RT} \qquad . \quad . \quad . \quad . \quad (1)$$

where T expresses the absolute temperature, p the elastic pressure, v the volume, and R is a constant which differs for each gas, being 29·2713 for ordinary pure dry air and 47·060 for pure aqueous vapour, if we use as fundamental units the kilogram, metre, and centigrade degree. This equation is sometimes called the law of Boyle and Charles; it is also known as the equation of condition for true gases, meaning thereby that it expresses the fact that a true gas would change its volume directly in proportion to its absolute temperature and inversely in proportion to its elastic pressure. All gases depart from this law in proportion as they approach the vaporous condition on the one hand, which is brought about by great pressure and low temperature, or the ultra-gaseous condition on the other hand, which obtains under high temperatures and low pressures. The more accurate law of Van der Waals would have no advantage in meteorological work. In place of the absolute temperature T we may substitute the expression 273° C. × $(1+\alpha t)$, where α is the coefficient of volumetric expansion of the gas for a unit degree of temperature $=0{\cdot}00367$ where t is the temperature expressed on the centigrade scale.

B. Hypsometric Conditions.—The pressure of the atmosphere at any place depends primarily on the weight of the superincumbent mass of air, and therefore diminishes as we ascend to greater heights. If the air is in motion, that and other considerations come in to affect the pressure; but if the air is quite relative to the earth's surface, then the pressure at any altitude is expressed by the so-called barometric or hypsometric formula

$$p=\int_{ho}^{h}-\sigma g dh \qquad . \quad . \quad (2)$$

where σ is the density and g the gravity for each layer of air whose vertical thickness is dh. The integral of this formula depends upon the vertical distribution of temperature, and moisture, and gravity; but under the simplest possible assumptions as to these vertical gradients, the following formula was deduced by Laplace and is generally known as his hypsometric formula:

$$h-h_o=18400\,(1+0{\cdot}00367t)\left(1+0{\cdot}378\frac{e}{v}\right)(1+0{\cdot}0026\cos 2\phi)$$

$$\left(1+\frac{h+h_o}{6370191}\right)(1+0{\cdot}00157)\log\frac{p_o}{p} \qquad 2a).$$

The modifications which this formula needs in order to adapt it to other hypotheses representing more nearly the actual distribution of temperature, moisture, and gravity, have been elaborately investigated by Angot in a memoir published in 1899 in Part I. of the Memoirs of the Central Meteorological Bureau of France for the year 1896. Angot, Hergesell, and Rykatcheff have also shown that for hypsometric work of any pretensions to accuracy it is simplest and best to use Laplace's formula for successive thin strata of air, and add together the individual results, rather than attempt a more complex single formula for the whole stratum; yet the latter seems to be essential for work in aërodynamics. In this formula t is the average temperature, e the average vapour tension of the layer of air, p the barometric pressure at the top of the layer, p_o the pressure at the bottom, ϕ the latitude of the station, h the elevation above sea-level of the lower limit of the stratum, and h_o that of the upper limit.

C. Thermodynamic Relations.—The temperature of the air is due to the quantity of molecular energy that is present in the form of heat, but usually there is also present a quantity of molecular energy that is spoken of as latent heat. This latent heat is said to do internal work, such as melting ice or boiling water, while the sensible heat does external work, such as expanding and pushing in all directions. These molecular energies can be transformed into each other over and over again without being sensibly diminished, and this power of transformation is expressed in the various equations of thermodynamics, of which the fundamental one for our purpose is

$$dQ=C_v dt+\mathrm{A}pdv=C_v dt+\mathrm{ART}\,dv/v \quad . \quad . \quad (3).$$

This equation expresses the fact that when a quantity of heat measured in calories, dQ, is added to or taken from a volume of dry air, there may result both the change of temperature, dt, corresponding to one portion of the heat, $C_v dt$, and a quantity of external work corresponding to the remaining portion of the heat ($\mathrm{A}pdv$). It usually happens that the quantity of heat in a given mass of air does not remain the same for any length of time; it is diminished by radiation or is increased by absorption, and a certain quantity is lost when rain, snow, or hail drops down from the air, while a quantity is added to the atmosphere when moisture evaporates and mixes with the dry air as invisible vapour. The changes due to increase and diminution of moisture are usually small as compared with the great gain due to absorption and convection of solar heat, and with the loss by radiation. If these losses and gains are to be taken account of, then the quantity dQ in the above equation is finite and important. On the other hand, in some cases atmospheric processes go on so rapidly or in such peculiar circumstances—for instance, in the interior of a cloud—that the change in the quantity of heat may be considered as temporarily negligible. In these cases dQ is zero; the changes in temperature balance the changes in external work, and the thermal process is said to be adiabatic.

D. The Condition of Continuity.—When a mass of liquid or gas goes through several motions and changes without being disrupted or otherwise broken into smaller portions, and without the formation of bubbles or vacuous spaces in its interior, and when all the changes that go on proceed by gradual continuous processes as to time, the mass of the fluid is subject to the law of continuity as to mass, and the motion of the fluid is continuous as to velocity. The latter condition is implied in the process of integration; the former is expressed by the equation of continuity

$$\frac{\partial\rho}{\partial t}+\frac{\partial(\rho u)}{\partial x}+\frac{\partial(\rho v)}{\partial y}+\frac{\partial(\rho w)}{\partial z}=o \quad . \quad . \quad (4)$$

where ρ is the density, t is the time, and ∂ the ordinary symbol for partial differentiation.

E. Conditions as to Energy and Motion.—When the total quantity of heat, both latent and sensible, remains constant or changes in a continuous manner, and when the motions are continuous, the mechanical and thermal processes are expressible by ordinary differentials and integrals. Motions of fluids involve both energy and inertia, and are subject to conditions expressed by the following equations of hydrodynamics:—

(*a*) Equations of energy. Let the kinetic energy be T, the potential energy V, the intrinsic energy W: l, m, n, be cosines of the angle between the pressure p and the inwardly direct d normal to the boundary surface S. Then will

$$\frac{\partial(\mathrm{T}+\mathrm{V}+\mathrm{W})}{\partial t}=\int\!\!\int p(lu+mv+nw)d\mathrm{S} \quad . \quad . \quad (5).$$

(*b*) Equations of acceleration and inertia. Let P be the potential of the external forces acting on a unit mass of the atmosphere; μ, be the coefficient of viscosity or internal friction. Then will

$$\left.\begin{cases} -\dfrac{\partial \mathrm{P}}{\partial x}-\dfrac{1}{\rho}\dfrac{\partial p}{\partial x}=\dfrac{\partial u}{\partial t}+u.\dfrac{\partial u}{\partial x}+v.\dfrac{\partial u}{\partial y}+w.\dfrac{\partial u}{\partial z} \\ \qquad\qquad -\mu\left[\dfrac{\partial^2 u}{\partial x^2}+\dfrac{\partial^2 u}{\partial y^2}+\dfrac{\partial^2 u}{\partial z^2}\right] \\ -\dfrac{\partial \mathrm{P}}{\partial y}-\dfrac{1}{\rho}\dfrac{\partial p}{\partial y}=\dfrac{\partial v}{\partial t}+u.\dfrac{\partial v}{\partial x}+v.\dfrac{\partial v}{\partial y}+w.\dfrac{\partial w}{\partial z} \\ \qquad\qquad -\mu\left[\dfrac{\partial^2 v}{\partial x^2}+\dfrac{\partial^2 v}{\partial y^2}+\dfrac{\partial^2 v}{\partial z^2}\right] \\ -\dfrac{\partial \mathrm{P}}{\partial z}-\dfrac{1}{\rho}\dfrac{\partial p}{\partial z}=\dfrac{\partial w}{\partial t}+u.\dfrac{\partial w}{\partial x}+v.\dfrac{\partial w}{\partial y}+w.\dfrac{\partial w}{\partial z} \\ \qquad\qquad -\mu\left[\dfrac{\partial^2 w}{\partial x^2}+\dfrac{\partial^2 w}{\partial y^2}+\dfrac{\partial^2 w}{\partial z^2}\right] \end{cases}\right\} \quad . \quad . \quad (6).$$

Approximate Assumptions and Solutions.—After introducing into the preceding system of fundamental equations (1–6) the actual conditions as accurately as they are known relative to gravity, solar radiation, the rotation of the earth, the viscosity of the air, its mass or inertia, its absorption and radiation of heat, its variable content of moisture, the precipitation of rain and cloud, the mutual interconversions of latent and sensible heat, a special difficulty occurs when we attempt to integrate these equations, because we have still to express analytically the initial conditions of the atmosphere as to pressure and temperature, and its boundary conditions as between the rough earth surface on the one hand and the unknown outward surface on the other. As the true earth's surface cannot possibly be represented by any algebraic formula, it is customary to assume simply that it is a uniform sphere, usually neglecting at least partially, if not wholly, the spheroidal shape. We next assume that there is no friction between the earth and the air. Thirdly, we assume that the power of the earth's surface to heat the air and to throw moisture by evaporation into the atmosphere is perfectly uniform. Finally, in many cases we go so far as to assume that the atmosphere is an incompressible rare liquid having a uniform density and a uniform depth of about 8000 metres, corresponding to the average standard density of dry air under a pressure of 760 millimetres and a temperature of 0° C. Even under these simplifications the analytic difficulties have been too great to admit of rigorous solutions, except in a few of the simplest cases. The treatment of atmospheric problems by Ferrel was followed by equally ingenious mathematical treatment by Professors Guldberg and Mohn, of Christiania, in two papers published by them in 1876 and 1880 respectively. These authors, like Ferrel, treat isolated portions of the atmosphere and obtain special solutions, which, however, have not the generality that must eventually be demanded in a rigorous and general discussion of the atmosphere as a whole. A more elegant mathematical solution of the subject was first given in 1882 by Oberbeck, of the University of Halle, in the *Annal. Phys.* xvii. p. 128. But even Oberbeck's solutions are obtained under various simplifying assumptions that restrict their satisfactory application to the daily weather maps. Oberbeck's first memoir treats of the mechanics of stationary cyclonic movements. Assuming that the isobars are concentric circles, and that in the outer portion of a cyclone the air has only horizontal movements, while in the inner portion it has only vertical movements, he solves his system of equations for the inner and outer regions of the cyclone separately. He shows that in general the pressure increases on all sides outwards from the centre; the gradient also increases from the centre outwards to the limit of the inner region, whence it diminishes in the outer region and at a great distance becomes inappreciable. In both regions the paths of the wind are curved lines, logarithmic spirals, which cut the isobars or the radial gradient everywhere at the same angle; therefore, the movement of the air can be considered as a spiral inflow from all sides towards the centre. But the angle between the wind and the gradient follows different laws in the outer and inner regions, depending in the former on the rotation of the earth and the friction, but in the latter also on the intensity of the ascending current of air. In passing from the outer to the inner surface the wind experiences a sudden change of angle, so that the directions of the winds are not continuous, although the movement and the barometric pressures are assumed to be continuous. This latter peculiarity does not occur in nature, and is undoubtedly an analytical result peculiar to Oberbeck's method of treating the fundamental equations.

An improvement in the mathematical analysis was introduced by Dr F. Pockels of Göttingen in a memoir published in the *Met. Zeit.* for 1893, pp. 9–19. He deduces equations showing continuous changes of temperature, pressure, gradient, wind direction, and velocity from the centre of the cyclone to the outer edge of the anti-cyclone, or, more properly, the peri-cyclone; these, therefore, may reasonably be supposed to have their counterparts in nature. Such mathematical solutions, however, are based upon the assumption that we are dealing with a comparatively small portion of the earth's surface, which may be considered as a plane and as having a uniform diurnal rotation and a uniform coefficient of friction. Moreover, the cyclones and anti-cyclones are assumed to be stationary and permanent by reason of the perfect balance of all the forces involved therein. Of course these conditions are not exactly fulfilled, but in general Pockels shows that his theoretical results agree fairly well with the observed conditions as to wind and pressure. He computes the actual distribution of these elements under the assumption that the centre of the anti-cyclone is at latitude 55·5, and that the coefficient of friction is 0·00008.

Notwithstanding the fact that these difficult mathematical investigations still lead us to unsatisfactory results, they are yet eminently instructive as showing the methods of interaction of the various forces involved in the motions of the atmosphere. We must, therefore, mention the interesting attack made by Oberbeck upon the problem of the general circulation of the atmosphere. His memoir on this subject was published in the *Sitzungsberichte* of the Academy of Sciences at Berlin in 1888. The fundamental assumption in this memoir implies that there is a general and simple system of circulation between the equatorial and the polar regions, but the eventual solution of the problem leads Oberbeck to two independent systems of winds, an upper and a lower, without any well-defined connexion at the polar and equatorial ends of these two currents, so that after all they are not rigorously re-entrant. Among the hypotheses introduced in the course of his mathematical work, the most important, and perhaps the one most open to objection, is that the distribution of temperature throughout the atmosphere in both the upper and lower strata can be represented by the equation $\mathrm{T}=\mathrm{A}+\mathrm{B}\ (1-3\cos^2\theta)$. Undoubtedly this equation represents observations in the lower strata near the surface of the earth, but the constants that enter into it, if not the form itself, must be changed for the upper strata. The solution arrived at by Oberbeck gives the following equations representing the movement of the components of the movement of the atmosphere towards the vertical V, towards the north N, and towards the east O:—

$$\begin{aligned} \mathrm{V}&=\mathrm{C}\ (1-3\cos^2\theta)f \\ \mathrm{N}&=-6\ \mathrm{C}\cos\theta\sin\theta\ \phi \\ \mathrm{O}&=\mathrm{D}\ [\sin\theta\ (1-3\cos^2\theta)\ g+6\cos^2\theta\gamma]. \end{aligned}$$

In accordance with these equations he deduces the general circulation of the atmosphere as follows:—In the lower current the air flows from the polar regions towards the south-east and north-east until it reaches the parallel of 30° or 40°; it then turns directly towards the equator, and eventually towards the south-west and north-west, until at the equator it becomes a strong easterly wind (or a so-called westerly current). In the upper layer the movement begins as an easterly wind, turns rapidly to the north at latitude 20° or 30°, and then becomes a south-westerly wind (or north-eastern current) in the northern hemisphere, but a north-westerly wind and south-eastern current in the southern hemisphere. Of course in the highest strata of air the currents must diminish in strength. In a second paper in the same year, 1888, Oberbeck determines the distribution of pressure over the earth's surface as far as it is consistent with his system of temperatures and winds. His general equation shows that as we depart from the equator the pressure must depend upon the square and the fourth power of the cosine of the polar distance or the sine of the latitude, and in this respect harmonizes with Ferrel's work of 1859, although more general in its bearings. By comparing his formulæ with the observed mean pressure in different latitudes, Oberbeck obtains the general angular velocity of the air relative to the earth, *i.e.*, $0{\cdot}0292 \{ \sin^2 \phi - 0{\cdot}0836 \}$, which is quite small and is a maximum (4·6 metres per second) at latitude S. 56° 27′.

Contemporary with Overbeck's are the admirable memoirs by Professor Dr Diro Kitao of the University of Tôkyô, who, as a student of mathematics in Germany, had become an expert in the modern treatment of hydrodynamic problems. In three memoirs published by the Agricultural College of the University of Tôkyô in the German language in the years 1887, 1889, and 1895, he develops with great patience many of the minutiæ of the movement of the earth's atmosphere and cyclonic storms. The assumptions under which he conducts his investigations do not depart from nature quite so far as those adopted by other mathematicians. Like Ferrel, he adheres as closely as possible to the results of physical and meteorological observations; and although, like all pure mathematicians, he considers Ferrel as having departed too far from rigorous mathematical methods, yet he also unites with them in acknowledging that the results attained by Ferrel harmonize with the meteorology of the earth. The fact is that the solution of the hydrodynamic equations is not single, but multiplex. Every system of initial and boundary conditions must give a solution appropriate and peculiar to itself. The actual atmosphere presents us with the solution or solutions peculiar to the conditions that prevail on the earth. Entirely different conditions prevail on Jupiter and Saturn, Venus and Mars, and therefore a wholly new series of problems pertain to the various planets of the solar system. It matters not whether we attempt to resolve our equations by introducing terrestrial conditions expressed by means of analytical algebraic formulæ, and integrate the equations that result, or whether we adopt a graphic process for the representation of observed atmospheric conditions and integrate by arithmetical, geometrical, or mechanical processes. In all cases we must come to the same result, namely, our resulting expressions for the distribution of pressure and wind will agree with observations just as closely as our original equations represented the actual temperatures, resistances, and other attending conditions. In the last portion of Kitao's third memoir he gives some attention to the interaction of two cyclonic systems upon each other when they are not too far apart in the atmosphere, and shows how the influence of one system can be expressed by the addition of a certain linear function to the equations representing the motions of the other. He even gives the basis for the further study of the extension of cyclonic storms into higher latitudes where conditions are so different from those within the tropics. Finally, he suggests in general terms how the resistances of the earth's surface, in connexion with the internal friction or viscosity of the air, are to be taken into consideration, and shows under what conditions the assumptions that underlie his own solutions may, and in fact must, very closely represent the actual atmosphere.

The General Theory of the Circulation of the Atmosphere.—If the meteorologist had a sufficient number of observations of the motions of the winds and clouds to represent both the upper and lower currents, he would long since have been able to present a satisfactory scheme showing the average movement of the atmosphere at every point of its course, and the paths of the particles of air as they flow from the poles to the equator and return. This motion has been called the general circulation of the atmosphere; it would be a complex matter even if the surface of the earth were homogeneous and without special elevations, but the actual problem is far different. Something like this general circulation is ordinarily said to be shown by the monthly and annual charts of pressure, winds, and temperature, such as were first prepared and published by Buchan in 1868, and in Bartholomew's *Physical Atlas* of 1899. We must not, however, imagine that such charts of averages can possibly give us the true path of any small unit mass of air. The real path is a complex curve, not re-entrant, which is never described twice over, and would not be even if we had an ideal atmosphere and globe. It is a compound of vertical and undulatory movements in three dimensions of space, variable as to time, which cannot properly be combined into one average. The average temperatures, winds, and pressures presented on these charts suggest hypothetical problems to the student's mind quite different from the real problems in the mechanics of the atmosphere —problems that may, in fact, be impossible of solution, whereas those of the actual atmosphere are certainly solvable. The momentary condition presented on any chart of simultaneous observations belongs to the real, natural, and important questions of meteorology. The efforts of mathematicians and physicists have been devoted to these ideal conditions because of their apparent simplicity, whereas the practical problems offered by the daily weather chart are now so easily accessible that attention must be turned towards them. The most extensive system of homogeneous observations appropriate to the study of the dynamics of the atmosphere is that shown in the *Daily Bulletin of International Simultaneous Observations*, published by the U.S. Signal Service in the years 1875–84, with monthly and annual summaries, and a general summary in "Bulletin A," published by the U.S. Weather Bureau in 1893. The study of these daily charts for ten years shows how the general circulation of the atmosphere differs from the simple problems presented in the idealized solutions based on monthly and annual averages. The presence of a great and a small continent, and a great and small ocean, and especially of the moisture, with its consequent cloud and rain, has complicated and altered the problem. Nevertheless, it is important for us to follow the historical development of our subject. The most prominent features of the general circulation of the atmosphere are the system of trade winds, north-easterly in the northern tropics, and south-easterly in the southern tropics, the system of westerly winds beyond the trade-wind region, namely, north-westerly in the north temperate and south-westerly in the south temperate zone, and again the system of upper winds shown by the higher clouds, namely, south-westerly in the northern hemisphere and north-westerly in the southern.

Halley in 1680, and Hadley in 1735, gave erroneous or imperfect explanations of the mechanical principles that bring about these winds. As some errors in regard to this subject are still current, it is necessary to say that it is erroneous to teach that atmospheric air weighs less on being heated, or by reason of the infusion of more moisture, and that therefore the barometer falls. The addition of more moisture must increase its weight as a whole; heat, being imponderable, cannot directly affect its weight either way. We are liable to disseminate error by the careless use of the word "lighter," since it means both a diminution in absolute weight and a diminution in relative weight or specific gravity. Heat and moisture may diminish the specific gravity of a given mass of air by increasing its volume, or of a given volume by diminishing its mass, but neither of them can of themselves affect the pressure shown by the barometer so far as that is due to the weight of the atmosphere. It is not proper to say that by warming the air, thereby diminishing its specific gravity and causing it to rise, so that colder air flows in to take its place, we thereby diminish the barometric pressure. It is easily seen that in the expression $p = \mathrm{R}T/v$, which, as we have before said, is the law of elasticity, T and v may so vary as to counterbalance each other, and allow the pressure p to remain the same. Within any given room or other enclosure, as between the equator and the pole, hot air may rise on one side, flow over to the opposite, cool and return, and the circulation be kept up indefinitely without any necessary change in pressure. The problem of the relation between wind and pressure is more complex than this, and involves the consideration of the inertia of the masses of air that are in motion with the earth around its axis. The air is so extremely mobile that it moves quickly in response to slight differences in pressure that cannot be detected by ordinary barometric measurement. The gradients or differences of pressure that are shown on meteorological charts, whether daily, or monthly, or annual, are not directly, but only very indirectly, due to buoyancy, as caused by heat and moisture. The pressure gradients so-called are not merely the prime causes of the winds, but are equally and essentially the results of the winds. They are directly due to the fact that the atmosphere is rapidly revolving with the surface of the earth around the earth's axis, while at the same time it may be circulating about a storm centre. Inappreciable differences of pressure start the winds in motion, and the air moves towards the region of low pressure, just as in the pneumatic despatch tubes the flow of air towards the low pressure carries the packages along. But in the free air, where there are no important resistances to be overcome, the freedom of motion is greater than in these pneumatic tubes. No sooner is the atmosphere thus set in motion from all sides towards the central low pressure than it rapidly acquires a spiral circulation, and thereby, in addition to the slight diminution of pressure in the direction of the motion of the wind, there is superimposed a much more decided one towards the left hand from the wind, and an equally rapid increase towards the right hand. This gradient of pressure, perpendicular to the direction of the wind, is far greater than that in the direction of the wind, and is that which produces the areas of decided low and high pressures that appear as storm centres and fair-weather centres respectively on the daily weather map. Therefore, in general, the wind cuts across the chartered isobars in directions oblique to these curved lines, and at angles which are nearly 90° for the feeble winds far removed from the centres, but which are almost zero for the most violent winds near the low centre. The winds acquire this spiral circulation for two reasons—(*a*) all straight line gusts or jets in fluids, subject to any form of resistance, necessarily break up into rotating spirals whenever the velocity exceeds a certain limit, because the resistances of the viscosity deprive some particles of the fluid of a little more of their original velocity and energy than the other particles near by them, and thus the whole series is drawn away from linear into curvilinear paths; (*b*) in addition to their rectilinear motions the particles of air have a rapid circular motion in common with the whole atmosphere diurnally around the earth's axis. Therefore every particle of moving air comes under the influence of a set of forces depending on its own rate of motion, relative to the earth's surface and its position relative thereto. If the particles are moving eastwards, viz., in the same direction as the earth's diurnal rotation, then the result is as though the atmosphere were rotating more rapidly than does the earth at present; consequently the particles of wind push towards the equator as though the atmosphere were trying to adopt a more flattened spheroidal figure corresponding to its greater velocity of rotation. If the particles are moving westwards, on the other hand, it is as though the atmosphere were revolving less rapidly than the earth, and as though the flattened spheroid of revolution due to the present rate of rotation were more decidedly flattened than need be; consequently the particles of air push towards the poles. If the winds blow towards either pole, then their initial moment of inertia about the earth's axis, due to the initial radius and the eastward movement of the air, must be retained; consequently, as the air advances into higher latitudes and to smaller circles of diurnal rotation its velocity must increase, and must carry the particles to the east of their initial meridians. If the wind blow towards the equator its initial moment of inertia must be applied to a larger radius, and its velocity correspondingly diminished, so that it is left behind or falls away somewhat to the west. "The reasoning, therefore, of those who in attempting to explain the trade winds assume that the atmosphere in moving towards or from the equator has a tendency to retain the same original linear velocity is erroneous" (Ferrel's *Movements of Fluids*, 1859). In general the winds tend to retain their moments of inertia, and in the northern hemisphere must necessarily always be deflected continuously towards the right hand. The exact amount of this deflection was first distinctly stated by Poisson, as applied to the movements of projectiles; it was also announced by Tracy of New Haven in 1843, but was first applied to the atmosphere by Ferrel, who deduced its meteorological consequences. This law is not to be confounded with that of Buys Ballot, who in 1861 deduced from the weather charts of western Europe the rule that the gradient of pressure shown on the weather map for any day would be followed in twenty-four hours by a wind perpendicular to that gradient, and having the lower pressure on the left hand. Buys Ballot's law was in the nature of a rule for prediction, and was modified by Buchan, who enunciated the following: "The wind blows towards the regions of low pressure, but is inclined to the gradient at an angle which is less than 90°." In this form Buchan's law was an improvement upon the laws current among cyclonologists, who had assumed that, in a rough way, the wind blew in circles around the low centre, and was therefore sensibly at right angles to the gradient. It ought, however, to be said that Redfield throughout the whole course of his studies, from 1831 to 1857, never gave adherence to this view, and in fact determined the average inclination of the movements of the lower clouds at New York City to be about 7° inwards as compared with the truly circular theory, at least for the severer portions of hurricanes. Now Ferrel's law explains mechanically the reason why the winds do not blow exactly radially or circularly, and gives the means for determining their inclination to the isobar in all portions of the cyclone, and for various degrees of resistance by the earth's surface. The general proposition that the barometric gradients on the weather map are not those that cause the wind, but are, properly speaking, the result of the combined action of the wind, the rotation of the earth, and the friction of the earth's surface, as first explained by Ferrel, seems to have been neglected by meteorologists until brought to their attention repeatedly by the present writer between 1869 and 1875. In 1874 Professor Hann published a review of Ferrel's work that rectified this important oversight. The independent investigations of Sprung, Koeppen, Finger, and especially Guldberg and Mohn, confirm in general the correctness of Ferrel's views.

It is quite erroneous to imagine that the low pressures in storm regions and in the polar regions, and especially the belt of low pressure at the equator, are due simply to the diminution of the density and weight of the air by the action of its warmth or its moisture, or to the abundant rainfall as relieving the atmosphere of the weight of water. It has been clearly shown that none of these operations can directly affect the barometric pressure to any appreciable extent, but that high and low pressure areas, as we see them on the weather map, owe their existence entirely to the mechanical interaction of the diurnal rotation of the earth and the motions of the atmosphere. Both Espy and Hann have abundantly shown that the formation and downfall of rain do not produce any low barometric pressure unless they produce a whirling action of the wind—that, in fact, the latent heat evolved by the condensation of vapour into rain may so warm up the cloud as to produce a temporary rise in pressure even at the surface of the ground, due to the downward push produced by the sudden expansion of the cloud, analogous to the backward kick of a gun when shot off. The force with which the wind presses to the right or tends to be deflected in that direction is $2n$ sine ϕ, while the curvature of the path of the wind is measured by its radius of curvature, which is $v/2n$ sine ϕ, where v is the velocity of the wind, n is the equatorial velocity of the earth's rotation, and ϕ is the latitude. It will be seen from this that there is no deflection at the equator; therefore, as Ferrel stated, there is no tendency to the formation of great whirlwinds at the equator, hence hurricanes and typhoons are rarely found within 10° of the equator.

Ferrel frequently speaks of an anti-cyclone, whereby he means the area of high pressure just outside of a strong cyclonic whirl; the expression peri-cyclone would have been more appropriate and is sometimes substituted. The term *anti-cyclone*, as first introduced by Galton in 1863, is applied to a system of winds blowing out from a central area of high pressure, and this is the common usage of the term in modern meteorology. The term cyclone among meteorologists and throughout English literature, except only a few cases in the United States, is equivalent to the older usage of whirlwind, and it is unfortunate that misunderstandings often arise because local usages in America apply the word cyclone to what has for centuries been called a tornado. The mechanical principles discussed by Ferrel led him to an algebraic relation between the barometric gradient G, the wind velocity v, the radius of curvature of the isobar r, and the inclination i between the wind and the isobar, which is expressed by the following formula for the pressures that prevail at sea-level:—

$$G=[(2\,n\sin\phi+\cos i\;v/r)\;v\sec i]/[83{,}000{,}000].$$

A popular exposition of this and other results of Ferrel's work is given by Archibald in *Nature*, 4th May 1882, and still better in Ferrel's *Treatise on the Winds*, New York, 1897.

The charts of mean annual pressure, temperature, and winds above referred to show certain broad features that embrace the whole system of atmospheric circulation, viz., the low pressures at the equator and the poles, the high pressures under the tropics, the trade winds below and the anti-trades above, with comparative calms under the belts of equatorial low pressure and tropical high pressure. The first effort of the mathematician was to explain how these mean average conditions depend upon each other, and to devise a system of general circulation of the wind consistent with the pressures, resistances, and densities. But, as we have already said, such a system may be very far from that presented by the real atmosphere, and little by little we are being led to a different view of the question of the general circulation. The earlier students of storms generally accepted one of two views as to the cause of whirlwinds. They were either—(1) formed mechanically between two principal currents of air flowing past each other, the so-called polar and equatorial currents; or (2) they were due to the ascent of buoyant air while the heavier air flowed in beneath, the whirling motion being communicated by the influence of the rotation of the earth, or by the greater resistances on the one side or the other. In order to explain why hurricanes and typhoons exist continuously for many days, or even weeks, it is necessary that there should be a source of energy which would maintain a continued buoyancy and rising current at the centre, and this was supposed to be fully provided for by Espy's proof of the liberation of latent heat consequent on the formation of cloud and rain. To this latter consideration the present writer has added the even more important influence of the sun's heat intercepted at the upper surface of the cloud. At this stage of the investigation the whirlwind was but an incident in the general circulation of the atmosphere, but further consideration showed that it ought rather to be regarded as an essential portion of that circulation, and that when temperature gradients and density gradients exceeded a certain limit the formation of great whirlwinds was inevitable. Therefore, an atmosphere containing several whirlwinds is just as truly a system of general circulation in the one case as an atmosphere without a whirlwind is in the other. The formation of rain, the evolution of latent heat, and even the absorption of heat at the upper surface of the cloud really constitute a normal general circulation in this special case.

In 1890 Professor Hann published a careful analysis of the actual temperature conditions prevailing over an extensive area of high pressure in Europe, and showed that the temperatures of the upper strata in both high and low areas, namely, in anticyclones and cyclones, are often directly contrary to those supposed to prevail by Espy and Ferrel. This study necessitated a more careful examination into the radiation of heat from the dust and moisture of the atmosphere, and the present writer seems to have shown that in areas of high pressure and clear weather a very slow descending movement throughout each horizontal layer gives time for the radiation of heat that will fully explain the anomalies of temperature. On the other hand, von Helmholtz in several memoirs of 1888–91 showed that waves or billows may be formed in the atmosphere of great extent at the dividing surface between upper and lower strata moving in different directions and with different velocities. Under specific conditions these billows may become like the breakers and caps of waves of the ocean when driven by the wind. The hypothesis that these aërial breakers correspond to our storms and troughs of low pressure experienced in the lower atmosphere is very plausible. As these billows are formed between upper and lower air currents of great extent, which themselves represent a large portion of the horizontal circulation between the poles and the equator, it results that if von Helmholtz's suggestion and Hann's hypothesis are correct then our storms must be considered as essentially incidents in the general circulation rather than as caused by the vertical circulation over any locality. It must occur to every one to adopt the intermediate view that, on the one hand, the local vertical circulation, with its clouds, rain, hail, and snow, and evolution of latent heat, and, on the other, the waves and whirls in the general circulation, mutually contribute toward our storms and fair weather. It only remains to allot to each its proper importance in any special case.

Undoubtedly aërial billows, and the clouds that must frequently accompany them, exist everywhere in the earth's atmosphere. Perhaps their extent and importance are not properly appreciated. A voyage around the Atlantic Ocean in 1889–90, made by the writer, specifically to study cloud phenomena, revealed many remarkable cases, such as the cumulus rolls that extend in a remarkably symmetrical series from the island of Ascension westwards for a hundred miles in the south-easterly trades, or the delicate fields of cirro-cumuli that extend from the islands of Santa Lucia and Barbados for two hundred miles eastwards under favourable conditions. The mixtures and vorticose motions going on within aërial billows to form these clouds have been interpreted by Brillouin; but to a certain extent we must still agree with Ferrel, who could not accept the conclusion that the great storms, in which ascending currents and heavy rains are the most prominent features, depend to any extent on these phenomena of mixture, and therefore on the general circulation of the atmosphere.

Mathematicians have, almost without exception, assumed a so-called steady condition in the motion of the atmosphere in order to achieve a successful integration of the general equations of motion. The restrictions within which Helmholtz and others have worked, and the limits within which their results are to be accepted, have been analysed by Dr E. Herrmann in a memoir of which a translation is published in the bulletin of the American Mathematical Society for June 1896. Of course Herrmann's own investigation is also based upon certain simplifying hypotheses, such as the absence of outside disturbing forces and of viscosity and friction, a homogeneous ellipsoidal surface, and a uniform initial temperature and rate of revolution corresponding to an initial state of equilibrium. If now the initial static equilibrium be disturbed by introducing a different distribution of temperature, viz., one that varies with altitude and latitude, but is uniform in longitude along any circle of latitude, then the first question is whether the atmosphere can settle down to a new state of static equilibrium. Herrmann shows that in general it cannot do so, but that the new state and the future states can only be one of motion and dynamic equilibrium. If, however, there be no external forces acting on the atmosphere, then in one case static equilibrium relative to the earth can occur, namely, when the new temperatures are so distributed in the atmosphere as to satisfy the equation

$$\int \rho\, r^2\, w\, d\, \mathrm{V} = \mathrm{M},$$

in addition to the ordinary equations of elasticity, inertia, and continuity previously given, and to those representing the boundary conditions, M being the total amount of inertia of the atmosphere relative to the axis of rotation. In general, the movements in the atmosphere must consist not only of an interchange between the poles and the equator, but also of east and west motions, and there must therefore be a different rate of diurnal rotation for each stratum. The second step in this inquiry is, Can these movements become perfectly steady with this unvarying or steady distribution of temperature? In other words, Can the temperature and the movements be so adjusted to each other that each shall remain invariable within any given zone of latitude? The reply to this is, that the temperatures and the movements, if they are to become thus adjusted, must satisfy a certain differential equation which itself shows that steady motions and stationary temperatures cannot exist if there is any north or south component. Apart from the fact that Herrmann assumes no friction, it would seem that he has proved that steady motions and stationary pressures cannot exist in the atmosphere over a homogeneous globe, and presumably the same result would follow for the irregular surface of the actual globe. The motions of the real atmosphere must therefore consist of irregularities and periodic oscillations superimposed upon more uniform, regular progressions, but never repeating themselves. Consequently, the conclusions deduced by those who have assumed that stationary conditions are possible must depart more or less from meteorological observations. There is a general impression that the belt of low pressure at the equator and the low areas at the poles and the high pressures under the tropics are pseudo-stationary, and really represent what would be steady conditions if we had an ideal smooth globe; but Herrmann's researches show that the unsteadiness observed to attach to these areas under existing conditions would also attach to them under ideal conditions. They really have and must have irregular motions, and we, by taking annual averages, obtain an ideal annual distribution of pressure, temperature, and wind that does not represent any specific dynamic problem. The averages represent what is considered proper in climatology, but are quite improper and misleading from a dynamic point of view, and have no simple logical connexion with each other.

Closely connected with this study of steady motions under a constant supply and steady distribution of solar heat comes the further question as to whether regular seasonal variations in atmospheric pressure and wind can be produced by regular seasonal variations in the heat received from the sun; for instance, a variation in the earth's atmosphere corresponding to the periodic variations of the solar spots. The general current of Helmholtz's investigations seems to show that no periodic change in the earth's atmosphere can be maintained for any length of time by a given periodic influence outside of the atmosphere. On the other hand, it is barely possible that wave and vortex phenomena on the sun's surface may have the same periodicities as regular phenomena in the earth's atmosphere, so that there may be a parallelism without any direct connexion between the two.

An important paper on the application of hydrodynamics to the atmosphere is that by Professor V. Bjerknes, of Stockholm, Sweden, which was read in September 1899 at Munich, and is now published in English translation by the U.S. Weather Bureau. In this memoir Bjerknes applies certain fundamental theorems in fluid motion by Helmholtz, Kelvin, and Silberstein, and others of his own discovery to the atmospheric circulation. He simplifies the hydrodynamic conceptions by dealing with density directly instead of temperature and pressure, and uses charts of "isosteres," or lines of equal density, very much as was proposed by the present writer in 1889 in his *Preparatory Studies*, where he utilized lines of equal buoyancy or "isostaths." Bjerknes has thus made it practicable to apply hydrodynamic principles in a simple manner without the necessity of integrating the equations, at least for many ordinary cases. He also gives a criterion by which we may judge between the physical theory of Espy and Ferrel, according to which cyclones are perpetually renewed, and the mechanical theory according to which the cyclone is simply carried along in the general atmospheric current. Bjerknes's paper is illustrated by another one due to Mr Sandström, of Stockholm, who has applied these methods to a storm of September 1898 in the United States. The further development of Bjerknes's methods promises a decided advance in theoretical and practical meteorology. They are also applicable to the problems of oceanic circulation.

The Diurnal and Semi-diurnal Periodicities in Barometric Pressure.—For a long time attempts were made to explain the periodic variations of the barometer by a consideration of static conditions, but it is now evident that this problem, like that of the circulation of the atmosphere, is a question of aërodynamics. A most extensive series of researches into the character of the phenomena from an observational point of view has been made by Dr Julius Hann, who has also given a summary of the present condition of our knowledge of the subject in the *Met. Zeit.* for 1898, which has been translated by Mr R. H. Scott in the *Quarterly Journal of the Royal Meteorological Society* for January 1899 (see also an important addition by Hann and Trabert in the *Met. Zeit.* for November 1899). Professor Hann has shown that at the earth's surface three regular periodic variations are established by observation, viz., the diurnal, semi-diurnal, and ter-diurnal. On the higher mountains these variations change their character with altitude. (1) At the equator the diurnal variation is represented by the formula $0{\cdot}30$ mm. $\sin(5^\circ + x)$, where x is the local hour angle of the sun. In higher latitudes either north or south the coefficient $A_1 = 0{\cdot}30$ mm. diminishes, but the phase angle, 5°, varies greatly, generally growing larger. It is therefore evident that this diurnal oscillation depends directly on the hour angle of the sun, and probably, therefore, principally on the amount of heat and vapour received by the atmosphere from the ocean and the ground at any locality and season of the year. It is apparently but little affected by the wind, but somewhat by altitude above sea; the amplitude diminishes to zero at a certain elevation, and then reappears and increases with the opposite sign; the phase angle does not change. (2) Superimposed upon this diurnal oscillation is a larger semi-diurnal one, which goes through its maximum and minimum phases twice in the course of a civil day. The amplitude of this variation is largest in equatorial regions, and is expressed by the formula $A_2 = (0{\cdot}988 \text{ mm.} - 0{\cdot}573 \text{ mm. } \sin^2\phi)\cos^2\phi$ as given by Hann, or $A_2 = (0{\cdot}92 \text{ mm.} - 0{\cdot}495 \sin^2\phi)\cos^2\phi$ as revised by Trabert. This amplitude also may be considered as variable along each zone of latitude having a maximum value on certain central local meridians. The times at which the semi-diurnal phases of maximum and minimum occur are subject to laws different from those for the diurnal period. Within the tropics the phase angle is 160°

and at 50° N. it is 147°, and between these limits it seems to be the same over the whole globe, so that the phase does not depend clearly upon the hour angle of the sun or on the local time. The amplitudes appear to depend on the excess of land in the northern hemisphere as compared with the water and cloud of the southern hemisphere. The amplitude also varies during the year, being greatest at perihelion and least at aphelion. Hann suggests that this is an indirect effect of the sun's heat on the earth, as the northern hemisphere is hotter when the earth is in aphelion than is the southern hemisphere when the earth is in perihelion, owing to the preponderance of land in the north and water in the south. (3) The ter-diurnal oscillation has the approximate value shown by the formula $0\cdot04$ mm. $\sin(355^\circ + 3x)$. The phase angle is sensibly the same everywhere, and the amplitude varies slightly with the latitude. Both phase and amplitude have a pronounced annual period which is as remarkable as that of the semi-diurnal oscillation; the maximum amplitude occurs in January in the northern hemisphere, and in July in the southern.

The dynamics and physics of the atmosphere have not yet been explored so exhaustively as to explain fully these three systematic barometric variations, but neither have we as yet any necessity for appealing to some unknown cosmic action as a possible cause of their existence. The action of the solar heat upon the illuminated hemisphere, and the many consequences that result therefrom, may be expected to explain the barometric periods. The variations of sunshine and cloud must inevitably produce periodic variations of temperature, moisture, pressure, and motion, whose exact laws we have not as yet fathomed. Among the many methods of action that have been studied or suggested in connexion with the barometric variations the most important of all is the so-called tidal wave of pressure due to temperature. Laplace applied his investigations on the tides to the gravitational tide of the ocean, and when he passed to the corresponding solar and lunar gravitational tides of the atmosphere he was able to show that they must be inappreciable, unless, indeed, certain remarkable relations existed between the circumference of the earth and the depth of the atmosphere. As these relations do not exist, it is generally conceded as certain that the gravitational tides, both diurnal and semi-diurnal, cannot exceed a few thousandths of an inch of barometric pressure. On the other hand, the same process of mathematical reasoning enables us to investigate the action of the sun's heat in producing a wave of pressure that has been called a pressural tide, due to the expansion of the lower layer of air on the illuminated half of the globe. The laws that must govern these pressural tides have been investigated by Kelvin, Rayleigh (*Phil. Mag.* February 1890), and especially by Margules (*Vienna Sitz. Ber.* 1890–93). The two latter have shown the truth of a proposition enunciated by Kelvin in 1882, without demonstration, to the effect that the free oscillation produced by a relatively small amount of tide-producing force will have an amplitude that is larger for the half-day term than for the whole-day term. They therefore explain the diurnal and semi-diurnal variations of the barometric pressure as simple pressural tides or waves of expansion, originally produced by solar heat, but magnified by the relation between forced and free waves in an atmosphere on a globe having the specific dimensions of our own. The analytical processes by which Laplace and Kelvin arrived at this special solution of the tidal equation were objected to by Airy and Ferrel, but the matter has been, as we think, most fully cleared up by Dr G. H. Ling, in a memoir published in the *Annals of Mathematics* in 1896. He seems to have shown that, although a literally correct result was attained by Laplace, his methods were at fault from a rigorous and analytical point of view, at least in so far as they are presented in the *Mécanique Céleste.* The process by which a diurnal temperature wave produces a semi-diurnal pressure oscillation, as explained by Rayleigh and Margules, may be stated as follows: The diurnal temperature wave having a twenty-four hours period is the generating force of a diurnal pressure tide, which is essentially a forced and small oscillation. The natural period of the free waves in the atmosphere agrees much more nearly with twelve than with twenty-four hours. In so far as the forced and the free waves reinforce each other, the semi-diurnal waves are reinforced far more than the other, so that a very small semi-diurnal term in the temperature oscillations will produce a pressure oscillation two or three times as large as the same term would in the diurnal period. These reinforcements, however, depend upon the elastic pressure within the atmosphere, just as does the velocity of sound. If the prevailing barometric pressures were slightly increased, the adjustment of the twelve-hours free wave of pressure to the forced wave of temperature could be so perfect that the barometric wave would increase to an indefinite extent. For the actual temperatures the periodicity of the free wave is about thirteen hours, or somewhat longer than the forced wave of temperature, so that the barometric oscillation does not become excessive. It would seem that we have here a suggestion to the effect that if in past geological ages the average temperature at any time has been about 268° C. on the absolute scale, then the pressure waves could have been so large as to produce remarkable and perhaps disastrous consequences, involving the loss of a portion of the atmosphere.

The Thermodynamics of a Moist Atmosphere.—The preceding section deals with an incompressible gas, and therefore with simple, pure hydrodynamics. If now we introduce the conception of an atmosphere of compressible gas, whose density increases with altitude, so that rising and falling currents change their temperatures by reason of the expansion and compression of the masses of air, we take the first step in the combination of thermodynamic and hydrodynamic conditions. If we next introduce moisture, and take precipitation into consideration, we pass to the difficult problems of cloud and rain that correspond more nearly to those which actually occur in meteorology. This combination has been elucidated by the works of Espy and Ferrel in America, Kelvin in England, Hann in Austria, but especially by Hertz, Helmholtz, and von Bezold in Germany, and by Brillouin in France. A most complete study of the subject will be found in Prof. Bigelow's report on the cloud work of the U.S. Weather Bureau.

The proper treatment of this subject began with the memoir of Kelvin on convective equilibrium (see *Trans. Manchester Phil. Soc.* 1861). The most convenient method of dealing approximately with the problems is graphic and numerical rather than analytical, and in this field the pioneer work was done by Hertz, who published his diagram for adiabatic changes in the atmosphere in the *Met. Zeit.* in 1884. He considers the adiabatic changes of a kilogram of mixed air and aqueous vapour, the proportional weights of each being λ and μ respectively. In a subsequent elaborate treatment of the same subject by von Bezold in four memoirs published during 1889 and 1899, the formulæ and methods are arranged so as to deal easily with the ordinary cases of nature which are not adiabatic; he therefore prepares diagrams and tables to illustrate the changes going on in a unit mass of dry air to which has been added a small quantity of aqueous vapour, which, of course, may vary to any extent. Both Hertz and von Bezold consider separately four stages or conditions of atmosphere:—(A) The dry stage, where aqueous vapour to a limited extent only is mixed with the dry air. (B) The rain stage, where both saturated vapour and liquid particles are simultaneously present. (C) The hail stage, where saturated aqueous vapour, and water, and ice are all three present. (D) The snow stage, where ice vapour and snow itself, or crystals of ice, are present. The expressions aqueous vapour and ice vapour do not occur in Hertz's article, but are now necessary, since Marvin, Fischer, and Juhlin have been able to show that vapour from water and vapour from ice exert different elastic pressures, and must therefore represent different modifications of liquid water. According to Hertz, we may easily follow this mass of moist air as it rises in the atmosphere, if by expansion it cools adiabatically so as to go successively through the four preceding stages. For a few thousand feet it remains dry air. It then becomes cloudy and enters the second stage. Next it rises higher until the cloudy particles begin to freeze into snow, sleet, or hail, which characterizes the third stage. When the hail has fallen and the remainder of the cloud has ascended higher, it contains only ice particles and the vapour of ice, a condition which characterizes the fourth or snow stage. If in this condition we give it plenty of time the precipitated ice or snow may settle down, and the cloudy air, becoming clear, return to the first stage; but the ordinary process in nature is a circulation by which both the cloud and the air descend together slowly, warming up as they descend, so that eventually the mixture returns to the first stage at some level lower than the clouds, though higher than the starting point.

The exact study of the ordinary non-adiabatic process must be carried out by the help of Prof. Bigelow's tables, but the approximate adiabatic study is so helpful that in Fig. 10 we have traced a few lines from Hertz's diagram sufficient to illustrate its use and convenience. The reader will perceive a horizontal line at the base representing sea-level; near the middle of this line is zero centigrade; as we ascend above this line into the upper regions of the air we come under lower pressures, which are shown by the figures on the left-hand side. The scale of pressures is logarithmic, so that the corresponding altitudes would be a scale of equal parts. The temperature and pressure at any height in the atmosphere are shown by this diagram. If the air is saturated at a given temperature, then the unit volume can contain only a definite number of grams of water, and this condition is represented by a set of moisture lines, indicated by short dashes, showing the temperature and pressure under which 5, 10, or 20 grams of water may be contained in the saturated air. Let us now suppose that we are following the behaviour of a kilogram mass of air rising from near sea-level, where it has a pressure of 750 millimetres, a temperature of 27° C., and a relative humidity of 50 per cent. A pointer pressing down upon the diagram at 750 millimetres and 27° C. will represent this initial condition. A line drawn through that point parallel to the moisture lines will show that if this air were saturated it could contain about 22 grams of water; but inasmuch as the relative humidity is only 50 per cent., therefore it actually contains only 11 grams of water, and an auxiliary moisture line may be drawn for this amount. If now the mass rises and cools by expansion, the relation between pressure and temperature will be shown by the line *a a*. When this line intersects the inclined moisture line for 11 grams of water we know that the rising mass has cooled to saturation, and this occurs when the pressure is about 640 millimetres and the temperature 13·2° C. By further rise and expansion a steady condensation continues, but by reason of the latent heat evolved the rate of cooling is diminished and follows the line $\beta\ \beta$. The condensed vapour or cloud particles are here supposed to be carried up with the cooling air, but the temperature of freezing or zero degrees centigrade is soon attained—as the diagram shows—when the pressure is about 472 millimetres. At this point the special evolution of latent heat of freezing comes into play; and although the air rises higher and more moisture is condensed, the temperature does not fall because the water already converted into vapour and now becoming ice is giving out latent heat sufficient to counteract the cooling due to expansion. This illustration from Hertz's diagram therefore shows that the curve for cooling temperature coincides with the vertical line for freezing, and is represented on the diagram by the short piece $\beta\ \gamma$. By this expansion due to ascent the volume is increased while the temperature is not changed; therefore, the quantity of aqueous vapour has increased. When the ascending mass has reached the level where the pressure is 463 millimetres it has also reached the moisture line that represents this increase in aqueous vapour. As this shows that the aqueous particles have now all been frozen, and as the air is now continuously rising, while its temperature is always below freezing-point, therefore at levels above this point the vapour that condenses from the air is supposed to pass directly over into the condition of solid ice. Therefore from this point onwards the falling temperatures follow along the line $\gamma\ \gamma$, and continue along it indefinitely. From these considerations it follows that the clouds above the altitude of freezing temperatures are essentially snow crystals, and if the air rises slowly there may be time for the water and ice to settle down towards the ground; in this case the quantity of snow left within the clouds must be very small, and the cloud has the delicate appearance peculiar to cirrus. Hertz's original diagram is quite covered by these systems of a, β, γ, and δ lines, and the moisture lines. The lines show the density of the moist air at any stage of the process. An improved diagram by Neuhoff was published in 1900.

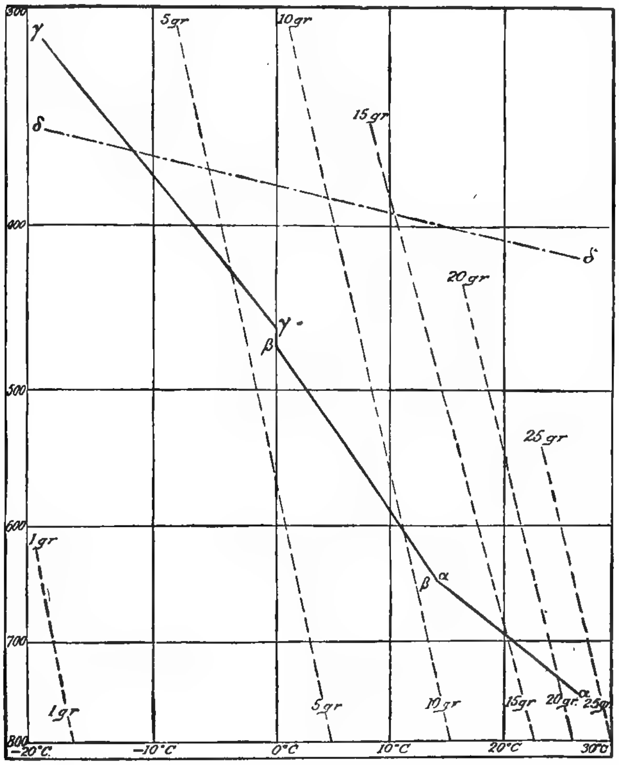


FIG. 10.—Diagram for Graphic Method of following Adiabatic Changes. (*After Hertz.*)

In von Bezold's treatment of this subject only illustrative diagrams are published, because the accurate figures, drawn to scale, are necessarily too large and detailed. He presents graphically the exact explanation of the cooling by expansion, the loss of both mass and heat by the rainfall and snowfall, and the warmth of the remaining air when it descends as foehn winds in Switzerland and chinook winds in Montana. Even in the neighbourhood of a storm, and over low lands and the ocean, the warm moist air in front, after being carried up to the rain or snow stage, descends drier and warmer on the opposite side of the central low pressure. In order to have a convenient term expressive of the fact that two masses of air in different portions of the atmosphere having different pressures, temperatures, and moistures, would, if brought to the same pressure, also necessarily attain the same temperature, von Bezold introduced the expression "potential temperature," and devised a simple diagram by which the potential temperature may be determined for any mass of air whose present temperature, pressure, and moisture are known. In an ascending mass of air, from the beginning of the condensation onwards, the potential temperature steadily increases by reason of the loss of moisture, but in a descending mass of air it remains constant at the maximum value attained by it at the highest point of its previous path. In general the potential temperatures of the upper strata of the atmosphere are higher than of the lower. In general the so-called vertical temperature gradient is smaller than would correspond to the adiabatic rate for the dry stage. This latter gradient is 0·993° C. per hundred metres for the dry stage, but the actual atmospheric observations give about 0·6°. Apparently this difference represents primarily the latent heat evolved by the condensation of vapour as it is carried into the upper layers, but it also denotes in part the effect of the radiant heat directly retained in the atmosphere by the action of the dust and the surfaces of the clouds. Passing from simple changes due to ascent and descent, von Bezold next investigated the results of the mixture of different masses of air, having different temperatures and humidities, or different potential temperatures. The importance of such mixtures was exaggerated by Hutton, while that of thermodynamic processes was maintained by Espy, but the relative significance of the two was first clearly shown by Hann as far as it relates to the formation of rain, and further details have been considered by von Bezold. The practical tables contained in Prof. Bigelow's report on clouds complete our methods of studying this subject.

A most important application of the views of von Bezold, Hertz, and Helmholtz was published by Brillouin in his memoir of 1898. Just as we have learned that the motions of the atmosphere are not due either to the general distribution of heat or to local influences exclusively, but in part to each, and just as we have learned that the temperature of the air is not due either to radiation and absorption or to dynamic processes exclusively, but to both combined, so in the phenomena of rain and cloud the precipitation is not always due to the cooling by mixture, or to the cooling by expansion, or to radiation, but is in general a complex result of all. The effect of the evaporation of cloudy particles in the production of descending cold currents has always been understood in a general way, but was first brought to prominence by Espy in 1838, and perhaps equally forcibly by Faye in 1875. Helmholtz, in his memoirs on billows in the atmosphere, showed how contiguous currents may interact on each other and mix together at their boundary surface; but Brillouin explains how these mixtures produce cloud and rain—not heavy rains, of course, but light showers, and spits of snow and possibly hail. He says: "When the layers of clear or cloudy air are contiguous, but moving with very different velocities, their motion, relative to the earth because of the rotation of our globe, assumes a much more complicated character than that which obtains when the air has no horizontal but only a vertical motion. We know in a general manner what apparent auxiliary forces must be introduced in order to take into account this rotation, and numerous meteorologists have published important works on the subject since the first memoirs by Ferrel. But their points of view have been very different from mine. The subjects that I desire to study are the surfaces of discontinuity as to velocity, temperature, and cloudiness in one special case only. Analytical methods permit us to resolve complex questions only for limited areas in longitude and for contiguous zones within which the movements are steady, but not necessarily uniform nor parallel. But it is evident that one can learn much as to the condition of permanence or destruction of annular zones having uniform and parallel movements. Thus simplified, the questions can be treated by elementary geometric methods, by means of which we at once rediscover and complete the results given by Helmholtz for zones of clear air and discover a whole series of new results for zones of cloudy air." Among Brillouin's results are the following theorems:—

A. If the atmosphere be divided into narrow zonal rings, each extending completely around the globe, thus covering a narrow zone of latitude, and if each is within itself in convective equilibrium so that the surfaces of equal pressure shall be surfaces of revolution around the axis of rotation, then within any such complete ring in convective equilibrium the angular velocity of any particle of the air will vary in inverse ratio of the square of its distance from the axis of rotation, or ar^2 is constant; that is to say, the air will not move like a rotating solid, but will have a variable angular velocity, smaller far from the axis and greater near to it.

B. The surfaces of equal pressure are more concave towards the centre than is the surface of the globe itself, and they are tangent to the latter only along the parallel where calms prevail.

C. A heavy gaseous atmosphere resting upon a rotating frictionless globe divides itself into concentric rings whose angular movements increase as we pass from the polar region towards the equatorial ring; the central globe rotates more rapidly than the equatorial atmospheric ring.

D. The surface of separation between two contiguous concentric rings must be such that the atmospheric pressure shall have the same value as one approaches this surface from either direction, and the surface of separation is stable if the differences of pressure in different parts of this surface are directed towards the surface of equilibrium. As the distribution of pressure along a line parallel to the axis of rotation is independent of the velocity of rotation, the ordinary condition of stability, viz., that the gas of which the lower ring is composed shall be denser than that above, will hold good for this line. In general, any inclination of the surface of separation to the horizon amounting to 10° must be associated with very small differences of density and large differences of velocity; in practice the inclinations are far less than 10°.

E. If the surfaces of equal pressure or isobars are nearly horizontal, as in ordinary cases, the calculations are comparatively easy to make. Let the inclination of the isobaric surface ascending towards the pole be ϕ; let h_1 be a distance counted along the axis of the earth, and H_1 the distance measured in the direction of the attraction of gravity; then the angle of inclination of the isobaric surface is given by the equation

$$\text{tang. } \phi = -\frac{H_1 - h_1 \sin \lambda}{h_1 \cos \lambda}$$

where λ is the complement of the angle between the direction of gravity and the line drawn to the poles, or the axis of rotation of the earth. The surface of separation is that over which the pressure is the same in two contiguous masses or zones, and is identical with a vertical plane only when the densities and velocities in the two layers have certain specific relations to each other. It can never lie between the isobaric surfaces that Brillouin designates as 1 and 2. In order that the equilibrium may be stable, it is necessary that when ascending in the atmosphere along a line parallel to the polar axis one should traverse layers of diminishing density. In the midst of any zone there cannot exist another zone of limited altitude; it must extend upwards indefinitely. Whenever there is any zone of limited altitude it must necessarily have, near its highest or lowest point, an edge by which it is attached to the surface of separation of two other neighbouring zones. In other words, the surfaces of separation of the three zones, of which one is limited and the other two are indefinite, must all run together at a common point or edge, very much as in the problem of the equilibrium of thin films.

F. When the contiguous zones are cloudless the mixtures take place under the following conditions:—Starting from the stable conditions, the cloudless mixture ascends on the polar side when the west wind which prevails on the equatorial side of the surface of separation is warmer, but descends between the pole and the equatorial side of the horizon when the west wind which prevails on the equatorial side of the surface of separation is colder. The mixtures of cloudless air rapidly occupy the whole height of the two layers that are mixing. When they form along a surface that becomes unstable the whirlwind that is thus engendered is sensibly cylindrical at first, but finally becomes extremely conical. This whirlwind may be limited as to height when the two contiguous masses that are mixing are surmounted by a third clear or cloudy layer which intersects the other two and whose lower surface is stable. (Brillouin suggests that possibly this corresponds to the formation of water-spouts and tornadoes.)

G. When the contiguous zones are cloudy and the mixtures produce decided condensations, and sometimes even precipitation, the study of these must follow closely in the train of thought followed out by von Bezold. When the contiguous winds are feeble, but the temperatures are very different and the zones are near the equator, then the position of the mixture can be inverted by condensation, since the influence of difference of pressure becomes predominant. At the equator, whatever may be the difference of temperature, a mixture that is accompanied by condensation always rises if the surface of separation is stable. The condensation increases by the expansion, each zone of mixture being an outburst of ascending cumuli. At the equator, whatever may be the difference of temperature, a mixture accompanied by condensation always descends when the surface of separation is unstable; moreover, the adiabatic compression rapidly evaporates the mixture.

In the last three chapters of his memoir, Brillouin applies these principles and other details to almost every observed variety of mixtures due to the pressure of one current of air against another. Fig. 11, prepared for the *U.S. Monthly Weather Review*, October 1897, gives five of the cases elucidated by Brillouin. In each of these the left-hand side of the diagram is the polar side, the air being cold above and the wind from the east, while the right-hand side is the equatorial side, the air being warm above and the wind from the west. The reader will see that in each case, depending on the relative temperatures and winds, layers of cloud are formed of marked individuality. As none of these clouds appear in the *International Cloud Atlas* or the various systems of notation for clouds, one is all the more impressed with the importance of their study and the success with which Brillouin has opened up the way for future investigators. "We have no longer to do with personal and local experience, but with an analytical description of a small number of characteristics easy to comprehend and applicable at every locality throughout the globe."

The Formation of Rain.—Not only has dynamic meteorology made the progress delineated in the previous sections, but one of the most important questions in molecular physics is in rapid process of being cleared up. The formation of rain, from a physical point of view, is the ultimate step in the formation of cloud. The cloud consists, like fog, of extremely small particles, so light that they float indefinitely in the air; rain and snow represent those particles that have grown to be too large and heavy to be any longer sustained by the air—that is to say, their rate of fall through the air is greater than the ascending component of the air in which they float. The process by which such larger rain-drops are formed out of the lighter particles that constitute a cloud has not yet been satisfactorily explained. It is probable that either one of several processes contributes to bring about this result, and that in some cases all of these conspire together. The following paragraphs represent the hypotheses that have marked the gradual progress of our knowledge:—

A. Cloud particles may be driven together by the motions imparted to them by the wind, and may thus mechanically unite into larger ones, which, as they descend more rapidly, overtake the smaller ones and grow into rain-drops.

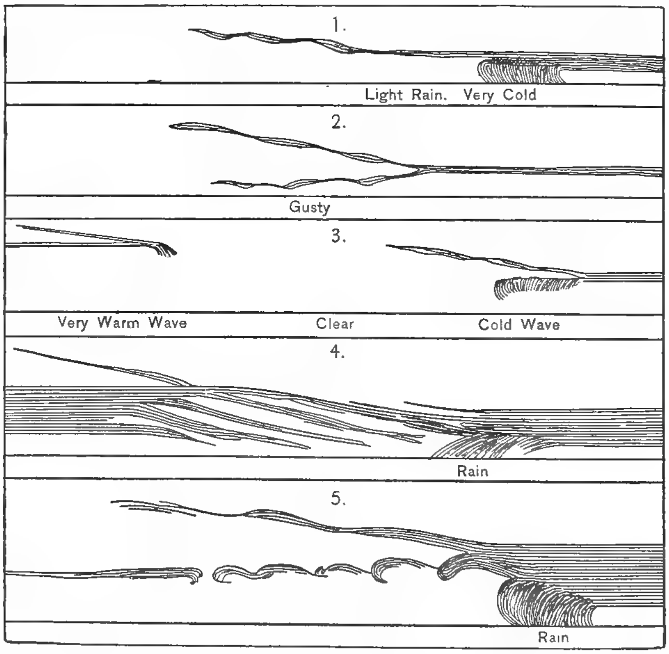


FIG. 11.—Diagram illustrating Clouds due to Mixture. (*After Brillouin.*)

B. The particles on the upper boundary of a cloud may at night-time, or in the shade, cool more decidedly than their neighbours below them, either by radiation or by mixture; then the air in their immediate vicinity becomes correspondingly cold, the particles and their envelopes of cold air sink more rapidly, overtaking and therefore uniting with other particles until the large rain-drops are formed.

C. Some cloud particles may be supposed to be electrified positively and others negatively, causing them to attract each other and run together into larger ones, or, again, some may be neutral and others charged, which may also bring about attraction and union.

D. When any violent agitation of the air, such as the sound waves due to thunder, or cannonading, or other explosions, sets the particles in motion, they may be driven together until brought into contact, and united into larger drops.

E. The air—or, properly speaking, the vapour—between cloudy particles, that is to say, within fog or cloud, is generally in a state of supersaturation; but if it is steadily rising to higher altitudes, thereby expanding and cooling, the supersaturation must increase steadily until it reaches a degree at which the molecular strain gives way, and a sudden violent condensation takes place, in which process both the vapour and the cloud particles within a comparatively large sphere are instantaneously gathered into a large drop. The electricity that may be developed in this process may give rise to the lightning flash, instead of the reverse process described in the preceding paragraphs (C and D), by which the lightning and the thunder either change the electrical conditions or cause noises and concussions that lead to the formation of rain.

F. However plausible the preceding five hypotheses have seemed to be, it must be confessed that no one has ever yet observed precipitation actually formed by these processes. The laborious observations of Mr C. T. R. Wilson of Cambridge, England, probably give us our first correct idea as to the molecular processes involved in the formation of rain. After having followed up the methods inaugurated by Aitken showing that the particles of dust floating in the air, no matter of what they may be composed, become by preference the nuclei upon which the moisture begins to condense when air is cooled by expansion, Wilson then showed that in absolutely dustless air, having therefore no nuclei to facilitate condensation, the latter could only occur when the air is cooled to a much greater extent than in the case of the presence of dust; in fact, dustless air requires to be expanded more than dusty air in the ratio of 4 to 3, or 1⅓ times more. The amount of this larger expansion may vary somewhat with the temperature, the moisture, and the gases. More remarkable still, he showed that dustless air, having no visible or probable nuclei, acquired such nuclei when a beam of ultra-violet light, or of the Röntgen rays, or the uranium radiation, or of ordinary sunlight (which possibly contains all of these radiations), was allowed to pass through the moist air in his experimental tube. In other words, these rays produce a change in the mixed gas and vapour similar to the formation of nuclei, and condensation of aqueous vapour takes place upon these invisible nuclei as readily as upon the visible dust nuclei. Further, the presence of certain metals within the experimental tube also produces nuclei; but the amount of expansion, and therefore of cooling, required to produce condensation upon these metallic nuclei is rather larger than in the case of dust nuclei. The nuclei thrown into the experimental tube by the discharge of electricity from a pointed metal wire produced very dense fogs by means of expansions slightly exceeding those required for ordinary dust. Finally, Wilson has been able to show that when dust particles are electrified negatively their tendency to condense vapour upon themselves as nuclei is much greater than when they are electrified positively, and he suggests that the descent of the rain-drops to the ground, carrying negative electricity from the atmosphere to the earth, may perhaps explain the negative charge of the earth and the positive electricity of the atmosphere.

At this point we come into contact with the views developed by J. J. Thomson as to the nature of electricity and the presence of negative and positive nuclei in the atmosphere. According to him, "The molecules made up of what chemists call atoms must be still further subdivided, and the atoms must be conceived as made up of corpuscles; the mass of a corpuscle is the same as the mass of the negative ion in a gas at low pressure. In the normal atom this assemblage of corpuscles forms a system which is electrical and neutral. Though the individual corpuscles behave like negative ions, yet when they are assembled in a neutral atom the negative effect is balanced by something which causes the space through which the corpuscles are spread to act as if it had a charge of positive electricity equal in amount to the sum of the negative charges on the corpuscles. I regard electrification of a gas as due to the splitting up of some of the atoms of the gas, resulting in the detachment of a corpuscle from such atoms. The detached corpuscles behave like negative ions, each carrying a constant negative charge which we shall call the unit charge, while the part of the atom left behind behaves like a positive ion with the units positively charged, but with a mass that is large compared with that of the negative ion. In a case of the ionization of the gas by Röntgen or uranium rays, the evidence seems to be in favour of the view that not more than one corpuscle can be detached from any one atom. Now the ions by virtue of their negative charges act as nuclei around which drops of water condense when moist dust-free gas is suddenly expanded. . . . Mr C. T. R. Wilson has shown that it requires a considerably greater expansion to produce a cloud in dust-free air on positive ions than on negative ones, when the ions are produced by Röntgen rays." It would therefore appear that the moist atmosphere above us may, through the action of sunlight, as well as by other means, become ionized. The negative ions attract moisture to themselves more readily than the positive; they grow to be larger drops, and descending to the earth with their negative charges give it negative electricity, while the atmosphere is left essentially either positive or neutral. (See also ATMOSPHERIC ELECTRICITY.)

METEOROLOGICAL ORGANIZATIONS.

During the latter half of the 19th century the prosecution of work in meteorology gradually passed out of the hands of individuals into the control of large national organizations. This was the natural result of the discovery that, by the spread of the electric telegraph and ocean cables, it had become possible to compile daily weather maps for large portions of the globe and make predictions of the weather and the storms for a day or two in advance, of sufficient accuracy to be of the greatest importance to the material interests of civilized nations. One by one every civilized nation has established either a weather bureau or a meteorological office, or a bureau of hydrography and marine meteorology, according as its special interests demanded. These governmental bureaux usually pursue both climatology and theoretical meteorology in addition to their daily practical work of telegraphy, forecasting, and publication of charts. Although, of course, in most cases, the so-called practical work absorbs the greater part of the labour and the funds, yet everywhere it is recognized that research and the development of a correct theory of the motions of the atmosphere are essential to any important progress in the art of forecasting. Among other important works in which the official weather bureaux have united, we may enumerate the International Meteorological Congresses, of which the first was held in 1853 at Brussels, the second in 1873 at Vienna, and others more frequently since that date; the establishment of an International Committee, to which questions of general interest are referred; the organization of a systematic exploration of the polar regions in the years 1882 and 1883; the general extension of the meteorological service to include terrestrial magnetism as an essential part of the physics of the globe; the systematic exploration of the upper atmosphere by means of kites and balloons; and the general co-operation with the U.S. Weather Bureau in the contribution of data for its international bulletin and its daily map of the whole northern hemisphere. The hydrographic offices and marine bureaux of the principal commercial nations have united so far as practicable in the daily charting of the weather, but have especially developed the study of the climatology of the ocean, not only along the lines laid down by Maury and the Brussels Conference of 1853, but also with special reference to the tracks of storm centres and the laws of storms on the ocean. The present condition of these governmental organizations is well presented in the annual address of the Hon. F. Campbell Bayard, delivered before the Royal Meteorological Society of London in January 1899, and in the text accompanying Bartholomew's *Physical Atlas*, vol. iii.

The development of meteorology, in both its scientific and its practical aspects, is intimately dependent upon the progress of our knowledge of physics, and its study offers innumerable problems that can be solved by proper combinations of mathematical theory and laboratory experimentation. The professors in colleges and universities who have hitherto lectured on this subject have not failed to develop some features of dynamic meteorology, although most of their attention has been given to climatology. In fact, many of them have been engrossed in the study of general problems in molecular physics, and could give meteorology only a small part of their attention. The early text-books on meteorology were frequently mere chapters or sections of general treatises on physics or chemistry. The most prominent early cases of university professorships almost wholly devoted to meteorology are those of the eminent Prof. Quetelet at Brussels and Prof. Kaemtz at Dorpat, Russia. In modern times we may point to Prof. von Bezold at Berlin, Prof. Hann at Vienna and Gratz, Prof. Pernter at Linz and Vienna, Prof. Woeikof at St Petersburg, Profs. Hildebrandsson at Upsala, Mohn at Christiania, Loomis at New Haven, and Davis and Ward at Cambridge, Mass. With these and a few other exceptions, the great universities of the world have as yet given but little special encouragement to meteorology; it has even been stated that there is no great demand for higher education on the subject. On the other hand, the existence of thousands of voluntary observers, the profound interest in the weather actually taken by every individual, and the numerous schemes for utilizing our very limited knowledge of the science through the activities of the large weather bureaux of the world demonstrate that there is a demand for knowledge perhaps even higher than the universities can offer. It would be very creditable to a nation or to a wealthy patron of science if there should be established meteorological laboratories in connexion with several important universities, at which not only instruction but especially investigation might be pursued, as is done at the magnificent astronomical observatories that are to be counted by hundreds throughout the world. The great difficulties inherent in meteorology should stimulate the devotion of the highest talent to the progress of this branch of science. The practical value of weather predictions justifies the expenditure of money and labour in order to improve them in every detail. (C. A.)

Method of Differences. See INTERPOLATION.

Methodism.—Since 1882 there have been two Methodist movements of world-wide importance: the "Forward Movement," and Methodist Reunion. The forward movement originated in the fact that sanctuaries in the crowded centres of modern cities were being gradually abandoned, while the majority of the people were outside all churches. The problem was solved in Manchester, where an almost abandoned sanctuary was reconstructed and immediately filled. The Manchester example has been followed in London, Leeds, Birmingham, Hull, Glasgow, and Edinburgh, and will be followed in the principal cities in the United Kingdom. The agencies are adapted to the actual human environment, great variety of method exists, and marked features of the work are the combination of social enterprises with individual evangelism, and the organization of sisterhoods. The second notable movement is the growing tendency towards the reunion of the various Methodist churches. The true inwardness of the terrible struggles which so greatly injured British Methodism in the first half of the 19th century had never been clearly stated to the public until 1898, when Dr Benjamin Gregory published *Side Lights on the Conflicts of Methodism* (Cassell and Co.), which must determine the attitude of all future historians of Methodism. The possibility of such conflicts has now passed away. In 1878 laymen were admitted into the Conference, and from that time have taken an equal share in the settlement of all questions of "policy and finance." By the wish of the laymen themselves, doctrinal issues, the appointment of ministers, and all questions of discipline are left to the pastoral session. After much further controversy, it was resolved in 1900 that the representative session should henceforth meet before the pastoral session, and also be enlarged to 300 ministers and 300 laymen. This growing liberalism of the parent Conference has brought Methodist reunion, even at home, within the range of possibility. In Canada all branches of Methodism have been united. A similar movement is being consummated throughout Australasia. The British and American Methodist Churches in Germany, Switzerland, Austria, and Hungary have also been united. The day is evidently not very far distant when Great Britain will follow the example of her colonies. The present ideal of most enlightened Methodists is one Methodist Church in every country, and an œcumenical conference every ten years to bind them all together. Three such conferences have already been held: in London in 1881, in Washington in 1891, and in London in 1901. The quadrennial general conference of the Methodist Episcopal Church in 1900 reached three ecclesiastical decisions of importance—for the future there will be an equal number of ministerial and lay representatives, the time limit has been abolished, and women as well as men may be elected lay representatives. The most authentic available statistics of Methodism are those presented to the second œcumenical conference in Washington in 1891. A special statistical committee collected the facts from all Methodist Churches throughout the world. The following is a summary:—

Summary of Geographical Distribution.

Continents.	Ministers.	Local Preachers.	Churches.	Other Preaching Places.	Members.	Sunday Schools.	Sunday School Teachers.	Sunday School Scholars.	Adherents.
Europe	4,488	39,748	15,584	3503	915,896	14,405	243,748	1,781,612	4,212,601
Asia	602	356	326	34	35,314	282	1,944	47,430	118,968
Africa	365	2,146	571	1264	77,234	450	2,669	28,267	295,376
America (*see also below*)	39,042	51,578	57,465	...	5,382,375	62,323	593,246	4,579,539	19,784,293
Australasia and Polynesia	786	5,375	3,250	2138	93,140	3,828	19,785	197,314	488,183
Total for churches represented at the Conference as far as reported	45,283	99,203	77,196	6939	6,503,959	81,288	861,392	6,634,162	24,899,421

As the advance during the decade 1880 to 1890 amounted to 30 per cent., and as the ratio of growth continually increases, the total number of Methodist adherents throughout the world must in 1900 have exceeded thirty millions. (H. P. H.)

United States.—The first œcumenical Methodist Conference, held in London in 1881, greatly broadened the views of its members, and especially increased the spirit of fraternity among American Methodists. This found expression in the centennial Methodist Conference, which in 1884 celebrated the one hundredth anniversary of the organization of American Methodism into a church. The second œcumenical Conference, in Washington in 1891, equalled its predecessor in influence and interest. These events materially modified the extent and form of the development of American Methodism. The spirit of fraternity has been illustrated and increased by the establishment of the Epworth League, which was formed in May 1889 by representatives of five of the largest Young People's societies in the Methodist Episcopal Church, and has spread to other Methodist denominations until there are 1,860,000 members. The Woman's Home Missionary Society, which was formed in 1881, has greatly increased its membership, enlarged its revenue, and expanded its work. In the conduct of a training-school in Chicago the need of a deaconess was felt; the office had been introduced into the Methodist Church in Germany; and memorials from the Conference, including Chicago and other cities near it, were sent to the general Conference asking for the authorization of deaconesses. These memorials were greatly reinforced by a similar memorial from Bengal in India, showing the imperative necessity of deaconesses to the highest success of the mission. Provision was made for their establishment in 1888. The same institution has been established in other Methodist denominations, especially in the Methodist Episcopal Church, South, and with it are connected prosperous hospitals; and generous bequests and benefactions have been made to that class of institutions which also exist independently. Philanthropic institutions, such as orphan asylums, children's homes, and homes for the aged, have relatively absorbed a large part of the energies and beneficence of Methodism, particularly of its women. The first Methodist Episcopal hospital in American Methodism, founded some years before, was opened in 1886 in Brooklyn, and the next in Philadelphia in 1892. So rapidly has this movement spread that there are more than thirty general hospitals under Methodist auspices.

The Methodist Episcopal Church, South, established equal ministerial and lay representation in 1866, in the general Conference, and lay representation in the annual Conference, in the proportion of four for each presiding elder's district. The Methodist Episcopal Church in 1872 introduced lay representation, limiting the number of laymen to one for each Conference having but one ministerial delegate, and in all other Conferences to two, whatever the number of ministerial delegates. From time to time efforts have been made to remove this limitation so as to make the representation equal. This involved a change in the constitution, which can be accomplished only by a vote of three-quarters of the members of the annual Conferences and a two-thirds vote of the general Conference. The first condition having been complied with by the ministers, and the second by the general Conference in May 1900, the restrictive rule was altered, and laymen, selected to be in readiness, were admitted to seats. The Methodist Episcopal Church, South, has largely increased its contributions for missions, for Church extension, and for denominational education. Since the overthrow of Spanish rule in Cuba it has established a mission in that island, and in the spring of 1900 had a number of workers in the field. The contributions for missions of the Methodist Episcopal Church have increased since 1884 from $813,269 per annum to $1,864,325 in 1901, and its missions, in number of societies and members, in proportion. The missionary enterprises of all Methodist denominations in nearly all pagan lands have prospered, prejudices melting away and converts becoming so numerous as to outrun the provisions for their training and organization. The Woman's Foreign Missionary Societies have contributed in very large measure to these results. In the Methodist Episcopal Church a controversy has prevailed on the eligibility of women to membership in the general Conference. Several in 1888 and 1896 appeared with credentials in due form; thus far the question is unsettled, some opposing on principle and expediency, more on the ground that the constitution must first be changed. Two ineffectual efforts have been made to do this. The constitution of the Methodist Episcopal Church has been entirely revised since 1900, and women are now eligible to seats in the general Conference. The changes made in the polity of the Methodist Episcopal Church, South, in 1866, were so radical that there has been no disposition since, or at most no widespread desire, to do more. Occasionally a few, who meet with little support, advocate the abolition of the life tenure of the bishops, or propose radical modifications in the presiding eldership. The Methodist Protestant Church, the largest non-episcopal body, is constantly raising the standard of its ministerial qualifications and the grade of its preparatory schools and colleges. It has revised its hymnal and its discipline, restricted its church boards, and has had the satisfaction of seeing lay representation (the chief reform advocated by its founders) adopted by those who rejected their propositions. At the general Conference of 1884 the rule limiting a continuous pastorate to five years was abolished, and a rule adopted giving each annual Conference authority to decide for itself whether there should be any limit, or, if any, what it shall be. The overture sent down to the Conferences authorizing the ordination of women to the ministry, after much discussion and agitation, was rejected. The Wesleyan Methodist body, formed in 1843, though small, has a strong denominational spirit, and is true to its fundamental and somewhat exclusive principles. These were tested in 1895, when the Church refused to modify the rules relating to secret societies, dress, and furniture, though an important Conference threatened disloyalty if it was not done. They declared that on this question as a unit they would survive or perish, and decided that, however few the members that adhered to a Church in case of a rebellion, they should constitute the Church and hold the Church property.

The African Methodist Episcopal Church has extended its missions into British, French, and Dutch Guiana, Trinidad, St Thomas, Hayti, Liberia, and Sierra Leone. This body has devoted itself to education with extraordinary zeal and success, and for this purpose it has raised within a few years above $1,000,000. At the Conference of 1884 of the African Methodist Episcopal Zion Church the word "male" was struck out from the Discipline, so that the sexes are equally eligible to all positions, lay and clerical. It has been constantly growing in numbers and in zeal for missions, education, and churchly order.

Statistics of American Methodists (1899).

Methodists.	Ministers.	Churches.	Communicants.
1. Methodist Episcopal	16,771	26,424	2,762,691
2. Union American Methodist Episcopal	175	200	16,200
3. African Methodist Episcopal	6,179	5,715	698,354
4. African Union Methodist Protestant	63	73	2,608
5. African Methodist Episcopal Zion	3,475	2,955	537,337
6. Methodist Protestant	1,647	2,401	184,097
7. Wesleyan Methodist	699	506	16,496
8. Methodist Episcopal, South	6,166	14,479	1,477,180
9. Congregational Methodist	345	350	21,000
10. Congregational Methodist (Coloured)	5	5	319
11. New Congregational Methodist	192	366	4,000
12. Zion Union Apostolic	30	32	2,346
13. Coloured Methodist Episcopal	2,061	1,433	204,972
14. Primitive	68	100	6,834
15. Free Methodist	1,003	1,034	27,487
16. Independent Methodists	8	15	2,569
17. Evangelist Missionary	48	13	2,010
Total Methodists	38,935	56,101	5,966,500

(J. M. BU.)

Metković, or METKOVICH, a market-place and seat of the administration of the government district of the same name in the Austrian crownland of Dalmatia. It is situated near the frontier of Herzegovina, on the Narenta river, navigable thus far, and has since the Austrian occupation been the chief depôt for imports to Herzegovina. It is a railway and steamship station. Population (1890), 4198; (1900), 4878, chiefly Serbo-Croatians.

Metz, a town, first-class fortress, and episcopal see of Germany, in Alsace-Lorraine, capital of (German) Lorraine, on the Moselle, 99 miles north-west of Strasburg by rail, and 10½ miles east of the French frontier. The strength of the fortifications now lies chiefly in the ring of detached modern forts, two to three miles distant from the town. Its garrison, a mixed body of Prussians, Saxons, and Bavarians, numbers 22,000 men. The cathedral (Roman Catholic) has been undergoing restoration since 1875. The town hall (1771) contains a small museum (this is in addition to the library museum). A fine equestrian statue of the Emperor William I. (1892) adorns the esplanade, and a bronze statue of Prince Frederick Charles (1898) the adjacent Boufflers garden; and there are also statues to Generals Ney (1855) and Fabert. The noteworthy public buildings and institutions include also the law courts, episcopal palace, provincial administrative offices, the arsenal, military school, music school, teachers' seminaries, theological seminary, deaf and dumb asylum, glass-painting school, &c. Except for tanneries, leather factories, and ironworks, there is relatively little industry. Since the war of 1870–71 Metz has been visited annually by great numbers of people desirous of seeing the famous battlefields of the former year—that is, Gravelotte, St Privat, Rezonville, and Vionville, on the west (battles of 16th and 18th August), Colombey and Nouilly on the east (14th and 31st August and 1st September), and Woippy, where Bazaine made his last attempt to break through on 7th October. The capitulation was signed at the château of Frescati, about three miles south of Metz. Population (1885), 54,072; (1900), 58,424.

Meudon, a town in the arrondissement of Versailles, department of Seine-et-Oise, France, 6 miles east of Versailles by rail. The remains of a castle, burned by the Germans in 1871, have since been adapted for an observatory of astronomical physics, connected with which is an important magnetic observatory, installed in a modern high tower. The handsome Galliera Institutions, on the hill of Fleury, were founded by the duchess of Galliera for the reception of 100 aged persons and 350 orphans. The buildings were completed in 1885 at a cost of £560,000, and provided with an endowment of £400,000. Meudon is the seat of extensive manufactures of munitions of war for the artillery, and in the neighbouring park of Chablais is the Government establishment of military ballooning. Population (1891), 7258; (1901), 9702.

Meurthe-et-Moselle, a department of the east of France, bordering on German Lorraine, watered by the two rivers naming it.

Area, 2037 square miles. The population, 419,317 in 1881, had increased to 484,002 in 1901. Births in 1899, 11,044, of which 1054 were illegitimate; deaths, 9888; marriages, 3479. There were in 1896, 1055 schools, with 66,000 pupils, the illiterate forming 2 per cent. of the population. Out of 1,218,272 acres in 1896 of cultivated land, 635,084 acres were plough-land and 39,530 acres vineyards. The produce of wheat in 1899 was valued at £814,000; oats, £524,000; potatoes, £432,000, mangold-wurzel, £121,000. The natural pastures returned the value of £368,000; hops, £51,000. The live stock of 1899 included 51,240 horses, 91,590 cattle, 115,100 sheep, and 88,620 pigs. Meurthe-et-Moselle takes precedence of all the other departments of France for iron-mining, its production in 1898 amounting to 3,804,000 metric tons, of the value of £445,000, and constituting four-fifths of the total production of France. It further extracted 508,000 metric tons of rock-salt, valued at £202,000. Metallurgy is highly advanced, forming the chief wealth of the department. In 1898 it produced 1,545,000 metric tons of cast-iron, 50,500 tons of iron, and 158,000 tons of steel, totalling altogether the value of £4,410,000. Distilleries manufactured, in 1896, 110,048 gallons of alcohol. Glass-works, peltry, and spinning also occupy many lands. Nancy, the capital, had 102,463 inhabitants in 1901.

Meuse, a department in the north-east of France, watered by the Meuse.

Area, 2409 square miles. Population, 289,861 in 1881; 283,136 in 1901. Births in 1899, 5477, 324 of them illegitimate; deaths, 5985; marriages, 1821. There were in 1896, 900 schools, with 40,000 pupils, the illiterate composing 2 per cent. of the population. Out of 1,457,300 acres of cultivated land in 1896, 810,160 acres were plough-land and 22,230 acres vineyards. The wheat crop of 1899 amounted to the value of £981,000; barley, £104,000; oats, £640,000; vines, £268,000; potatoes, £342,000; mangold-wurzel, £108,000. The live stock in 1898 included 47,000 horses, 103,480 cattle, 124,680 sheep, and 75,210 pigs. The department is not rich in minerals, yet its industry in metals produced in 1898, 9000 metric tons of iron and 8700 tons of steel, valued at £168,000. Distilling yielded 101,000 gallons of alcohol. There is also a brisk industry in sugar-refining. Bar-le-Duc, the capital, had 17,693 inhabitants in 1901.

Meuse (Dutch *Maas;* Flemish, *Maes*), a river rising in the department of Haute-Marne, France, 16 miles north-east of Langres, and after pursuing an extraordinary course through France, Belgium, and Holland, falling into the North Sea about 52°. In the department of Vosges the river disappears underground between Bazeilles and Noncourt, a distance of 3½ miles. In Belgium it has been canalized from Liège to Visé, close to the German frontier, as has also the lower course of the Ourthe, which joins the Meuse at Liège. In Holland the distance between Maastricht and Eindhoven has been reduced from 144½ to 75½ miles by means of the South Willems canal; and below Mook, where the banks are low, the Meuse is confined by dykes. But, as a means of safety, portions of the river are left undyked, so that at high flood the water overflows the low lands of Grave, Bois-le-Duc, and the Langstraat. To obviate the inconveniences of these inundations, the mouth of the Maas was diverted in 1883 into a new channel. Starting at Hedikhuizen, the new course runs westwards, follows the line of the Old Maas, and issues into the Amer, and thence into Hollandsch Diep, where the level is lower than that of the confluence of the Waal and the Maas at Loevenstein. By this new regulation the Maas will discharge its waters by mouths nearly identical with those of its earlier history. The new channel thus provided has a breadth of 1640 feet. Total area of river basin, 18,530 square miles; length, 500 miles; breadth at Verdun, 213 feet; at Namur, 426 feet; at Liège, 656 feet; at Gorinchem (Gorkum), 1066 feet. (See also HOLLAND: *Rivers and Canals*, and ROTTERDAM.)

Mexborough, a town in the Doncaster parliamentary division of Yorkshire, England, on the Don, 5½ miles north-north-east of Rotherham, and on the Great Central railway. It has potteries and ironworks. Population (1881), 6319; (1891), 7734; (1901), 10,417.

Mexico, or the UNITED STATES OF MEXICO, lying between the United States of America on the north and Guatemala on the south, extending from 14° 30′ 42″ to 32° 24′ N., and from 86° 46′ 08″ to 117° 07′ 31″ W. The boundary towards the United States, determined generally by treaties of 1848 and 1853, has in disputed localities been demarcated in accordance with conventions of 29th July 1882 and 18th February 1889, but this precise delimitation is not yet complete. Towards Guatemala the boundary was fixed by treaties of 27th September 1882

States and Territories.	Area. Sq. miles.	Population (1895).	Population (1900).	Density per sq. mile in 1900.
Federal District	463	476,413	540,478	1167
Tlaxcala . .	1,595	166,803	172,217	108
Guanajuato .	11,370	1,062,554	1,065,317	94
Mexico . .	9,247	841,618	924,457	100
Puebla . .	12,204	984,413	1,024,446	84
Queretaro . .	3,557	228,551	228,489	64
Hidalgo .	8,917	558,769	603,074	67
Morelos .	2,773	159,355	161,697	58
Michoacan .	22,875	896,495	935,849	40
Aguascalientes .	2,950	104,615	101,910	34
Jalisco . .	31,846	1,107,227	1,137,311	35
Vera Cruz . .	29,202	866,355	960,570	33
Oaxaca . .	35,382	884,909	947.910	26
Colima . .	2,272	55,752	65,026	28
San Luis Potosi	25,316	568,449	582,486	23
Zacatecas . .	24,757	452,578	462,886	18
Guerrero . .	24,996	420,339	474,594	19
Tabasco . .	10,072	134,839	158,107	15
Tepic (Territory)	11,275	148,776	149,677	13
Nuevo Leon .	24,317	309,252	326,940	13
Chiapas . .	27,222	319,599	363,607	13
Yucatan .	35,203	298,850	312,264	[illegible]
Sinaloa . .	33,690	258,865	296,109	9
Durango . .	38,009	295,105	371,274	9
Tamaulipas .	32,576	206,502	218,948	7
Campeche . .	18,086	88,121	84,281	5
Coahuila . .	62,358	241,026	280,899	4
Chihuahua .	87,802	262,771	327,004	4
Sonora . .	76,900	191,281	220,553	3
Lower California (Territory) .	58,328	42,245	47,082	8
Total .	765,560	12,632,427	13,545,462	17·7

and 1st April 1895. Towards British Honduras the boundary runs in a course defined by treaty of 8th July 1893, from the mouth of the Bocalarichica, the strait between Yucatan and Ambergris Cay, to the boundary between Mexico and Guatemala.

On an area of about 767,000 square miles Mexico contained in 1895 a population of 12,632,427, and in 1900, of 13,545,462. The area and the census population of the Federal District, and of each of the 27 states and 2 territories, are given in the table on the preceding page. (The total area given in the table is exclusive of the coast islands, covering altogether about 1420 square miles.) The population consisted in 1900 of 6,716,007 males and 6,829,455 females. Of the total in 1895, 19 per cent. were of white race, 43 per cent. Indian, and 38 per cent. mixed. The prevailing language is Spanish, but Indian languages were in 1895 spoken by 2,034,712 inhabitants, and foreign languages by 22,972. The number of foreigners resident within the republic in the same year was 49,698, the nations most numerously represented being Guatemala, 12,333; Spain, 12,228; North America, 10,222; France, 3763; Great Britain, 3384; Germany, 2337; Italy, 1574; China, 987. The population, classified according to occupation, was as follows:—

Professional (teachers, doctors, &c.)	38,081
Students and school children	635,365
Public services	57,488
Agricultural and pastoral	2,935,070
Mining	80,158
Commercial	205,942
Proprietors	38,560
Industries and arts	681,974
Various (household servants, &c.)	1,562,362
Without occupation	2,831,363
Children	3,255,052
Occupation unknown	310,143
Total	12,631,558

The registration of births, deaths, and marriages was begun in 1893, but the results annually published do not appear to be trustworthy. For 1898 the registered births numbered 489,933; deaths, 452,238; marriages, 61,687. The chief cities and towns of Mexico are the following:—Mexico, 329,774; Puebla, 88,684; Guadalajara, 83,934; San Luis Potosi, 69,050; Leon, 58,426; Monterey, 45,695; Pachuca, 40,487; Zacatecas, 39,912; Guanajuato, 39,404; Merida, 36,935; Queretaro, 34,576; Morelia, 33,890; Oaxaca, 32,437; Orizaba, 31,512; Aguascalientes, 30,872; Saltillo, 26,801; Durango, 26,425.

Constitution and Government.—The constitution in force in Mexico in 1902 was originally promulgated 5th February 1857, and has been frequently amended. It declares that the Mexican Republic, established under the representative, democratic, and federal form of government, consists of states free and sovereign in everything relating to their internal administration, but united in a federation for common interests. Among the provisions of the constitution may be noted that which restricts military authority in time of peace to the functions connected with discipline, that which declares the Church and the State to be separate, and that which makes marriage a civil contract.

Legislative.—The legislative power is vested in a General Congress of two chambers. The Senate consists of two senators (each with an alternate) from each state and the Federal District, elected indirectly by the people for a term of four years. They must be at least thirty years old, in the enjoyment of all their civil rights as Mexican citizens, be residents of the states which they represent, and not be in ecclesiastical orders. Federal office-holders are ineligible. The deputies are elected in the same manner as the senators, but in the proportion of one deputy for every 40,000 inhabitants or fraction over 20,000. Their term of office is two years, and an alternate is elected for each deputy. Deputies must be at least 25 years of age. In 1897 there were 227 deputies. Members of both houses are paid £300 a year. Electors are all Mexicans possessing honest means of livelihood, and, if married, being over 18 years of age; if unmarried, over 21. The Congress has two ordinary sessions: the first begins on 16th September and ends 15th December; the second is held from 1st April to 31st May. During the recesses a standing committee of 15 deputies and 14 senators, selected by the respective chambers, is endowed with limited legislative functions.

Executive.—The President of the United Mexican States is elected for four years by electors chosen by the people. His term of office commences on the 1st of December after election. He may be re-elected indefinitely (Amendment to Constitution, 20th December 1890). In case of his death, or permanent disability, a provisional President is elected by Congress to hold office until an election can be held in the usual manner. Temporary vacancies in the Presidency are filled by the Secretary of State. The President must be a native-born Mexican possessing full civil rights, must be at least 35 years of age, must not belong to any ecclesiastical order, and must be resident in the country at the time of election. He is assisted in the discharge of his duties by a cabinet composed of seven secretaries, who are heads of departments of foreign relations; of finance and public credit; of communications and public works; of promotion, colonization, and industry; of interior; of justice and public instruction; of war and navy. Secretaries must be native-born citizens at least 25 years of age.

Judicial Power.—The Supreme Court contains 11 justices and 4 alternate justices, an attorney-general, and a public prosecutor, elected by the people indirectly in the same manner as senators and deputies, and for a term of six years. There are 3 circuit courts and 32 district courts.

Local Government.—The government of the states under the constitution is republican, representative, and popular. Legislative power in most of the states is vested in a congress of one chamber, the members of which are called deputies, and are in most states elected by indirect popular vote for a term of two years. The subject-matter of state legislation includes all that is not expressly given to the Federal authority. It was only in 1883 that an Act was passed for the unification of the mining and commercial legislation within the republic. The executive power is vested in a governor elected for four years, and the states have their own courts of justice. For administrative purposes they are divided usually into districts governed by a prefect. The smaller divisions are municipalities, the local authority being a town council (*ayuntamiento*).

Religion.—In 1895 over 99 per cent. of the population belonged to the Roman Catholic faith. The number of Protestants was 42,259; of Mormons, 1560; Mahommedans, Buddhists, and others, 804; of no professed religion, 62,560; and of unknown religion, 6847.

Instruction.—The condition in 1895 with respect to education is indicated by the following figures:—

Able to read and write	1,817,414
Able to read only	328,007
Able neither to read nor write	8,094,520
Young children (untaught)	2,351,100
Unknown	40,517
Total	12,631,558

Education is gratuitous, obligatory, and lay. Under an Act, passed 14th May 1896, official primary instruction in the Federal

District and in the territories is under the control of the executive. In the states the schools are maintained either from state funds or municipal funds. The school system comprises primary elementary, primary superior, and preparatory schools, the last being institutions for professional or technical instruction. Besides primary and normal schools, the Federal Government supports schools of jurisprudence, of agriculture and veterinary art, of engineering, of fine arts, of trades and arts for men and for women, of commerce and administration, a national conservatory of music, a preparatory school, schools for the blind and for deaf mutes, reformatory schools, &c.; also museums, and 17 libraries containing from 400 to 159,000 volumes.

In 1898 the number of schools was as follows:—Federal and state schools, 6738; municipal, 2953; private, 2158; Church, 346; association, 163; total, 12,358. In 1899 the total number of schools was 11,925 (6376 federal and state schools). At the federal, state, and municipal schools in 1899 there were 15,505 teachers and 684,563 enrolled pupils, the average attendance being 474,622; at the other schools the enrolled pupils numbered 134,987, and the average attendance 103,955. The amount spent on federal, state, and municipal schools in 1899 was £680,500.

Within the republic, in 1899, there were 33 museums, 139 libraries, with an aggregate of 992,000 volumes, and 39 scientific and literary societies. The number of periodical publications was 702—18 being in English, 11 in English and Spanish, 3 in French, and 1 in German. The daily papers numbered 55; weekly, 242; monthly, 85; others being published at various other intervals.

Crime.—Criminal statistics for the whole republic are not published; those for the Federal District showed that, in 1897, 14,512 persons (11,487 males and 3025 females) were tried for crimes or misdemeanours, and 8108 were convicted. The convictions comprised 5830 cases of assault, 1230 of theft, and 102 of homicide.

Finance.—The federal revenue is derived chiefly from import duties and internal taxation, and the most important branches of expenditure are the public debt, the army and navy, and public works. For each of the years specified the amount of revenue and of expenditure (estimated for 1902–03) has been as follows, the dollar being taken at two shillings:—

Year.	Revenue.	Expenditure.
1896–1897	£5,150,062	£4,833,050
1899–1900	6,426,100	5,830,990
1902–1903	6,482,360	6,473,880

The foreign debt of the republic consists mainly of the 5 per cent. external consolidated gold loan contracted in 1899 for the conversion of prior loans. The original amount was £22,700,000, of which, in the middle of 1901, £22,479,660 was outstanding. The whole debt is redeemable, not later than the year 1945, by a sinking fund secured on the national import and export duties. The external silver currency bonds of 1890 have been nearly all redeemed; the outstanding amount in 1900 was about £11,400. The internal debt amounts to $121,824,750, or about £12,182,475; and the floating debt to $1,015,836, or about £101,540. The fiscal value of property within the republic in 1899 was—urban, £35,052,370; rural, £42,394,780; total, £77,447,150, the fiscal value being taken at one-third less than the actual value. The revenues of the Mexican states vary within narrow limits, while their expenditures on the whole show a considerable decrease. The revenue and expenditure of the municipalities show a considerable increase within the five years ending 1899, when the annual aggregates of these local revenues and expenditures were:—

	Revenue.	Expenditure.
States	£1,995,250	£1,969,590
Municipalities	1,652,250	1,591,970

Army.—The military forces consist of the active army and the reserve, in one or other of which every Mexican capable of bearing arms is, from his twentieth to his fiftieth year, liable to serve. The active army in 1900 was composed as follows:—

	Officers.	Men.
Infantry	1314	21,291
Cavalry	452	5,042
Artillery	179	1,982
Engineers	9	119
Other services	114	1,641
	2068	30,075

On war footing the numbers may be increased to 120,000 infantry, 20,000 cavalry, and 6000 artillery. The infantry are armed with the Mauser rifle, the cavalry with the Mauser carbine; the artillery are provided with Bange field-guns and Gruson mountain batteries.

Navy.—The Mexican navy in 1900 comprised 2 first-class gunboats (450 tons), 2 second-class gunboats (425 tons), a transport ship, 2 despatch boats, a corvette, and a training-ship. The personnel of the navy consists of 90 officers and 500 men.

Agriculture.—It is estimated that Mexico contains about 3400 square miles of thick forests, 113,280 of woodland, and 299,280 of uncultivated land. The highlands of the central plateau can produce all known varieties of wheat, maize, beans, and root crops, as well as agave (maguey) and grapes, and they are also adapted to stock-raising. In the hot region rice, sugar-cane, tropical fruits, cacao, and rubber can be produced; and in the temperate region coffee grows abundantly, as do also all the products common to this zone in other countries. Notwithstanding this capability of the soil, agriculture is carried on to a very limited extent and by antiquated methods, due to scarcity of labourers and of means of communication, as well as to ignorance of agricultural matters. The Government endeavours to improve the conditions by disseminating useful knowledge and distributing seeds and plants, especially vines, olives, fruit trees, cork, oak, fodder plants, and flax, besides mulberry trees and silk-worms. It has also taken measures to extend irrigation. The quantities of the principal cereals produced in 1898 and 1900 were as follows:—

Crops.	1898.	1900.
Wheat, tons	235,360	331,500
Rice, ,,	20,710	20,360
Barley, bushels	12,977,220	10,203,580
Maize, ,,	107,905,320	89,354,360

The chief wheat-producing states are Chihuahua, Guanajuato, Puebla, and Sonora. A favourite crop in general cultivation in Mexico is beans (*frijol*), the total yield of which in 1899 amounted to 12,314,400 bushels. Of root crops the most usual is the sweet potato or *camote*, and, at a long interval, the common potato. The cultivation of the sugar-cane is carried on throughout the hot region and a great part of the temperate, its yield ranging from about 40 to 60 tons to the acre. Official returns give as follows the production of sugar and its by-products in 1898 and 1900:—

Products.	1898.	1900.
Sugar, tons	66,770	73,554
Brown sugar, ,,	71,650	65,689
Molasses, ,,	65,210	51,770
Rum, gallons	13,729,760	11,312,900

Coffee is widely cultivated both in hot and temperate regions, but chiefly in Vera Cruz. Cocoa is grown in Tabasco, vanilla in Vera Cruz, and tobacco most extensively in Tabasco. The yield of these products in 1900, with the values, was as follows:—

Product.	Quantity. lb.	Value. £.
Coffee	46,393,870	604,850
Cocoa	4,341,374	170,980
Vanilla	32,798	47,267
Tobacco	20,555,830	243,910

The chief gums collected are chicle and caoutchouc, the former to the amount of 4,690,940 lb, valued at £143,270, and the latter to the amount of 434,630 lb, valued at £24,530 in 1900. Cotton has been cultivated from time immemorial. The staple of the Mexican cotton is longer than that of the United States, but not so soft and lustrous. The chief cotton-growing states are Durango and Coahuila. The total yield in 1898 amounted to 100,156,687 lb, in 1900 to 47,950,970, the value in the latter year being estimated at £614,877. One of the most important products is henequen (*Agave rigida*), also called Sisal grass or Sisal hemp. The production of this fibre in 1898 amounted to 66,235 tons, valued at £1,535,120; in 1900 to 85,860 tons, valued at £1,826,280. The production of ixtle (*Agave ixtle*), another fibrous plant, in 1899 amounted to 8305 tons, valued at £80,860. Many fruits are produced, and the official statistics annually state the production of 68 varieties. In the official list of the flora of the hot lands there are enumerated 233 distinct species of medicinal plants, 14 dyewoods, and 193 varieties of trees, among which are numerous valuable hardwoods.

Live Stock.—The raising of cattle has always been one of the most important industries. The states in the northern part are practically vast cattle ranges. The total consumption of meat in the republic in 1899 comprised 817,037 cattle, 807,375 sheep, 680,908 pigs, and 620,723 goats, the whole being valued at £4,597,365.

Mining.—The great mining region runs from the north-west to the south-east, following the direction of the Sierra Madre Cordillera from Sonora to the south of Oaxaca, a distance of 1600 miles. The richest mines have been discovered on the west slope of the Cordillera at an elevation of from 3000 to 8200 feet. The number of mineral districts is 1092. In 1901 the number of existing titles to mining properties amounted to 12,518, covering an area of 209,700 acres; of these 2666 were for gold and silver claims, 4328 for silver claims, 1922 for silver and lead, 1059 for gold. Besides gold, silver, lead, mercury, copper, iron, antimony, tin, zinc, sulphur, &c., there are also deposits of precious stones, such as the opal, topaz, emerald, agate, amethyst, and garnet. The production of the principal metals was as follows, in quantity and value, in 1899:—

Metals.	Quantity.	Value.
Gold, oz. . . .	263,830	£670,490
Silver, ,, . . .	43,266,900	5,398,950
Copper, tons . . .	26,962	1,465,930
Lead, ,, . . .	62,550	405,120
Iron, ,, . . .	3,239	28,230
Mercury, ℔ . . .	273,090	26,970

The total value of the metallic output for the year was £8,479,774.

Industries and Manufactures.—Mexico has only manufactures of such articles as are required by the mass of the people. The principal article of manufacture is a coarse unbleached cotton cloth called *manta*, in the production of which over 26 million pounds of cotton are annually used, and more than 50,000 families directly or indirectly employed. In 1898–99 there were 125 mills with 491,443 spindles, 14,759 looms, employing 23,731 hands. The production of *manta* reached 10,239,799 pieces, and of yarn 4,171,290 ℔. A considerable quantity of cotton yarn is used in the manufacture of shawls and scarfs (*rebozos*), knitted goods, &c. Mexican industry also produces woollen blankets (*zarapes*) and blankets of mixed cotton and wool. Silk-weaving is in its infancy, but is rapidly progressing. There are a few paper mills. Sugar mills and distilleries are numerous. In 1899–1900 there were 2065 distilleries producing 7,664,732 gallons of spirits from sugar, maguey, and grain. The tobacco industry is extensive, nearly every town having a cigarette factory, the quantity of tobacco manufactured in 1898–99 amounting to 12,202,690 ℔. The flour mills cannot supply the local demand. Iron-foundries are numerous, but their work is mostly limited to the manufacture of small agricultural implements and ordinary marketable iron. The Government maintains a large arsenal and gun foundry in the city of Mexico. Hammocks and pottery are extensively manufactured, the former more especially in Yucatan. Cotton-seed oil mills are numerous, as are manufactories of chocolate, felt hats, rubber, &c.

Commerce.—The principal exports are precious metals, henequen, coffee, cattle, &c., while the principal imports are machinery, cotton and woollen textiles, iron and steel, wines and liquors, wood, paper and manufactures thereof, and textile fibres. The value of the imports and exports was as follows for the years named (the Mexican dollar being taken at two shillings and the gold dollar at four shillings):—

Years.	Imports.	Exports.
1895–1896	£8,450,780	£10,501,690
1898–1899	10,173,840	13,847,810
1900–1901	13,094,480	14,865,900

In 1900–1 the principal exports were as follows:—Silver, £4,319,400; silver coin, £1,638,480; silver ore, £1,274,200; gold, £859,200; henequen, £1,640,230; coffee, £688,980; timber, £239,020; cattle, £585,760; hides, &c., £497,400; tobacco, £150,940.

In the year 1900–1 the commerce was distributed as shown in the following table:—

Countries.	Imports from.	Exports to.
United States . .	£6,767,100	£11,722,900
Great Britain . .	2,217,100	1,203,310
France	1,383,900	282,430
Germany . . .	1,476,600	501,850
Spain	596,200	118,770
Other countries . .	653,600	1,036,640

In 1900 the trade between Mexico and the United States, by railway overland, amounted to £2,102,860 imports and £3,938,360 exports; a total of £6,041,220.

Shipping.—In 1900 Mexico had a merchant marine of 17 steamers of in all 3961 tons net, and 50 sailing vessels aggregating 8445 tons. In the year 1900, including coasting trade, 8905 vessels of 6,670,429 tons entered the ports. The number of British vessels that entered was 803 of 1,241,231 tons, and of American, 1432 of 2,620,456 tons. The ports which have the largest share in the foreign sea-borne trade of Mexico are Vera Cruz and Tampico.

Railways.—The railways, though their construction began only about 1870, had in 1900 a total length of 9600 miles. In the populous region round the capital they form a complicated network extending across the country from the Gulf to the Pacific, while from the long trunk lines running from Mexico City to the frontier of the United States branches have been constructed for the development of the mining industries. The first railway concession, granted in 1857 and renewed and amended in 1867 and 1868, authorized the construction of a line from the capital to Vera Cruz, and in 1873 this line, called the Mexican railway, was opened for traffic. The main line is 264 miles in length, and there are two branches, one to Puebla and another to Pachuca, of 29 and 28 miles respectively. The Interoceanic railway connects Vera Cruz, Jalapa, and Puebla with Mexico City, and then runs southwards to Jojutla and Amacusac (1894), to be ultimately extended to Acapulco on the Pacific. The main line has a length of 463 miles, while its several branches have a length of 92 miles, the longest being the Matamoros branch of 42 miles. At Amacusac the line joins the Mexico, Cuernavaca, and Pacific railway, which, with a length of about 500 miles, runs from the capital to Mexcala and ultimately reaches the Pacific at Sihuatanejo. Puebla and Oaxaca have been connected since 1892 by the Southern railway, 228 miles in length, which has been extended to Ejutla, about 35 miles to the south. The National Tehuantepec railway, constructed under a law of 1882, connects Coatzacoalcos on the Bay of Campeche with Salina Cruz on the Pacific, 192 miles distant. This system is connected by rail with Vera Cruz, and a line is being constructed from Cordoba on the Mexican railway, which will run to Santa Lucretia on the Tehuantepec railway. In Campeche and Yucatan there is a railway system of over 320 miles, connecting the ports of Campeche and Progreso with Merida, Valladolid, and other inland towns. The Mexican Central railway, running from Mexico City to Ciudad Juarez on the northern frontier, a distance of 1224 miles, was opened in 1884, and has now branches with an aggregate length of nearly 1000 miles. The branch from Irapuato to Guadalajara, opened in 1888, has been extended to Ameca and Etzatlan, and from Guadalajara a line runs to Colima, Cayutlan, and Manzanillo on the Pacific coast. From Aguascalientes a branch runs to Tampico on the Gulf of Mexico, where there is a harbour constructed for and owned by the railway company, the Government having granted subsidies. A railway from Tampico to Monterey, opened in 1891 and subsequently extended to Treviño, with a total length of 388 miles, had been acquired by a Belgium company, but was in 1902 transferred to the Mexican Central Railway Company. The Mexican National railway, completed in 1888, runs from Mexico City to New Laredo on the frontier of Texas, a distance of 839 miles, and is extended into Texas for about 160 miles. The branches in Mexico have a length of 320 miles. One branch runs westwards from Mexico City to Morelia and Uruapan, a distance of 120 miles, and the system includes suburban lines near the capital. The International railway from Porfirio Diaz, or Piedras Negras, on the Texan frontier, to Lerdo on the Central railway, 410 miles distant, was opened in 1888. It has since been extended 130 miles to Durango, whence the line is continued northwards for 130 miles to Cuanacevi. A branch of 71 miles connects Reata on the main line with Monterey, and thus with the Monterey and Tampico system. The International railway is worked in connexion with the Southern Pacific railway of the United States. The Sonora railway from Guaymas on the Gulf of California to Nogales on the frontier of Arizona, nearly 280 miles in length, has been leased to the Southern Pacific Railway Company, and is worked in connexion with their system. The Mexican Northern railway (for mineral traffic) runs from Escanlon, on the Central railway, to Sierra Mojada, 81 miles; the Coahuila and Pacific railway has 100 miles of line open; the Chihuahua and Pacific has 125 miles open; the Rio Grande, Sierra Madre, and Pacific has 156 miles open, and will be continued to Guerrero and the Pacific coast. In the earlier stages of railway enterprise liberal assistance was granted by Government to companies undertaking the construction and working of new lines, but later the subvention system was more sparingly employed, and in concessions it is usually provided that the lines shall revert to Government at the end of ninety-nine years. The first Mexican railway was, with a Government subvention, constructed by a British company, and British capital is still largely invested in Mexican railways, but the rapid development is mainly due to the enterprise and capital of United States financiers. The following table shows for the year 1899 the number of passengers and the weight of goods carried on the principal Mexican railways, with the gross revenues expressed in sterling, the Mexican dollar being taken at two shillings:—

Railways.	Passengers.	Tons.	Revenue.
Mexican . . .	799,575	940,000	£475,490
District (Mexico City) .	25,235,528	...	192,390
National . . .	909,965	1,019,000	691,660
Interoceanic . . .	1,184,360	620,000	385,310
Central	1,837,299	1,886,000	1,560,210
International . . .	213,276	741,000	438,000
Monterey to Gulf . .	149,604	219,000	129,360
Northern . . .	5,207	194,300	146,990

The development of the railways may be judged from these figures:—In 1890 there were 6037 miles of line; in 1894, 7070; in 1896, 7550; in 1898, 9044; in 1900, 9798. The lines in 1900 consisted of 8454 miles under federal concession, 283 miles of urban railway, 163 miles of foreign line under state concession, 333 miles for private use, and 565 miles of light railway. In 1899, 36,122,930 passengers and 5,852,000 tons of goods were carried on the railways of federal concession, the gross proceeds amounting to £4,637,740. At the end of 1896 the amount of £12,134,370 had been paid in subsidies.

Post Office.—In the year 1900–1 the Mexican postal system was served by 2082 post offices, of which 594 were principal offices and 488 agencies. The correspondence (including letters and post-cards) amounted to 148,086,513 pieces, of which 109,669,465 were in the internal service and 38,417,048 in the international. Postal receipts amounted to £213,560, and expenses to £263,850. In 1899, 23 steamship lines had contracts with the Government for carrying the mails; of these, 11 were Mexican, 5 American, 4 English, 1 Spanish, 1 French, and 1 German.

Telegraph.—The extension of the telegraph system is shown by the following figures:—In 1890, 31,300 miles; in 1894, 38,310; in 1896, 41,040; in 1900, 43,394. The total length in 1900 was made up as follows:—

	Miles.
Federal lines	28,702
State lines	5,305
Private enterprise lines	2,433
Railway lines	6,954
Total	43,394

In 1900–1 the Federal lines were served by 362 telegraph offices; the number of messages transmitted was 2,604,711. In addition to the telegraph lines there were, at the end of 1900, 22,770 miles of telephone line belonging to the states or to companies. The number of instruments working in the service of the public in 1900 was 8600.

Money and Credit.—There is a gold coinage, but practically no gold is in circulation. Within the republic there are three mints (Mexico, Zacatecas, and Culiacan); the mint at Guanajuato was closed on 30th June 1900. At these Mexican silver is coined into dollars, which are shipped to China and other Eastern countries. The nominal value of the money coined in the years specified (expressed in Mexican dollars) is given in the following table. In the total of each year the small amount of copper coinage is included.

Years.	Silver.	Gold.	Total.
1890–91	$24,237,449	$308,083	$24,764,402
1891–92	25,526,717	291,940	25,975,351
1892–93	27,169,876	361,672	27,618,604
1893–94	30,185,591	553,978	30,739,569
1894–95	27,628,981	545,237	28,207,175
1895–96	22,634,788	565,786	23,237,099
1896–97	19,296,009	453,474	19,781,733
1897–98	21,427,057	459,219	21,917,876
1898–99	20,184,117	715,882	20,910,693
1899–1900	18,102,630	598,086	18,723,726

There are 24 banks, 19 being banks of issue; their paper is not a legal tender, but is covered by deposits of coin. The Government issues no paper money, and as a rule does not retain any specie in the treasury, the National Bank, which acts as a depository, paying all the warrants, &c. On 31st January 1902 the capital of all the banks amounted to $82,300,000; notes in circulation, $72,890,000; cash, $55,975,000. The metric system of weights and measures has been compulsory since 16th September 1896.

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(W. W. R.; I. P. A. R.)

HISTORY, 1820–1901.

General characteristics.

The history of Mexico from its separation from Spain till the year 1884 exhibits an almost continuous conflict in which the empire of Maximilian is a mere episode. The struggles, which may at first sight seem to be merely between rival generals, are seen upon closer examination to be mainly (1) between the privileged classes, *i.e.*, the Church and (at times) the army, and the mass of the other civilized population; (2) between Centralists and Federalists, the former being on the whole identical with the army, the Church, and the supporters of despotism, while the latter on the whole represent the desire for republicanism and local self-government. Similar conflicts are exhibited, though less continuously, by most of the other Spanish-American states. On both sides in Mexico there was an element of honest doctrinaires; but rival military leaders exploited the struggles in their own interest, sometimes taking each side successively; and the instability was intensified by the extreme poverty of the peasantry, which made the soldiery reluctant to return to civil life, the absence of a regular middle class, and the concentration of wealth in a few hands, so that a revolutionary chief was generally sure both of money and of men. The period of instability ceased soon after the second election of Porfirio Diaz in 1884. Under his rule the Federal system continued in name, but it concealed in fact, with great benefit to the nation, a highly centralized administration, very intelligent, and on the whole both popular and successful—a modern form of rational despotism.

War of independence, 1810.

The war of independence which began in 1810 was largely a movement of native-born Mexicans against Spaniards, and had almost resulted in the extinction of the separated forces, when a new turn was given to the course of events by news of the revolutionary movements in Spain. The Spanish king, Ferdinand VII., was seen to be ready to profess Liberal principles in order to secure his throne. The Mexican Clericals and Conservatives, fearing lest disendowment, toleration, and other changes should be forced on them from Spain, induced Agustin de Iturbide, who had already been conspicuous in the revolution, to take the field against Guerrero, the only revolutionary leader still in arms, in order to suppress Republicanism and set up an independent and non-Liberal monarchy. Iturbide eventually combined with Guerrero, and proclaimed the "Plan of Iguala," which laid down, as the bases of the new state, the maintenance of the Roman Catholic religion and the privileges of the clergy, the establishment of a limited monarchy, and equality of rights for Spaniards and native-born Mexicans. Iturbide sought the co-operation of the viceroy Apodaca, who, however, refused; but he was presently superseded by General O'Donojú, who, being unable to get beyond Vera Cruz, recognized the independence of Mexico. O'Donojú shortly afterwards died; the Spanish Government repudiated his act; and Spanish troops held the fortress of San Juan de Ulúa, off Vera Cruz, till 1827. A provisional Junta, nominated by Iturbide, issued a declaration of independence (October 1821), and nominated a regency of five, with Iturbide as its president. The first Mexican Congress met 24th February 1822. A section of it favoured a republic; another, monarchy under Iturbide; another, which was broken up by the refusal of Spain to recognize Mexican independence, monarchy under a Bourbon prince. A conflict now arose between the Republican majority and Iturbide, which was settled by a military pronunciamiento in his favour, and the Congress was intimidated into electing him emperor. He was crowned 21st July 1822. Fresh conflicts, however, soon broke out between him and the Congress, and Antonio Lopez de Santa Anna, captain-general of Vera Cruz, proclaimed a republic, promising to support the Plan of Iguala. He was defeated at Jalapa and driven to Vera Cruz; but the army deserted Iturbide, who was compelled to abdicate (19th April 1823). The Congress deported him to Italy, and granted him a pension. He returned almost immediately, on the pretext that Spain was intriguing against Mexican independence, and on landing was arrested and executed (1st July 1824).

General Iturbide becomes emperor, 1822-23.

The Congress had meanwhile undone much of his work, and had divided into Federalists and Centralists, the latter largely Monarchists and Freemasons. The Federalists were strong enough to secure the adoption of a constitution (4th October 1824) modelled on the United States, with additional and incongruous clauses, notably one declaring the Catholic religion to be alone recognized. A source of abundant discord was opened by the provision that each state should contribute its quota to the Federal revenues. No proper statistical basis for estimating the quotas existed, and the device gave each state a plausible reason for attempting secession on occasion. Moreover, the capital and some territory round it was severed from the rest of the Republic as a "Federal district"—another grievance intensifying the antagonism of the state to the central power. The Freemasons had been largely instrumental in overthrowing Iturbide; they now divided into the Escoceses (lodges of the Scottish ritual), who were Monarchist and Centralist, and the Yorkinos, who took their ritual from New York, and their cue, it was alleged, from the American minister, Joel Poinsett. An attempt at revolt, headed by Nicolas Bravo, vice-president, the Grand Master of the Escoceses, was suppressed, but dissensions ensued in the Yorkino party between the followers of President Guerrero (a man largely of native blood, and the last of the revolutionary leaders) and of Gomez Pedraza, the war minister.

President Guerrero, 1825-31.

A conflict broke out, the Guerrerists were victorious, and the pillage of foreign shops in Mexico city (1828), among them that of a French baker, gave a basis for the foreign claims which, ten years later, caused the "Pastry War" with France. Meanwhile, attacks on Spanish ships off Cuba by a Mexican squadron, commanded by an American, David Porter, had induced Spain to send an expedition to reconquer Mexico, which, however, was decisively checked at Tampico by Santa Anna. During the invasion Vice-President Antonio Bustamante declared against President Guerrero; the bulk of the army supported him. Guerrero was deposed, and his partisans in the south, continuing their resistance, were defeated at Chilpancingo (2nd January 1831); and Guerrero, retiring to Acapulco, was enticed on board an Italian merchant-ship, and treacherously seized, tried, and executed (January–February 1831). Next year, however, a revolt broke out against Bustamante, which was joined by Santa Anna, and eventually resulted in a pronunciamiento in favour of Gomez Pedraza. He, and his successor, Vice-President Gomez Farias (1833), assailed the exemption of the clergy and of military officers from the jurisdiction of the civil courts, and Santa Anna took advantage of the situation to assume the presidency.

Santa Anna dictator, 1834.

He eventually became dictator, dissolved Congress (31st May 1834) and the state legislatures, and substituted creatures of his own for the governors of the states and mayors of towns, then retiring into private life. A new Congress, having resolved itself into a constituent assembly, followed up this Centralist policy (30th December 1836) by framing a new constitution, the Siete Leyes or Seven Laws, which converted the states into departments, ruled by governors appointed by the central authority, and considerably reduced popular representation. Antonio Bustamante became the first president under it.

Bustamante president, 1837.

The French claims set up by the pillage of foreign shops in Mexico had, however, remained unsatisfied, and in 1838 a French fleet blockaded the coast, bombarded the fortress of San Juan de Ulúa, off Vera Cruz, and occupied the town. The Mexican Government gave way, threatened by Federalist risings and secessions of states, which culminated in 1841.

Santa Anna restored, 1841.

Santa Anna appeared, nominally as a mediator, and put forward a programme, the bases of Tacubaya (28th September 1841), abolishing all the Siete Leyes except the part relating to the judicial system, arranging for a new constituent assembly, and reserving for the president (himself) full power of reorganizing the administration. The Centralist Government, after a vain attempt to defeat him by professing a more thorough Federalism, gave way to force, and Bustamante was allowed to leave the country. But the new Congress was too Federalist for Santa Anna, and he retired, leaving the reins to Nicolas Bravo, under whose auspices a new Centralist constitution was established (1843). This expressly retained the privileges of the clergy and army, and was in some respects more anti-Liberal than that of 1836. But new complications were now introduced by the question of Texas.

The Texas question.

Texas, a state of the Mexican Union, had been settled largely from the United States in consequence of a land grant given by the Spanish viceroy to Moses Austin in 1820, and had been estranged from Mexico partly by the abolition of slavery under a decree of President Guerrero, and partly by the monstrous Centralist constitution of 1836. It then seceded. Santa Anna attempted to reduce it, but was defeated and captured by Houston at the battle of San Jacinto, and compelled to sign a treaty recognizing Texan independence, which he disavowed on returning to Mexico, as extorted by compulsion. A state of war thus continued nominally between Mexico and its seceded member, whose independence was recognized by England, France, and the United States. The slaveholders in the United States favoured annexation of Texas, and pressed the various claims due from Mexico to American citizens, partly perhaps with the ulterior aim of forcing war. Most of these claims were settled by a mixed commission, with the king of Prussia as umpire, in 1840–41, and a forced loan was raised to pay them in 1843, which greatly increased the internal difficulties of Mexico, and stimulated the revolt of Paredes against Santa Anna, who had returned to power in 1844. It resulted in Santa Anna's downfall, imprisonment at Perote, and eventual exile (December 1844 to January 1845), and the election of General José Joaquin Herrera as president. But Herrera was displaced in the last days of the year 1845 by a pronunciamiento in favour of Paredes, who undertook to uphold the national rights against the United States, and who was elected president on 3rd January 1846. Texas had meanwhile applied for admission into the American Union. The annexation, rejected in 1844 by the United States Senate, was sanctioned on 1st March 1845, and carried out on 22nd December 1845. The Mexican minister withdrew from Washington, and both sides made active preparations for war.

War with United States, 1846-48.

The United States forces were ordered by President Polk to advance to the Rio Grande in January 1846. They established a depôt at Point Ysabel (behind the opening of Brazos Santiago), and erected a fort in Texan territory, commanding Matamoras, on the Mexican side of the Rio Grande. This provoked the Mexican forces into a defensive invasion of Texas, to cut the American communications with Point Ysabel. They were, however, defeated at Palo Alto (8th May) and Resaca de la Palma (9th May). There was an outburst of warlike feeling in the United States (accompanied with emphatic opposition to war in the North), and an invasion of Mexico was planned by three routes—from Matamoros towards Monterey in New Leon, from San Antonio de Bexar to Chihuahua, and from Fort Leavenworth to New Mexico. Importance attaches chiefly to the movements of the first force under General Zachary Taylor. During the war preparations President Paredes, suspected of intriguing to overthrow the Republic, had to give place to his vice-president Bravo, who in his turn gave way before the military partisans of Santa Anna, who was hastily recalled from his exile at Havana to assume the presidency and the conduct of the war (August 1846). He was allowed by the American squadron blockading Vera Cruz to pass in without hindrance. Probably it was thought his presence would divide the Mexicans.

The preparations of the United States took some months. It was not till 5th September 1846 that General Zachary Taylor could leave his depôt at Camargo on the Rio Grande, and March on Monterey. It was taken by assault 23rd September; Santa Anna was defeated at Buena Vista (near Saltillo) on 27th February 1847, and forced back on San Luis Potosi. New Mexico was occupied without opposition; Chihuahua was occupied, but not held, owing to the difficulties in maintaining communications; and Upper California was seized in the autumn of 1846 by John C. Fremont, who had been exploring a route across the continent, and by the United States Pacific squadron, and made secure by the aid of the New Mexico expedition. But as Mexico still continued to fight, it was determined to reach the capital *viâ* Vera Cruz. That city was taken by General Scott after a siege (9th to 29th March 1847); and after winning the battle of Cerrogordo (18th April), and a long delay at Puebla owing chiefly to illness among his troops and the need of reinforcements, Scott marched on Mexico city, stormed its defences against greatly superior forces, and effected an entrance after severe fighting on 13th September 1847. This virtually ended the war: Santa Anna was deprived of his command, and the treaty of Guadalupe Hidalgo, concluded 2nd February 1848, ceded to the United States Texas, New Mexico, and Upper California, in return for a payment of $15,000,000 by the United States to Mexico, and the assumption of liability by it for the claims of its subjects which it had hitherto been pressing against Mexico.

Treaty of Peace.

The object of this payment was doubtless to strengthen the United States' title to the conquered territory. It is generally admitted that Mexico was provoked into aggression in order that additional territory might be available for the extension of slavery.

Herrera president, 1848-51.

The American forces were withdrawn in May and June 1848 after the ratification of the treaty by Mexico. Under the presidency of Herrar (1848–51) praiseworthy attempts were made to restore order and the public credit. An arrangement was effected with English holders of Mexican stock, on the basis of a considerable reduction of the capital (swollen by arrears of interest) and of the annual interest thenceforward, which latter was made a charge on the customs revenue. An attempt was made to carry out a consolidation of the internal debt, which failed owing to the total inadequacy of the funds allotted for interest; the army was reduced and reorganized, new muskets were purchased, and the northern frontier was defended against Indians and raiders by military colonies, formed partly of civilized Seminole Indians from the United States. But the financial situation was desperate;

the federal revenue, mostly from customs—which were evaded by extensive smuggling—was not half the expenditure; and Indian revolts in Yucatan (1847–50) and in the Sierra Gorda had added to the strain. Arista succeeded Herrera as president (January 1851), but resigned (January 1853) through inability to cope with the financial and social disorder.

Santa Anna in power, 1853-54.

After a sort of interregnum (January–March 1853) Santa Anna was recalled (by a vote of the majority of the states under the Plan of Arroyozarco, 4th February 1853, the result of a pronunciamiento), and made dictator in the interests of federation. His measures, partly inspired by an able Conservative leader, Lucas Alaman, proved strongly Centralist: one is especially noteworthy, the establishment of the ministry of "fomento," or encouragement to public works, education, and intellectual and economic development, which is a conspicuous aid to Mexican welfare to-day. He also negotiated (at the end of 1853) the sale of the Mesilla valley (now Arizona) to the United States, but the purchase money was soon dissipated. On 16th December 1853 Santa Anna issued a decree making himself dictator for an indefinite period, with the title of serene highness. A Federalist revolution soon broke out,[1] and on 1st March 1854, at Ayutla in Guerrero, a section of the army under Colonel Villareal proclaimed the Plan of Ayutla, demanding Santa Anna's deposition and the establishment of a provisional Government to secure a new constitution. Among the leaders in the movement were Generals Alvarez and Comonfort, and it is said that Porfirio Diaz, subsequently president, then a young soldier, made his way to Benito Juarez, then in prison, and arranged with him the preliminaries of the revolt. It spread, and Santa Anna, after severe but futile attempts to quell it, left the country (August 1854).[2]

Benito Juarez.

The provisional president who succeeded him, General Carrera, proving too Centralist, was replaced by Alvarez (24th September 1855), two of whose ministers are conspicuous in later history—Ignacio Comonfort, minister of war, and Benito Juarez, minister of finance. Juarez (b. 1806), one of the most remarkable men of the 19th century, was of unmixed Indian blood. The son of a Zapotec peasant in a mountain village of Oaxaca, he was employed as a lad by a bookbinder in Oaxaca city, and aided by him to study for the priesthood. He soon turned to the law, though for a time he was teacher of physics in a small local college; eventually went into politics, and did excellent work in 1847 as governor of his native state. Juarez almost immediately secured the enactment of a law (Ley Juarez, 23rd November 1855) subjecting the clergy and the army to the jurisdiction of the ordinary courts. "Benefit of clergy" was the curse of Mexico. Officers and soldiers could be tried only by courts-martial, the clergy (including numbers of persons in minor orders, who were practically laymen) only by ecclesiastical courts, and both sets of tribunals exercised civil as well as criminal jurisdiction, and were unduly favourable to their own order.[3] The measure roused the Clericals to resistance. Alvarez gave place (8th December 1855) to his war minister Comonfort, who represented the less anti-Clerical Liberals. He had to suppress a Clerical rising in Puebla (March 1856), which was punished by a considerable confiscation of Church property; sanctioned a law releasing Church land from mortmain, by providing for its sale, for the benefit, however, of the ecclesiastical owners (called after its author Miguel Lerdo de Tejada, brother of the subsequent presidents), and a new draft constitution, largely modelled on that of the United States, and implicitly incompatible with the maintenance of special ecclesiastical privileges (5th February 1857). The clergy protested violently, and the Plan of Tacubaya (17th December 1857), which made Comonfort dictator, and provided for the construction of a new constitution under his auspices, was forced on and accepted by him. He was presently displaced by a thorough reactionary, General Zuloaga, and expelled from Mexico early in 1858; and for three years Mexico was a prey to civil war between two rival governments—the Republicans' at Vera Cruz under Juarez, who, as Chief Justice of the Supreme Court, succeeded Comonfort under the constitution in the presidential office; and the reactionaries' at the capital. The latter were at first presided over by Zuloaga, who, proving incompetent, was replaced at the end of 1858 by Pezuela, who early in 1859 gave place to Miguel Miramon, a young, able, and unscrupulous soldier, who was shortly afterwards accepted as "constitutional" president by his party. The Juarists were defeated outside the city of Mexico twice, in October 1858 and on 11th April 1859. On the second occasion the whole body of officers, who had surrendered, were shot with Miramon's authority, if not by his express orders, together with several surgeons (including one Englishman, Dr Duval) and medical students who were tending the wounded of both armies, some as volunteers (the "martyrs of Tacubaya"). This atrocity caused great indignation in Mexico and abroad: the reactionists were divided; their financial straits were extreme, as the Juarists held all the chief ports. Juarez was recognized by the United States, and allowed to draw supplies of arms and volunteers thence; and on 12th July 1859 he published laws declaring ecclesiastical property confiscated, establishing civil marriage and registration, transferring the cemeteries to civil control, and, in short, disestablishing the Church. As opening up a source of revenue other than forced loans, the chief reliance of his opponents, these laws probably contributed largely to his eventual success. But his occupation of all the chief customs ports of the Republic, and the apparent hopelessness of any ending to the conflict, together with the frequent outrages of both parties on foreigners, afforded strong reasons for foreign intervention. Early in 1859 President Buchanan had recommended the step to Congress, which did not respond. On 12th December 1859 the M'Lean-Juarez treaty was concluded, which gave the United States a sort of disguised protectorate over Mexico, with certain rights of way for railroads over the Isthmus of Tehuantepec and between the Rio Grande and Pacific. The American Senate, however, did not ratify the treaty, and a motion for its reconsideration late in 1860 came to nothing, owing to the approach of the War of Secession.

Miramon.

Overthrow of Miramon, 1860.

The question of a joint intervention of Great Britain, France, Spain, and Prussia was mooted between those Powers in 1860. Early in 1859 the outrages on British subjects had caused the British minister to break off diplomatic relations. Forced contributions had been levied by both sides on goods or bullion, being European property, in transit to or from the coast, the reactionaries being the worst offenders; indeed, a seizure of British specie made by a Juarist, General Degollado, was repudiated by Juarez himself, and restitution was ordered; and there were numerous shocking cases of murder and robbery of Europeans. At last, on 17th November 1860, Miramon, under the plea of necessity, seized $660,000 in specie which had been left under seal at the British Legation and was intended for the bondholders. On 22nd December 1860 his forces were routed by the Juarist general Ortega at Arroyozarco, and his Government was overthrown.

European intervention, 1861.

Juarez entered Mexico city on 11th January 1861. He soon found that his Government was held responsible to Europe for the excesses of its rival as well as its own. Miramon's Government had violated the British Legation; the Spanish minister, with the Papal legate and two representatives of South American states, were expelled from the country for undue interference on behalf of the reactionaries; the payments on the British loan were suspended in fact, and afterwards formally by Juarez's Congress in July 1861; and various outrages had been committed on the persons and property of Europeans for which no redress could be obtained. Most serious and unreasonable were the Jecker claims. Jecker, a Swiss banker settled in Mexico, had lent Miramon's Government, when almost at its last extremity (March 1860), $750,000, receiving in payment 6 per cent. bonds for $15,000,000.[4] Juarez's Government declined to recognize the whole claim, but seems to have been ready to accept liability for the sum lent, with interest. Jecker, whose firm had meanwhile gone into liquidation, became a French citizen, and his claim furnished Napoleon III. with another reason for interference. A convention between Great Britain, France, and Spain for joint interference in Mexico was signed in London, 31st October 1861. A separate arrangement of the British claims was negotiated by Juarez, but rejected by the Mexican Congress, November 1861; and the assistance of the United States with a small loan was declined, Mexican territory being demanded as security. On 14th December Vera Cruz was occupied by Spanish troops under General Prim; the French fleet and troops arrived soon after, with instructions to seize and hold the Gulf ports and collect the customs for the three Powers till a settlement was effected; Great Britain sent ships, and landed only 700 marines. In view of the unhealthiness of Vera Cruz, the convention of Soledad was concluded with the Mexican Government, permitting the foreign troops to advance to Orizaba, and incidentally recognizing Mexican independence. But as the

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[1] Two filibustering expeditions at this time—one by William Walker, afterwards notorious in Nicaragua, in Lower California (December 1853), the other by Count Raousset de Boulbon and some French adventurers in Sonora, in Santa Anna's interest (July 1854)—added to the general disorder.

[2] Santa Anna tried to get back to politics in Mexico after Maximilian's fall, without success. He was amnestied with other exiles in 1874, and died in obscurity in 1876.

[3] It is even stated that the "housekeepers" of the priests, when in debt for dress, &c., supplied to them, would claim "benefit of clergy" in order to escape more easily.

[4] The operation was most ingeniously disguised as a conversion scheme, the old and practically valueless bonds being exchangeable at a vast discount, and along with cash, for the new bonds, which were assured of a sale by being made legal tender for one-fifth of any payment of customs duties.

French expedition, 1862-63.

French harboured leaders of the Mexican reactionaries, and showed a disposition to interfere in Mexican domestic politics, which lay beyond the terms of the joint convention, Great Britain and Spain withdrew their forces in March 1862. For the refugees in Paris had been taken up by the Empress Eugenie and the French Clericals, and had revived the old idea of a Mexican monarchy, which Napoleon adopted in the autumn of 1861. More troops were sent from France. Their advance was checked by Zaragoza and Porfirio Diaz in the battle of Cinco de Mayo, 5th May 1862; and in September of that year 30,000 more French troops arrived under General Forey. Wintering at Orizaba, they recommenced their advance, 17th February 1863, besieged and reduced Puebla, and entered Mexico city, 17th June. A provisional government of Mexicans was established, nominated directly or indirectly by Dubois de Saligny, the French plenipotentiary. It adopted monarchy, offered the crown to Maximilian of Austria, brother of the Emperor Francis Joseph, and should he refuse, left its disposal to Napoleon III.

Maximilian emperor, 1864.

Maximilian, after making some difficulty as to renouncing his right of succession to the throne of Austria, as was required of him, accepted the crown subject to the approval of the Mexican people, and reached Mexico city, 12th June 1864. Juarez meanwhile had set up his capital, first in San Luis Potosi, then in Chihuahua. The new empire was unstable from the first. Before Maximilian arrived the provisional government had refused to cancel the sales of confiscated Church lands as the Clericals demanded. When he came, a host of new difficulties arose. A new loan, nominally of about eight millions sterling, but yielding little more than four, owing to discount and commission, was raised in Europe, but no funds were really available for its service. Maximilian spent his resources too freely in mere luxury, and carried the elaborate etiquette of the Court of Vienna to Mexico. Favouring, as he did, toleration of Protestantism, and the supremacy of the Crown over the Church, he was too liberal for the Clericals who had set him up. As a foreigner he was unpopular, and the regiments of Austrians and Belgians which were to serve as the nucleus of his own army were more so. As an administrator he was enthusiastic, but futile: his reforms, excellent on paper, could not be carried out, for the trained bureaucracy necessary—nay, even the material for it—did not exist. For a time he nominally held sway over about two-thirds of the country,—roughly, from lat. 18° to 23°, thus excluding the extreme north and south. Oaxaca city, under Porfirio Diaz,[1] capitulated to Bazaine—who had superseded the too pro-Clerical Forey in October 1864—in February 1865, and by the autumn of that year the condition of the Juarists in the north seemed desperate. But the towns asked for permanent French garrisons, which were refused, as weakening their own power of self-defence. Instead, the country was traversed by flying columns, and the guerillas dealt with by a French service of "contre-guerilla," who fought with much the same savagery as their foes. Directly the French troops had passed, Republican bands sprang up, and the non-combatant Mexicans, to save themselves, could only profess neutrality. Yet on 3rd October 1865, Maximilian, misled by a false report that Juarez had left the country, issued a decree declaring the Juarists guerillas, who whenever captured were to be tried by court-martial and shot. Mexican generals on both sides had done as much. But Maximilian's decree prepared his own fate.

Maximilian deserted by France.

The American Civil War ended in the spring of 1865, and a strong popular feeling was at once manifested in favour of asserting the Monroe doctrine against Maximilian's Government. In the summer there were threatening movements of United States troops towards the Rio Grande; early in 1866 Napoleon III. announced to the French Chambers his intention of withdrawing his forces; in response to a note of Seward, the United States secretary of state, of 12th February 1866, he was induced to promise their return by three instalments at specific dates (November 1866, March and November 1867). Maximilian now turned for support to the Mexican Clericals; meditated abdication, but was dissuaded by his wife Charlotte ("the better man of the two," as he had once jestingly said), who went to intercede for him with the Emperor of the French. Finding him obdurate, she went on to appeal to the Pope; on her way, at Botzen, she went mad (end of September 1866).

Execution of Maximilian, 1867.

Maximilian had meanwhile drawn nearer to the Clericals, and farther from the French, and, to protect French interests, Napoleon III. had decided to send out General Castelnau to supersede Bazaine, arrange for the withdrawal of the French forces in one body, and restore the Republic under Ortega, who had quarrelled with Juarez, and was therefore, of all Republicans, least unacceptable to the Clericals. But fearing the prospect, they induced Maximilian, who had retired to Orizaba for his health, to remain. Father Fischer, a German-American by extraction, was specially influential here. A conference of eighteen representative Mexicans was summoned, and refused his offer to retire by ten votes to eight. He yielded on condition that a congress of all parties should be summoned to decide the fate of the empire. Hereupon he returned to the capital; the Juarist dominion extended rapidly; the French troops left (in one body) on 5th February 1867, ignoring and ignored by the Imperial Government, and shortly after Maximilian took command of the army at Queretaro. Here, with Miramon, he was besieged by the Juarists under Escobedo, and the garrison, when about to make a last attempt to break out and seek refuge in the fastnesses of the Sierra Gorda, was betrayed[2] by Colonel Lopez to the besiegers (15th May 1867). Maximilian, with the Mexican generals Miramon and Meija, was tried (fairly enough) by court-martial, and, refusing (or neglecting) to avail himself of various opportunities of escape, was convicted on charges which may be summarized as rebellion, murder, and brigandage, on 14th June, and executed, with Miramon and Meija, on 19th June 1867.

Juarez president.

Meanwhile Porfirio Diaz had captured Puebla (2nd April) and besieged Mexico city, which fell 21st June. The Republican Government behaved with comparative leniency, though Juarez and Diaz were to some extent forced on by their followers, who rejected a general amnesty. The last anti-Juarist stronghold (Inayarit) submitted on 20th July 1867. A good deal of discontent was caused among the Republican rank and file, partly by the reduction of the army, and partly by a proposal to allow priests to vote, which came to nothing, and in the result Juarez's election in October to the presidency was opposed by Diaz, or rather Diaz's friends, but without success. But so soon as Juarez was elected, insurrections broke out in various states, and brigandage prevailed throughout the following year. There were unsuccessful insurrections also in 1869 (Clerical) and 1870 (Republican), but an amnesty, passed 13th October 1870, helped to restore peace; trouble again arose, however, at the 1871 election, at which the candidates were Juarez, Sebastian Lerdo de Tejada, and Diaz. Juarez's continued re-election was regarded as unconstitutional, and no party obtaining a clear majority, the matter was thrown into Congress, which elected him. Diaz's supporters refused to recognize him, and a revolution broke out, which went on sporadically till Juarez's death on 18th July 1872. Sebastian Lerdo de Tejada, as president of the Supreme Court, succeeded him, and amnestied the rebels, but made no further concessions. In the next year, however, laws were passed repeating in a stronger form the attacks of 1857 on the supremacy of the Church, and prohibiting the monastic orders or monastic life. The first day of 1873 was marked by the opening of the Vera Cruz and Mexico railway. For the next two years there were only local disturbances, chiefly in Yucatan, and an Indian rising in Michoacan. Protestant missions established themselves (with some opposition) in the country, and diplomatic relations were renewed with France and Spain (1874). But towards the close of Lerdo de Tejada's term as president he was suspected of aiming at a dictatorship, and Diaz made preparations for a rising, then retiring to Brownsville. At the beginning of 1875 the revolution broke out in Oaxaca with the Plan of Tuxtepec, which was adopted by Diaz, and proclaimed as the Plan of Palo Alto (22nd March). Diaz's attempt to raise the north, however, failed, and, trying to reach Vera Cruz by sea, he was recognized on the steamer, recaptured while attempting a four-mile swim ashore, concealed by the purser for some days, generally inside one of the saloon sofas, and helped to get ashore in disguise at Vera Cruz. Lerdo was declared re-elected, but was overthrown and forced into exile (January 1877), and Diaz, who had assumed the provisional presidency, was declared constitutional president on 2nd May 1877. A law forbidding the re-election of a president till four years had elapsed from his retirement from office, the outcome of the Republican opposition to Juarez and Lerdo, was passed in the autumn of that year (but so modified as to enable Diaz to be re-elected indefinitely in 1887 and 1892).

Death of Juarez, 1872.

Administration of Lerdo de Tejada.

Porfirio Diaz president, 1877.

Diaz's first presidency (1877–80) was marked by some unsuccessful attempts at revolution, notably by Escobedo from Texas; by the resumption of diplomatic relations with Spain, Germany, Italy, and some South American states (1877), and France (1880); by some frontier difficulties with the United States, whose soldiery had occasionally followed brigands into Mexican territory, and with Guatemala, which revived a claim dropped since 1858 to a portion of the state of Chiapas; and by considerable internal progress, aided by a too liberal policy of subsidies to railways. The boundary questions were settled under President Gonzalez (1880–84); relations with Great Britain were renewed in 1883. The claims of the railways, however, necessitated retrenchment on official salaries, and the president's plan for conversion of the debt roused unexpected opposition in an ordinarily subservient Congress. It was attacked with great force and eloquence by the youngest member of the house, Señor Miron; Señor Guillermo Prieto, a noted poet and ex-minister, added the weight of his authority to the attack; the students demonstrated against the Bill in the streets; and finally it was rejected, on the ground that the expenses of conversion were too heavy and the burden on Mexico too great. At the end of 1884 Porfirio Diaz was again elected president, and was continually re-elected, the constitution being twice modified expressly to allow him to continue in office (1887, 1892).

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[1] Diaz refused parole, and was confined at Puebla for some months, but made his escape, and was soon in the field again.

[2] Lopez said he acted as Maximilian's agent, but his story was generally rejected. Yet see Mrs. Tweedie's *Mexico as I Saw It*, 1901.

Mexico under Diaz.

The history of Mexico from 1884 to 1902 is almost void of political strife. President Diaz's policy was to keep down disorder with a strong hand; to enforce the law; to foster railway development and economic progress; to develop native manufactures by protective tariffs; to introduce new industries, *e.g.*, the production of silk and wine, of coca and quinine; to promote forestry; to improve elementary and higher education—for all which purposes the Ministerio del Fomento is a potent engine; to encourage colonization; and, above all, to place the national credit on a sound basis. The first step in this process was a settlement of the British debt by direct arrangement with the bondholders, who were induced to exchange their outstanding bonds (at a discount of about 85 per cent.) for 6 per cent. bonds secured on one-fifth of the import and export duties and the product of certain direct taxes (1887–88). In 1890 the Spanish bondholders' claims were satisfactorily arranged also. In 1891 the tariff was made more protectionist. In 1893 the depreciation of silver, Mexico's currency and principal article of export, necessitated stringent retrenchment in the diplomatic service and reduction of official salaries; but the budget balanced for the first time during many years, the floating debt was converted, and a loan raised for the completion of the Tehuantepec railway. After 1896 there were substantial annual surpluses, which were spent in reducing taxation and in the extinction of debt. In 1895 the 6 per cent. external debt was converted into a 5 per cent. debt, the bonds of which were in 1902 at a premium; in 1896 the alcabalas or interstate customs and municipal *octrois* were abolished, and replaced in part by direct taxation and increased stamp duties.

Financial reorganization.

Pacification of the country.

The institution by Diaz of the *guardias rurales*, a mounted gendarmerie composed of the class who in former days drifted into revolution and brigandage, was a potent means of maintaining order, and the extension of railways and telegraphs enabled the Government to cope at once with any disturbance. The old local revolutions practically disappeared. In 1886–87 there were some disturbances in Coahuila, New Leon, Sinaloa, and Tamaulipas; subsequently hardly anything was heard of such disorders except on the Texan frontier, where in 1890 Francisco Ruiz Sandoval and in 1891 Catarino Garza made incursions into Mexico with some support from Mexican ranch-owners in Texas and speculators who expected mining concessions in the event of a revolution. But the raiders, though they seem to have had some sympathizers in the Mexican army, were few, and in fact little more than brigands. Occasionally the Church gave trouble—the presence of foreign priests was complained of; attempts to evade the law prohibiting conventual life were detected and foiled (1891, 1894); and there were Indian risings, repressed sometimes with great severity, among the Maquis of Yucatan and the Yaquis of Sonora. Now and then the old passions break out: in September 1897 an absurd attempt to assassinate President Diaz was made by a countryman named Arroyo, who was secured, and early next morning lynched in the central police office, partly by members of the force, ten of whom, however, were sentenced to death for the crime. Discontent with Diaz's rule was confined to a small minority.[1]

Foreign affairs.

In foreign affairs the rule of Diaz was uneventful. There have been transient disputes with the United States (1886, 1888). In 1888–90 and 1894–95 a boundary dispute with Guatemala became serious, and Mexican wood-cutters were driven out of the disputed territory between the rivers Xicoz and Usumacinto by Guatemalan officials, on the ground that an arbitration in progress being suspended, the territory was still Guatemalan. But Guatemala gave way at the threat of war (January 1895). In the difficulty between England and the United States over the Venezuelan boundary (December 1895) Mexico expressed strong adherence to the Monroe doctrine in the abstract, and suggested that its maintenance should not be left wholly to the United States, but should be undertaken by all American Powers.

Economic progress.

In brief, under President Diaz's rule the history of Mexico is mainly economic. In the six financial years 1893–94 to 1899–1900 inclusive the yield of the import duties increased by upwards of 80 per cent.; the revenue from stamps (an excellent index of the volume of business) over 60 per cent., though the duties were reduced; the postal revenue from 1895–96 to 1899–1900 rose 60 per cent.; the telegraph revenue over 75 per cent. The great drainage tunnel which is to take the waters of the valley of Mexico, hitherto most inadequately drained, out to the Pacific was completed in 1902; the Tehuantepec railway, likely to prove a formidable rival to any interoceanic canal, approached completion. Both tunnel and railway were the work of an English firm of contractors, Messrs S. Pearson and Sons. Great improvements have also been made in the harbours at Tampico and Vera Cruz. In 1891 elementary education was reorganized, and made compulsory, secular, and gratuitous. Great attention has been paid to higher education, and—at least in the hospitals—to modern sanitation and hygiene.

Authorities.—For English readers the standard work is H. H. Bancroft, *History of the Pacific States*, vols. vii.–ix. (Mexico, 1804–67), with vols. x. xi. (Texas), and vol. xii. (New Mexico, &c.). (In Bancroft's collected works the vols. are numbered xi.–xvii.) Also his *Popular History of Mexico.* For the war with the United States see R. S. Ripley, *The War with Mexico* (New York, 1849); G. D. Mansfield, *The Mexican War* (New York, 1849); and Winfield Scott's *Memoirs.* For Maximilian, the Blue-books on Mexican affairs contained in *Accounts and Papers* (presented to Parliament), vol. lxv. 1862, and vol. lxiv. 1863, are valuable; E. de Kératry, *La Créance Jecker; L'Empereur Maximilien, son Élévation et sa Chute* (translated into English by Venables); *La Contre-Guerilla Française au Mexique*, are specially noteworthy; Prince Felix Salm-Salm's *Diary* gives valuable information as to his decline and fall. Ulick Ralph Burke's *Life of Benito Jaurez* (London, 1894) is of considerable value and interest. For the period since 1887 information in English must be sought chiefly in magazine articles: Matias Romero, "The Garza Raid and its Lessons," *North American Review*, September 1892; Don Agustin Iturbide, "Mexico under Diaz," *ibid.* June 1894; Romero, "The Philosophy of Mexican Revolutions," *ibid.* January 1896; and C. F. Lummis, "The Awakening of a Nation," *Harper's Magazine*, 1897, February, March, and April are valuable, as giving information (especially the last named) and points of view. Van Dyke, "Politics in Mexico," *Harper's Magazine*, 1885, vol. lxxi., gives particulars of the opposition to Gonzalez's debt conversion scheme of 1884. President Diaz's message of November 1896, giving an account of his stewardship from 1884 to that year, has been translated into French (*Rapport du Général Porfirio Diaz . . . à ses Compatriotes sur les Actes de son Administration*, &c.), edited by Auguste Génin, Paris, 1897. The early constitutions of the Republic have been published (in Spanish) in three volumes; a study of that of 1857 by B. Moses (of the University of California) is in the *Annals of the American Academy of Political Science*, ii. i. 1891. Many books, chiefly American, have been written on Mexico of late years from a tourist's standpoint. Mrs Alec Tweedie's *Mexico as I Saw It* (London, 1901) contains valuable information personally obtained from good authorities in Mexico, and some interesting experiences of President Diaz.

(J. S. Ma.)

Mexico, a state of the Republic of Mexico, bounded on the N. by the state of Hidalgo, on the E. by Puebla and Tlaxcala, on the S. and S.E. by Morelos, on the S. and S.W. by Guerrero, and on the W. by Michoacan, with an area of 9250 square miles. It is one of the most important agricultural and industrial states. The leading manufacturing industries are cotton and woollen goods, bricks, dairy products, wines, glass-ware, flour-mills, sugar, distilleries, potteries, &c. The state is divided into fifteen districts. The capital, Toluca (population, 23,150), 46 miles from Mexico City, is a handsome town, containing fine public buildings; also cotton mills, breweries, oil and flour mills, ice factories, &c. Amongst other towns in the state are Zumpango (9090), Lerma (7167), San José de Malacatepec (6551), Tenango del Valle (5465), Metepec (5189).

Mexico, a city of Missouri, U.S.A., capital of Audrain county, at the intersection of the Chicago and Alton and the Wabash railways, north-east of the centre of the state, at an altitude of 831 feet. Its site is uneven and hilly, and the street plan irregular. It is the seat of Hardin College, a Baptist institution for women, founded in 1873, which in 1899 had 23 instructors and 252 students. Population (1890), 4789; (1900), 5099, of whom 111 were foreign-born and 948 were negroes.

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[1] Don Agustin Iturbide, grandson of the emperor, godson and (perhaps) at one time the destined heir of Maximilian, was turned out of the army and imprisoned in 1890 for abusing President Diaz.

Mexico City, capital of the Mexican Republic, situated in the centre of a high plain, 7460 feet above sea-level, 263 miles west of Vera Cruz by rail. It has undergone considerable improvement, and a very large increase of the suburbs has also taken place. The principal undertaking has been the great canal scheme for the drainage of the Mexican valley, completed in 1898 at a cost of $18,000,000. Almost equally important has been the introduction of a complete sewage system on the best scientific principles, a special feature being the flushing of the main drains by fresh water supplied by a pumping engine. The streets are lighted by electricity, and there is an adequate system of tramcars, formerly drawn by mules, but now on many lines propelled by electricity. In 1898 all the various hospitals were merged in one structure, consisting of thirty-five buildings on the scientific plan of pavilions, the whole erected at a cost of $800,000. A new prison has been erected, and also a fine new House of Congress. The industries have multiplied as well as increased. There are large cotton, linen, and paper factories, brick works, cork factories, soap works, machine factories, &c. There are many large foreign business houses—German, French, English, and Chinese—the Germans having almost a monopoly in the hardware trade. Population (1895), 329,774; (1900), 368,777.

Meyer, Julius Lothar (1830–1895), German chemist, was born on 19th August 1830, at Varel in Oldenburg. Determining to adopt the profession of his father, who was a physician, he went to study medicine first at Zürich University in 1851, and then, two years later, at Würzburg, where he had Virchow as his teacher in pathology. Even before he took his doctor's degree (1854), the influence of Ludwig, under whom he studied at Zürich, had decided him to devote his attention to physiological chemistry, and with that end in view he went, after his graduation, to Heidelberg, where Bunsen held the chair of chemistry. There he drifted still farther from medicine, and was so influenced by Kirchhoff's mathematical teaching that he took up the study of mathematical physics at Königsberg under F. E. Neumann. In 1859 he became *Privat-docent* in physics and chemistry at Breslau, where in the preceding year he had graduated as Ph.D. with a thesis on the action of carbon monoxide on the blood. In 1866 he accepted a post in the School of Forestry at Neustadt-Eberswalde, but soon moved to Carlsruhe Polytechnic. There he had an opportunity of utilizing his early medical training to great practical advantage, for during the Franco-German campaign the Polytechnic was used as a hospital, and he took an active part in the care of the wounded. Finally, in 1876, he became professor of chemistry at Tübingen, where he died on 11th April 1895. His name is best known for the share he had in the periodic classification of the elements. He noted, as did Newlands in England, that if they are arranged in the order of their atomic weights they fall into groups in which similar chemical and physical properties are repeated at periodic intervals; and in particular he showed that if the atomic weights are plotted as ordinates and the atomic volumes as abscissæ, the curve obtained presents a series of maxima and minima, the most electro-positive elements appearing at the peaks of the curve in the order of their atomic weights. His book on *Die modernen Theorien der Chemie,* which was first published in Breslau in 1864 and has passed through many editions, contains a discussion of this and other relations between the atomic weights and the properties of the elements. In 1882 he received from the Royal Society, at the same time as Mendeléeff, the Davy medal in recognition of his work on the Periodic Law. A younger brother, O. E. Meyer, became professor of physics at Breslau in 1864.

Meyer, Victor (1848–1897), German chemist, was born at Berlin on 8th September 1848, and studied at Heidelberg University under Bunsen, Kopp, Kirchhoff, and Helmholtz. At the age of twenty he entered Baeyer's laboratory at Berlin, and began original work in organic chemistry, attacking among other problems that of the composition of camphor. In 1871, on Baeyer's recommendation, he was engaged by Fehling as his assistant at Stuttgart Polytechnic, but within a year he left to succeed Wislicenus at Zürich. There he remained for thirteen years, and gained for himself a high place among contemporary chemists. It was during this period that he devised his well-known method for determining vapour densities at high temperatures (see CHEMISTRY in these new volumes), and carried out his experiments on the dissociation of the halogens with great heat, though it is to be noted that he himself never went so far as definitely to assert the decomposition of chlorine. In 1882, on the death of Weith, he undertook to continue the latter's lectures at the University on benzene derivatives, and his preparations for this task led him to the discovery of thiophen. In 1885 he was chosen to succeed Hübner in Göttingen, where stereo-chemical questions especially engaged his attention; and in 1889, on the resignation of his old master, Bunsen, he was appointed to the chair of chemistry in Heidelberg. He died on 8th August 1897. In recognition of his brilliant experimental powers, and his numerous contributions to chemical science, he was awarded the Davy medal by the Royal Society in 1891.

Mézières, chief town of department Ardennes, France, 152 miles north-east of Paris, an important junction on railway from Paris to Namur. It is now a fortified place of the second class. The walls have been demolished, detached forts having been erected outside their circle. There is a monument in memory of those who fell during the war of 1870–71, when the town was captured by the Prussians; also, a statue of Bayard. The church, which suffered severely in 1870–71, has since been restored. Population (1891), 4675; (1901), 7884.

Mezöhegyes, a market town of Hungary, in the county of Csanád, 31½ miles by rail north-west of Arad, with 6000 inhabitants. In the district is a great horse-breeding establishment founded in 1785 in connexion with a model farm. The town has a sugar refinery, a steam mill, and seven distilleries.

Mezzotint. See ENGRAVING.

Mhow, town of Central India, with British military cantonment, within the native state of Indore, on the Malwa branch of the Rajputana railway between Khandwa and Rutlam, 13 miles south of Indore. Population (1881), 27,227; (1891), 31,773. It is the headquarters of a military division, with a strong force of all arms. There are two high schools, a Zoroastrian and a Canadian mission, the Dorabji Pestonji dispensary, with an endowment of Rs.28,500, and a gaol. The number of police is 135, and the expenditure on public works in 1897–98 was Rs.61,220.

Miagao, a town on the southern coast of the province of Iloilo, island of Panay, Philippine Islands. It has a cool and healthful climate. The neighbouring country is hilly and sterile, but produces sibucao in considerable quantities. The weaving of fabrics of abacá (*Musa textilis*) and pine-apple fibre is the most important local industry. The language is Panay-Visayan. Population, 22,000.

Miasskiy Zavod, gold-mining centre and town of Russia, in the Urals, government of Orenburg, district of Troitsk, 4 miles from Mias railway station. The average annual extraction of gold amounts to 17,280 oz. Population, 10,580.

Miautze. See Lolos.

Michigan, one of the north central states of the American Union, lying in the valley of the Great Lakes. It is composed of two peninsulas, of which the northern, or as it is commonly called, the upper peninsula, is rich in minerals of various kinds; the southern, or lower peninsula, is adapted to agriculture.

Population.—In 1880 the population was 1,636,937; in 1890 it was 2,093,889. In 1880 the density per square mile was 27·80, and in 1900 it had risen to 41·1. In 1900 the total population had increased to 2,420,982. During the last twenty years of the 19th century the natural increase averaged 16·6 per cent. per year. The centre of population has been gradually moving northwards and westwards. In 1900, 541,653 inhabitants (22·4 per cent. of the population) were of foreign birth, and 22,419 (0·9 per cent. of the population were coloured, including 15,816 negroes, 240 Chinese, 9 Japanese, and 6354 Indians. In 1894, 200,447 were natives of British America; 96,384 of Great Britain and Ireland; 143,057 were Germans; 36,370 were from the Scandinavian peninsula; 32,868 were from Holland. These nationalities constituted 89 per cent. of the foreign population. There are eighty-five organized counties in the state, and seventy-eight incorporated cities. Ten cities had more than 15,000 inhabitants in 1900: Detroit, 285,704; Grand Rapids, 87,565; Saginaw, 42,345; Bay City, 27,628; Jackson, 25,180; Kalamazoo, 24,404; Muskegon, 20,818; Port Huron, 19,158; Battle Creek, 18,563; Lansing, 16,485. Nine cities had between 10,000 and 15,000 inhabitants: Ann Arbor, 14,509; Manistee, 14,260; Ishpeming, 13,255; West Bay City, 13,119; Flint, 13,103; Menominee, 12,818; Alpena, 11,802; Sault Ste Marie, 10,538; Marquette, 10,058. The proportion of population of incorporated cities and villages to the total population of the state was 50·1 per cent. The so-called urban population, classing as such all persons in cities of 8000 inhabitants or more, amounted to 747,334, or 30·9 per cent. of the total population, as against 26·1 per cent. in 1890. The death-rate in 1900 was 13·9 for the entire state. For the rural districts and the cities of less than 8000 inhabitants it was 13·3; for the rest of the cities it was 15·3.

Education.—At an early date Michigan obtained from the general government two townships of land for the support of a university, and, like many other Western states, one section in each township in the state for the support of schools. The funds received from the sale of these lands are held by the state as trust funds on which interest is paid. The annual income accruing to the University of Michigan from this source is $38,500. The school fund held by the state amounts to $4,694,625, and the income distributed to the schools from this source amounted to $319,430 in 1898. There are still over 190,000 acres of school land unsold; the university lands are almost entirely disposed of. The state holds a sum of $625,790 as a trust fund for the Agricultural College, and $66,128 as a normal school fund. In addition to these sums, the public schools received $636,982 from state specific taxes on corporations in 1898. Thes esums, supplemented by district taxation, show an annual expenditure of $7,867,646. In 1898 the ungraded school districts, numbering 6485, enrolled 208,751 pupils, while the graded school districts, 672 in number, enrolled 287,274. The total school attendance in 1898 was 541,490. In 1900 the number of persons of school age (5 to 20 years inclusive) was 790,275. The higher public institutions of learning are the University, which in 1900 had 3441 students, and 225 persons on the teaching staff; the State Normal College, with 979 students and 46 teachers; the Central Normal School, with 314 students and 14 teachers; the Agricultural College, with 528 students (1899) and 35 teachers; the Northern State Normal School at Marquette, with 90 students and 6 teachers; the College of Mines, with 122 students and 17 teachers. In 1894, 5·7 per cent. of all persons of both sexes over five years of age could not read or write. The illiterates twenty-one years of age and over were 2·7 per cent. of the population. In 1900, when the total male population twenty-one years of age and over numbered 719,478, 39,230 (of whom 26,823 were foreign-born) could not write.

Religion.—There were in 1894, 3936 church organizations holding property valued at $20,775,156. The six largest denominations are the Methodists, with 1044 churches and $4,263,835 worth of property; the Baptists, with 370 churches and $1,977,910 worth of property; the Lutherans, with 364 churches and $1,633,675 worth of property; the Roman Catholics, with 362 churches and $4,539,386 worth of property; the Congregationalists, with 284 churches and $1,701,900 worth of property; the Presbyterians, with 238 churches and $2,318,850 worth of property.

Charitable and Reformatory Institutions.—The school for the deaf at Flint and the school for the blind at Lansing may be classed as educational as well as charitable institutions. In 1898 the former had 412 pupils and the latter 109. The state public school for dependent and neglected children is situated at Coldwater; in 1898 the pupils numbered 529. The state has established an industrial home for boys at Lansing, an industrial school for girls at Adrian, a home for the feeble-minded at Lapeer, and the Michigan Soldiers' Home at Grand Rapids. Public institutions for the improvement of criminals are the state prison at Jackson, the state house of correction and reformatory at Ionia, and the house of correction and prison at Marquette. There are asylums for the insane at Kalamazoo (1308 patients), Pontiac (1057 patients), Traverse City (1011 patients), Newberry (300 patients), and Ionia (245 patients).

Agricultural Products.—Wheat continues to be the most important agricultural product. The acres sown in 1898 were reported as 1,698,453, and the amount produced as 33,006,869 bushels. The yield in bushels of other principal cereals is: Indian corn, 37,259,938; oats, 27,529,558; clover seed, 86,373. In the same year 1,890,181 tons of hay were raised, and 22,355,520 bushels of potatoes. The number of acres in the apple orchards decreased slightly during the last quarter of the 19th century, but in 1898, 6,024,975 bushels were raised. The acreage of peach orchards has grown with slight fluctuation. In 1881 there were 12,908 acres of peach orchards; in 1891 there were 20,124 acres; in 1898 there were 50,148. Of peaches 413,418 bushels were sold in 1880, and in 1898, 1,872,147 bushels were grown. The raising of small fruit has also considerably developed since 1890.

Lumber.—The lumber industry has materially diminished because of the rapid consumption of the standing timber. It has been estimated that Michigan had originally at least 150 billion feet of white pine. In 1897 not more than 10 billion feet were standing, and this was probably a large estimate. The largest cut of lumber ever made in a single year was in 1888, when the production is believed to have exceeded 4,200,000,000 feet. Since that time the decrease has been very marked. The following figures, though not official, are trustworthy, and include the cut of white pine, hemlock, and hard wood:—

Year.	Lumber—feet.	Shingles.
1885	3,578,138,732	2,574,675,900
1890	4,085,767,849	2,469,878,750
1895	2,731,029,535	1,360,535,500
1899	2,328,575,135	1,444,578,000

The eastern portion of the southern peninsula has been nearly cleared of pine timber; along the Saginaw river in 1899 there were probably not more than about 225,000,000 feet of timber cut. In Muskegon, where in a single year the cut has reached 750,000,000 feet, there are now only two or three mills, with an output of not far from 70,000,000 feet. The upper peninsula still has a good deal of lumber, but it is rapidly disappearing. In 1888 the Menominee River Boom Company handled 513,703,492 feet; in 1898 only 291,229,121 feet.

Fisheries.—The state through the agency of a commission has done valuable work in propagating fish and in protecting the natural industry. There are four state hatcheries, from which in two years (1897, 1898) 202,722,350 fish were planted in the waters of the state. The catch of all kinds in 1897 amounted to 32,602,745 pounds, valued at $709,831.

Minerals.—Michigan produces more iron ore than any other state. The high quality of the ore and the unusual shipping facilities make the iron industry exceedingly important. In 1898 and 1899 the output was very large, amounting in the former year to 7,380,319 tons, in the latter to 9,265,524. Copper-mining has greatly developed. The copper companies have distributed in dividends $96,933,120 since the beginning. Of this sum $6,900,000 was divided or declared for payment in the first half of 1899. For 1899 the production of refined copper was 146,950,338 pounds. The output is 28 per cent. of the total production in the United States. Montana is the only state producing a larger amount. The Calumet and Hecla mine now employs 5000 men, and in 1899 turned out 89,610,963 pounds of copper. Michigan retains its position as first in salt production in the United States. The number of barrels manufactured in 1898 was 4,171,916, valued at about $2,000,000. Large manufactories of soda ash and allied products have been established near Detroit, obtaining brine from deep wells. The coal deposits have attracted attention. In addition to those near Jackson, new mines have been opened in the Saginaw valley. The output in 1899 was 624,708 tons, and there are indications of a great development. There are many large beds of pure marl fitted to make the finest quality of Portland cement, for the manufacture of which companies have been organized and factories built. The daily production of cement for 1900 was estimated at 500 barrels.

Manufactures.—In 1900 Michigan ranked tenth among the states of the Union in the value of its manufactured products. The general increase in manufacturing industries during the decade 1890–1900 is shown by the following table:—

	1890.	1900.	Per cent. of increase.
Number of establishments	12,127	16,807	38·6
Capital	$262,412,240	$284,097,133	8·3
Salaried officials, clerks, &c.	15,267[1]	13,858	9·2[2]
Salaries	$11,364,892[1]	$12,562,855	10·5
Wage-earners (average number) . . .	148,674	162,355	9·2
Total wages . . .	$54,982,906	$66,467,867	20·9
Miscellaneous expenses	$18,348,381	$25,495,423	39·0
Cost of materials used .	$154,521,918	$199,559,905	29·1
Value of products .	$277,896,706	$356,944,082	28·4

Statistics of twelve of the principal industries are as follows:—

Industry.	Number of Establishments.	Capital.	Value of Products.
Agricultural implements .	59	$8,932,344	$6,339,508
Carriages and waggons .	299	7,935,269	11,205,602
Cars, steam railway . .	4	6,693,209	9,920,780
Chemicals	51	7,503,853	5,364,724
Flouring and grist-mill products	765	7,933,587	23,593,991
Foundry and machine-shop products . . .	364	19,595,771	20,615,864
Furniture . . .	124	13,900,789	14,614,506
Iron and steel . . .	10	3,859,050	5,902,058
Leather (tanned, curried, and finished)	27	5,214,042	6,015,590
Liquors, malt . . .	77	6,235,484	5,296,825
Lumber and timber products	1705	67,379,698	54,290,520
Lumber, planing-mill products	235	8,571,453	12,469,532

The making of furniture is one of the greatest industries of the state; in Grand Rapids alone, which is the centre of the furniture business, $7,494,607 worth of product was manufactured in 1900. One factory in 1899 consumed 2,800,000 feet of veneering and 4,800,000 feet of lumber. Half-yearly fairs are held in Grand Rapids, to which manufacturers in various parts of the country send exhibits, and which are attended by buyers from all over the world. In 1897 the legislature passed a law offering a bounty of one cent for every pound of sugar manufactured for the years 1897 and 1898. In 1900 there were nine large beet sugar factories, with an aggregate invested capital of $4,013,743 and employing 437 persons. In the year ending 31st May 1900 the product of these factories amounted to 33,708,283 ℔.

Railways.—There are 81 lines of railway, with a single track mileage of 10,497 miles. The capital stock is $441,685,405. Their gross earnings in 1899 amounted to $182,144,820, and the net earnings to $55,827,574. During that year 48,195,594 passengers were carried and 102,456,846 tons of freight handled. The chief lines are the Michigan Central, the Chicago and Grand Trunk, the Lake Shore and Michigan Southern, and the Pere Marquette. Besides these there are many inter-urban electric lines.

Banks.—At the end of 1899 there were 187 state banks, 3 trust companies, and 80 national banks. The state banks and trust companies had as their paid-up capital $12,262,100, with surplus and undivided earnings of $5,090,321. The following table will show the depositors and the sums deposited on 31st December 1899:—

Banks.	Class of Deposit.	No. of Depositors.	Sums on Deposit.	Average to each Depositor.
			$	$
187 State	Commercial	77,857	36,772,566	472
	Savings	216,488	62,660,212	290
80 National	Commercial	87,423	49,920,532	571
		381,768	149,353,310	391

Thus the total sum on deposit was nearly $60 for every inhabitant in the state.

Finances.—The financial condition of the state has for many years been peculiarly good. On 30th June 1900 the treasury held a cash balance of $2,501,557, while there was a total bonded indebtedness of only $500,000, most of which was borrowed to defray the war expenses in 1898. There is also a trust-fund debt of $6,273,144, on which interest is paid for the support of various state educational institutions. The aggregate value of property according to tax appraisal in 1896 was $1,105,100,000. A re-equalization was made in 1901, in accordance with which the appraisal was $1,578,100,000, because a great deal of personal property not before listed had been spread on the rolls. In 1896 the rate of taxation was 1·87 mills on the dollar; the next year it was 2·154 mills; in 1898 it was 1·95 mills, or a little less than one-fifth on 1 per cent. The proceeds from the direct taxes on real and personal property amounted in 1900 to $3,725,835. In the same year $1,438,946 were received from specific taxes on corporations.

History.—The Republican party has been successful in every election for governor except in 1882 and 1890, and since the formation of the party in 1854 has controlled the government, with the exception of four years. The constitution of 1850 still remains the fundamental law. The salaries paid under it to a number of the state officers were very small, and various amendments providing for an increase have usually been rejected. The salaries of the governor and the circuit judges have been increased. The Supreme Court is now composed of five justices, one of whom is chosen every two years. The state is divided in thirty-six judicial circuits, on some of which there are several judges.

AUTHORITIES.—COOLEY. *Michigan, A History of Governments (American Commonwealths).* Boston, 1885.—See also the State Census Reports for 1884 and 1894, published at Lansing two years later in each case, the *Legislative Manuals*, &c., for 1899–1900 (Lansing, 1899), and the reports of the various state officers for the year 1898 and 1899 (Lansing). (A. C. M.)

Michigan City, a city of Laporte county, Indiana, U.S.A., on Lake Michigan, near its southern end, and on three railways, the Chicago, Indianapolis, and Louisville, the Lake Erie and Western, and the Michigan Central, in the north-western part of the state, at an altitude of 600 feet. The city has a large trade by lake and rail, and varied manufactures. Population (1890), 10,776; (1900), 14,850, of whom 3662 were foreign-born and 197 were negroes.

Michigan, University of, the largest and most influential of the state universities of the United States, situated in Ann Arbor, Michigan, a city of 14,500 inhabitants, 40 miles from Detroit. It is the head of the state system of public instruction. Founded in 1837, it opened its doors in 1841, and graduated its first class in 1845. In 1900 its students numbered 3441. The enrolment in the different departments, including duplicates, was as follows: Literature, Science and the Arts, 1561; Engineering, 280; Medicine and Surgery, 500; Law, 882; School of Pharmacy, 76; Homœopathic Medical College, 70; College of Dental Surgery, 247. The teaching staff numbers 230 men. The five libraries, general, law, medical, dental, and homœopathic, contained, in 1899, 133,206 volumes. The laboratories are numerous and well equipped. The higher degrees (Ph.D. and Sc.D.) are conferred only on examination. The university is co-educational, the ratio of men to women in all departments being about four to one, but in the literary department 5·6 to 4·4. The institution is supported partly by the income of its endowment fund, partly by fees, partly by appropriations from the state treasury. The total receipts for the fiscal year ending 30th June 1899 were $530,000.

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[1] Includes proprietors and firm members, with their salaries.

[2] Decrease.

Michoacan de Ocampo, a state of Mexico, bounded on the N. by Guanajuato, on the N.E. by the states of Mexico and Queretaro, on the S.E. by the state of Guerrero, on the S.W. by that of Colima, on the W. by Jalisco, and on the S. by the Pacific. Its area is 22,881 square miles. The population in 1879 was 661,534, and in 1900 it was 935,849. It is mountainous, and has a wonderfully rich vegetation, and is also one of the richest mining sections of Mexico, gold, silver, copper, iron, cinnabar, lead, sulphur, coal, marble, &c., being found in abundance. Foreign trade is carried on through the ports of Vera Cruz and Manzanillo and the frontier towns of Paso del Norte and Nuevo Laredo. The total trade amounts on an average to about $25,000,000 a year. The Mexican National and the Mexican Central railways traverse the state. The manufacturing industries supply most of the local wants. The capital, Morelia, has 33,890 inhabitants. Amongst other towns are Zamora (10,373), Uruapan (9276), Angangueo (9115), La Piedad (8876), Sahuayo (8443), Puruandiro (7782), Patzcuaro (7082), Zatcuaro (6207), Tacambaro (5369).

Micronesia.—The three insular groups comprised under the expression MICRONESIA—*Carolinas*, *Marianas* or *Ladrones* and *Pelew* or *Palao Islands*—have been the scene of sweeping political changes, and of archæological discoveries of exceptional interest. Since their discovery by Spanish navigators in the 16th and 17th centuries all the groups had been recognized as Spanish territory till the year 1885, when the Germans, after proclaiming the New Britain and Admiralty Archipelagos (see MELANESIA), took possession of Yap (Wap), one of the largest of the western Carolinas. Before that time Spain never had occupied this or any other member of the group, or even had any relations at all with the Archipelago, except indirectly through the natives of Guam, largest of the Marianas, by whom most of the local trade of the Archipelago is even still carried on. Nevertheless an energetic protest was at once raised, and on the question being referred for arbitration to the Papal Court, an award was given by Pope Leo XIII. in favour of the Spanish claim to all the Carolinas. Thereupon a treaty (December 1885) was concluded between Germany and Spain, in which the Spanish sovereignty over the Carolinas and Pelews was recognized, and the groups defined as lying between the limits of the equator and 11° N. and 133°–164° E. A first attempt was now made by Spain to bring about an effective occupation, and the Archipelagos were divided into two administrative districts—the Eastern Carolinas and the Western Carolinas with the Pelews. But the new system of government was resented by the natives, and a general revolt in the large island of Ponape had to be suppressed with much bloodshed in September 1890. This was the last act of sovereign authority exercised by Spain in these waters, and the Spanish flag disappeared from the Pacific insular world in June 1899, when the whole of Micronesia, with the solitary exception of the island of Guam, was sold to Germany. Micronesia comprises altogether about 680 islands and islets, stretching from west to east for over 2000 miles, but with a total population of perhaps less than 50,000. All the islands are of low coralline formation except the Pelews and Yap in the west, Ruk in the centre, and Ponape and Kusaie in the east, which are of a rugged hilly character, rising from about 800 to nearly 3000 feet in altitude. In the central and eastern parts of Micronesia most of the foreign trade is in the hands of Japanese, American, and German shippers, who forward considerable quantities of copra, *bêche-de-mer* (sea-cucumber), vegetable ivory nuts, turtle-shell, and pearl-shell. In 1898 the copra exported from the Carolinas was stated to exceed 4,000,000 ℔ weight, of which nearly half was shipped at Yap.

Yap stone money.

The inhabitants of Yap on the western fringe of Micronesia are noted for possessing the most extraordinary currency, if it can be so called, in the whole world. Besides the ordinary shell money, there is a sort of stone coinage, consisting of huge calcite or limestone discs or wheels from 6 inches to 12 feet in diameter, and weighing up to nearly five tons. These are all quarried in the Pelew Islands, 200 miles to the south, and are now brought to Yap in European vessels. But some were in the island long before the arrival of the whites, and must consequently have been brought by native canoes or on rafts. The stones, which are rather tokens than money, do not circulate, but are piled up round about the chief's treasure-house, and appear to be regarded as public property, although it is hard to say what particular use they can serve. Mr Christian concludes that they are "more for show and ornament than for use." In Ponape and Kusaie, towards the eastern verge of the Carolina group, Herr Kubary, Mr F. J. Moss, and later Mr F. W. Christian, have made some remarkable discoveries amid the massive stone structures which were long known to exist in those islands, as well as in several other parts of the Pacific Ocean. None of the colossal remains hitherto described appear to have been erected by the present Melanesian or Polynesian peoples, while their wide diffusion, extending as far as Easter Island, within 400 miles of the New World, points to the occupation of the Pacific lands by a prehistoric race which had made some advance in general culture. The Funafuti borings (1897) show almost beyond doubt that Polynesia is an area of comparatively recent subsidence. Hence the land connexions must have formerly been much easier and far more continuous than at present. The dolmen-builders of the New Stone Age are now known to have long occupied both Korea and Japan, from which advanced Asiatic lands they may have found little difficulty in spreading over the Polynesian world, just as in the extreme west they were able to range over Scandinavia, Great Britain, and Ireland. To Neolithic man, still perhaps represented by some of the more light-coloured and more regular-featured Polynesian groups, may therefore not unreasonably be attributed these astonishing remains, which assume so many different forms according to the nature of the locality, but seem generally so out of proportion with the present restricted areas on which they stand. With the gradual subsidence of these areas their culture would necessarily degenerate, although echoes of sublime theogonies and philosophies are still heard in the oral traditions and folklore of many Polynesian groups. In the islet of Lele, close to Kusaie, at the eastern extremity of Micronesia, the ruins present the appearance of a citadel with cyclopean ramparts built of large basaltic blocks. There are also numerous canals, and what look like artificial harbours constructed amid the shallow lagoons.

The Ponape monuments.

In Ponape the remains are of a somewhat similar character, but on a much larger scale, and with this difference, that while those of Lele all stand on the land, those of Ponape are built in the water. The whole island is strewn with natural basaltic prisms, some of great size; and of this material, brought by boats or rafts from a distance of 30 miles, and put together without any mortar, but sustained by their own weight, are built all the massive walls and other structures on the east side of the island. Ponape is of circular form, scarcely 16 miles in diameter, and with an area of 340 square miles; yet the walls of the main building near the entrance of Metalanim harbour form a massive quadrangle 200 feet on all sides, with inner courts, vault and raised platform with walls 20 to 40 feet high and from 8 to 18 feet thick. Some of the blocks are 25 feet long and 8 feet in circumference, and many of them weigh from 3 to 4 tons. There are also numerous canals from 30 to 100 feet wide, while a large number of islets, mainly artificial, covering an area of 9 square miles, have all been built up out of the shallow waters of the lagoon round about the entrance of the harbour, with high sea-walls composed of the same huge basaltic prisms. In some places the walls of this "Pacific Venice," are now submerged to some depth, as if the land had subsided since the construction of these extensive works. Elsewhere huge breakwaters had been constructed, the fragments of which may still be seen stretching away for a distance of from 2 to 3 miles. Most observers, such as Admiral Cyprian Bridge and Mr Le Hunte, agree that these structures could not possibly be the work of any of the present Polynesian peoples, and attribute them to a now extinct prehistoric race; that is, as here suggested, the men of the New Stone Age from the Asiatic mainland.

Authorities.—J. S. Kubary. *Ethnographische Beiträge zur Kenntniss des Karolinen-Archipel.* Leyden, 1889–92.—F. W. Christian. *The Caroline Islands.* 1900.—Dr F. H. H. Guillemard. *Australasia*, vol. ii. London, 1894.—De Adrade. *Historia del Conflicto de las Carolinas*, &c. Madrid, 1886.—Montero y Vidal. *El Archipelago Filipino y las Marianas*, &c. Madrid, 1886.

(A. H. K.)

Microtomy is the term applied to the preparation of minute sections of organic tissue for the microscope. In 1875 the methods were yet in their infancy; their development has enabled observers to achieve the most exact study of minute anatomy, in the case of small objects, which without these methods could only be investigated by the unsatisfactory process of focussing with the microscope through the solid object. It is not necessary here to detail at length the well-known *wet method* of preparing sections. Briefly, the tissue is soaked in a solution of gum, or of gum and syrup, and after being frozen by ether spray, or by a mixture of ice and salt, is cut into sections either by the Rutherford, Cathcart, or some similar section-cutter, or by apparatus which can be fitted to the more modern types of microtome referred to below. This method, which is to-day used mainly by pathologists, has two main disadvantages: the prolonged action of watery fluids on the tissues, and the impossibility of getting ribbons, each section having to be picked up separately. The general processes of the *dry method* employed in zoological and botanical microtomy are, up to a certain point, practically identical with those used for the preservation of animals and their tissues for other branches of microscopic work. In the first place the tissues must be *killed;* in the second, they must be *fixed, i.e.*, the protoplasm must be set or coagulated as far as possible in the condition in which it appears in life; and in the third, they must be *hardened, i.e.*, in most cases dehydrated. Killing may be effected by asphyxiation or narcotization (nicotine, cocaine, chloral hydrate, &c.) in special cases, but is generally achieved by fixing reagents, of which corrosive sublimate and other chlorides, picric, acetic, osmic, and chromic acids, alone, or in combination, chromates, and strong alcohol, are the most usual. These serve to a great extent also as hardening agents, but alcohol, used after them, completes this process effectively, and when not too strong (70 per cent.) is the best storage fluid. The second set of processes relates to the *staining*, without which transparent sections are almost invisible. The stains are divisible into *general* stains, which dye the tissue practically uniformly and indifferently; and *selective* stains which have affinity for special tissues or cell elements. Of the latter group some fasten on nuclei, others only on the chromatin of the nuclei; some on connective tissues, others on muscle fibres, and so on. It is probable that the action of all these selective stains is produced by definite chemical combination with compounds originally present in, generated in, or introduced into the tissue selected. The most generally useful stains for ordinary work belong either to the *cochineal* series (borax-carmine, carmalum, &c.), or to the *logwood* series (hæmatoxylin, hæmalum, iron hæmatoxylin, &c.); in both of these great improvements have been introduced of late years by Dr Paul Mayer. The activity of these stains apparently depends upon the presence of alumina or of some similar base. For more special researches, such as cytology, neuro-pathology, neuro-histology, and so forth, greater dependence is placed on the *coal-tar* colours, the name of which is legion. Some of these, such as saffranin or gentian violet, are regressive stains; that is to say, the tissues are overstained uniformly, and the superfluous colouring matter washed out either by alcohol or by weak hydrochloric acid from the unselected parts. Others, such as methyl green, are progressive—that is, the colour is brought up to the pitch required and the reaction promptly stopped. The coal-tar stains can be used singly, or in combinations of two or three. Some of the best, unfortunately, are not permanent. A third group of stains is furnished by such reagents as silver nitrate, gold chloride, and the like (impregnation stains), which can be made not only to stain, but also to deposit a fine metallic precipitate on certain structures. In the case of small and delicate objects, the staining is done in the mass before any further preparation for sections, but with larger animals, or large pieces of resistant tissue, the stain is applied to the sections only. The processes so far mentioned are applicable to many branches of microscopic work.

When preparing tissues for sections, the first step is complete dehydration, generally effected by bringing the object into absolute alcohol. It is then transferred to one of a group of reagents, which are miscible with absolute alcohol, but would form an emulsion with water, and are solvents of the embedding medium. The embedding mass in most general use is paraffin wax, melting at a temperature of 54° to 60° C., according to the character of the object and the thickness of section required. The object is transferred from absolute alcohol to benzol, chloroform, cedar oil, or similar fluid to the melted paraffin; the fluid diffuses and evaporates, leaving the tissues to be completely permeated by the paraffin. This process can be greatly hastened by the use of a partial vacuum. When impregnation is complete the paraffin is cooled rapidly so as to assume a homogeneous non-crystalline condition, and the tissue thus comes to form part of a block of soft but tenacious material, which protects it from damage by air or damp, and can be readily cut by a razor. The block is then trimmed to the form of a triangle or rectangle, and fixed by a clamp or by local melting in the holder of the microtome.

Numerous forms of excellent microtome have been evolved since 1885. Some of these have distinct advantages over others, but with microtomes, as with other tools, the success of the results depends very largely on the manipulator, for every one works best with his accustomed instrument. In one type of microtome the razor is attached at one end only to a heavy block, sliding backwards and forwards in a horizontal V-groove; the paraffin-block is fed to this either up a vertical guide (Schanze, Reichert, &c.), or up an inclined plane (Thoma-Jung). In another type the razor is firmly clamped at both ends to diminish vibration, and the paraffin block advances to it at the end of a long lever on trunnion bearings (Cambridge rocker), or up a vertical guide (Minot types).

In the selection of a microtome, apart from its steadiness, rigidity, accuracy of workmanship, and so forth, it must be borne in mind that, in general, simplicity of working parts means longer life, and that an elaborate "automatic" mechanism, by which a single movement is translated into several in different directions, not only complicates the machine, but robs the operator of those alterations of pace, rigidity, pressure, &c., which are often necessitated by the varying texture in different parts of the object cut. For general use by less skillful students in a laboratory, price, simplicity, and rapidity of work recommend the rocking microtome of the Cambridge Scientific Instrument Company, but it tends to fail at large or hard objects. For the all-round work of an investigator, its simplicity and finish have made Jung's sliding microtome with the Naples improvements deservedly popular for many years; it can be fitted with special apparatus for cutting celloidin and frozen objects, and it can be relied upon to cut any tissue, however difficult; but it cannot be worked as rapidly as some others, nor produce long ribbons of large objects. For this latter purpose the Minot-Becker, Minot-Zimmermann, and Reinhold-Gilltay have been strongly recommended; these, however, are all of more complicated construction, with corresponding liability to uneven wear and damage; they are highly "automatic," leaving nothing but pace under control of the operator, and they are (particularly the last) expensive.

The sections, when cut by the microtome with the knife straight and the two sides of the rectangular paraffin block parallel to it, in most cases can be got off in a continuous ribbon, each sticking to its predecessor. This very desirable result generally can be insured by a coating of softer paraffin; but if the object be large, or brittle, or of varying texture, it is safer to cut the sections singly from a triangular block with an oblique knife. The sections or ribbon are often not quite flat, but rolled, creased, or compressed; they must be flattened before being attached to the slide. It is possible to carry out these two processes simultaneously by covering the carefully-cleaned slide with plenty of a very dilute solution of Mayer's glycerine and albumen, and laying the sections on the fluid and the slide on a hot-plate; as the water becomes warm the sections flatten out, and as it evaporates they settle down on the slide, and are held there by the albumen (many other methods are in use). The slide is then warmed to melt the paraffin, and plunged into benzol, or some similar fluid, which removes the paraffin; thence into absolute alcohol which dehydrates and coagulates the albumen. If the tissue has not been stained *en bloc*, the sections can now be stained on the slide. After staining they are finally dehydrated, rendered transparent by oil of cloves, and mounted in xylol-dammar or Canada balsam.

For ordinary work the paraffin method excels all others for rapidity, certainty, and cleanliness; but for large and hard objects, or crumbling tissues (such as ova with a large quantity of yolk), some manipulators prefer to embed in celloidin. By this method, after dehydration, the tissue is soaked in a mixture of absolute alcohol and ether; thence transferred either to increasingly strong solutions of celloidin in the same mixture or to a thin solution which is then boiled down till strong. The celloidin mass is then hardened, at first, if necessary, by drying, afterwards by a bath of chloroform or its vapour; it can then be cut in the microtome, either wet, or (if previously cleaned with cedar oil) dry like a paraffin block. The method is more tedious and more messy than the paraffin process; but amongst its advantages must be reckoned that little or no heat is required, and that the embedding mass is transparent, though it does not allow of such thin sections as paraffin.

The above accounts present an outline of the complex processes employed to-day, by which, on the one hand, sections 30 μ in thickness may be made through the entire human brain, and, on the other, organisms invisible to the naked eye may be cut into a long ribbon of consecutive sections 1 μ (one-thousandth of a millimetre) thick, every minutest fragment being retained in its proper place. The standard book on the subject is Bolles Lee's *Microtomist's Vade Mecum* (5th edition, 1900), but this should be used only to supplement direct practical training in a laboratory. (G. H. FO.)

Middelburg, ancient capital of the Dutch province of Zeeland, in the middle of the island of Walcheren, 4 miles north by east of Flushing, on the Rozendaal-Flushing railway. There are steam tramway and steamboat service to Flushing, and canals to Veere and Arnemuiden. Flourishing agricultural markets, flour and margarine factories, and trade in wood indicate partial revival of trade. In 1876 a large new dock was opened. The Zeeland society has increased its treasures with maps, plans, and drawings relating to Zeeland—*Zeelandia Illustrata*—and a complete collection of the fauna and flora of the province. Population (1882), 15,939; (1898), 18,635.

Middelburg (Transvaal). See TRANSVAAL.

Middleboro, a town of Plymouth county, Massachusetts, U.S.A., in the south-eastern part of the state, with an area of 73 square miles of rolling surface, interspersed with lakes and ponds. It contains several small villages, the largest of which bears the same name as the town. It is traversed by a branch of the New York, New Haven and Hartford railroad. Population (1890), 6065; (1900), 6885, of whom 920 were foreign-born.

Middlesbrough—often spelt MIDDLESBOROUGH, though never locally, the charter having been granted under the first name—a municipal, county (1888), and parliamentary borough, seaport, and market town of Yorkshire, England, on the Tees, 238 miles by rail north of London. Among modern erections are a music hall, co-operative stores, and extensions of the public baths. The high school was enlarged in 1892. The municipal buildings, costing about £130,000, were opened in 1889; thither has been removed the free library. There are 2 daily newspapers. In 1888 the artificial channel branching off from the river, by which the docks are reached, was deepened from 23 to 28 feet and widened from 80 to 200 feet, an extreme width of about 230 feet having been given at the mouth of the channel. The docks have also been enlarged to the extent of about 4 acres, and made accessible at all states of the tide for the largest vessels up to 8000 tons burden. There is nearly 1300 feet additional length of quay accommodation. Extensive tube works, wire mills, and oil works have become important. In 1891 there were 5460 persons employed in the iron and steel trade, and 1437 persons in the making of machinery. The imports of foreign and colonial merchandise in 1898 were valued at £1,081,693, against £773,485 in 1888. The exports of produce of the United Kingdom in 1898 were valued at £4,592,415, against £2,675,795 in 1888. The export of iron of all sorts in 1898 was valued at £2,887,067; of machinery and mill work, at £186,152; of cotton yarn, at £397,941; of cotton manufactures, at £382,940. In 1900 the total value of the exports was £6,318,282. In 1901 the output of pig-iron at the furnaces within the port amounted to 1,920,000 tons (annual average of 1896–1901, 2,190,250 tons); and in the same year 960,785 tons of pig-iron and 353,649 tons of manufactured iron and steel were exported. 99 vessels of 35,806 tons were registered in 1888, 67 of 39,594 tons in 1900. Vessels entering the port in 1888 numbered 3145 of 1,340,940 tons; clearances, 3619 of 1,380,279 tons. Entrances in 1900 numbered 3495 vessels of 1,843,165 tons; clearances, 3463 of 1,836,353 tons. Area of municipal and county borough, 2824 acres. Population (1881), 55,934; (1891), 75,532; (1901), 91,317.

Middlesex, an inland county in the south-east of England.

Area and Population.—The area of the ancient county as given in the census returns is 181,301 acres, or 283 square miles, with a population in 1881 of 2,920,486, in 1891 of 3,251,671, and in 1901 of 3,585,139, the number of persons per square mile being 12,068, and of acres to a person, ·05. The area of the administrative county is 149,046 acres, with a population of 792,225 in 1901. 31,484 acres of the ancient county were transferred under the provision of the Local Government Act, 1888, to the county of London, and 771 acres to Hertfordshire; and under the London Government Act, 1899, South Hornsey has been transferred to London. The area of the registration county is 178,754 acres, with a population in 1891 of 574,999, and in 1901 of 810,213. Within this area the increase of population between 1881 and 1891 was 50·93 per cent. The excess of births over deaths between 1881 and 1891 was 75,765.

The following table gives the number of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1899:—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				Males.	Females.
1880	2104	12,240	6,332	246	201
1890	3149	16,475	9,290	251	246
1899	5309	21,963	11,850	361	314

The following table shows the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years:—

	1870–79.	1880.	1880–89.	1890.	1889–98.	1899.
Marriage-rate	10·4	11·3	11·1	11·3	11·7	13·2
Birth-rate .	32·1	32·9	33·0	29·5	28·4	27·3
Death-rate .	18·8	17·0	16·5	16·6	14·7	14·7
Percentage of illegitimate births .	3·6	3·7	3·5	3·0	3·1	3·1

Both the birth-rate and death-rate are below the average of all England. The number of Scots in the county in 1891 was 6066; of Irish, 5834; and of foreigners, 4409.

Administration.—The ancient county is divided into seven parliamentary divisions, and contains no parliamentary boroughs, excepting those now included in the county of London. The administrative county includes the following urban sanitary districts:—Acton (37,744), Brentford (15,171), Chiswick (29,809), Ealing (33,040), Edmonton (46,899), Enfield (42,738), Finchley (23,591), Friern Barnet (10,101), Greenford (819), Hampton (6812), Hampton Wick (2606), Hanwell (10,437), Harrow (10,220), Hendon (22,450), Heston and Isleworth (30,838), Hornsey (72,056), Kingsbury (757), Southall Norwood (13,200), Southgate (14,993), Staines (6686), Sunbury-on-Thames (4544), Teddington (14,029), Tottenham (102,519), Twickenham (20,991), Uxbridge (8585), Wealdstone (5852), Wembley (4568), Willesden (114,815), Wood Green (34,183). With the exception of the City of London, which has a separate police force, the county of Middlesex is wholly within the Metropolitan Police District and jurisdiction of the Central Criminal Court. The administrative county has one court of quarter sessions, and is divided into eight petty sessional divisions. The ancient county, which is almost entirely in the diocese of London and province of Canterbury, contains 122 ecclesiastical parishes and parts of eleven others, exclusive of those now in the county of London. Part of Stanwell parish is in the diocese of Oxford.

Education.—The number of elementary schools in the county on 31st August 1899 was 245, of which 84 were board and 161 were voluntary schools. The average attendance at board schools was 435,298, and at voluntary schools 177,124. The total school board receipts for the year ended 29th September 1898 were over £287,985. The income under the Agricultural Rates Act was over £1813. At Twickenham there is a training college for school-mistresses, and one at Spring Grove for masters. At Whitton, Kneller Hall is a college for military musicians. In 1899 there were twelve reformatory and industrial schools in the county.

Agriculture.—Nearly two-thirds of the area of the county is under cultivation, and of this about one-fourteenth is in permanent pasture. In 1899, 4316 acres were devoted to small-fruit cultivation, and 3656 were under wood. There is no heather land in the county. The following table gives the main divisions of the cultivated area at intervals from 1880:—

Year.	Total Area under Cultivation.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	117,087	17,169	14,161	3236	81,470	1051
1890	112,847	12,811	12,755	2806	80,873	771
1899	102,198	9,469	10,875	2517	73,940	1081

The following table gives particulars regarding the principal live stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or in Calf.	Sheep.	Pigs.
1880	6183	25,859	16,790	32,267	10,962
1890	6240	20,878	14,100	21,358	11,667
1899	6279	16,742	9,096	18,717	13,271

Industries and Trade.—According to the annual report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 23,922, as compared with 20,744 in 1896. Textile factories only employed 27. In non-textile factories 20,497 persons were employed, as compared with 17,875 in 1896. Of this number 6143 were employed in the manufacture of machines, appliances, conveyances, or tools. Of the 3398 persons employed in workshops, 1894 were employed in the clothing industries. The chief industries besides these are brick- and tile-making, malting, distilling, and soap-making. The gunpowder mills known as the Houston Mills are extensive establishments.

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Middleton, a municipal borough (1886) and market town in the Middleton parliamentary division of Lancashire, England, 5 miles north of Manchester on the Lancashire and Yorkshire railway. There are chemical works and coal mines, but the staple industry is in cotton and silk. Population (1881), 19,750; (1901), 25,178.

Middletown, a city of Connecticut, U.S.A., capital of Middlesex county, on the west bank of the Connecticut river, 30 miles from its mouth, and on the New York, New Haven and Hartford railroad. It is well laid out, with broad, shaded streets, and has a good water-supply brought by gravity. Wesleyan University, which is situated here, had, in 1899, 35 professors and instructors, and was attended by 331 students, 75 of whom were women. Its property was valued at $1,983,133, and its income was $108,669. Population (1890), 9013; (1900), 9589, of whom 2316 were foreign-born and 127 were negroes.

Middletown, a city of Orange county, New York, U.S.A., on the Walkill river, in the south-eastern part of the state, at an altitude of 564 feet. It is on three railways, the Erie, the New York, Ontario and Western, and the New York, Susquehanna and Western. Population (1890), 11,977; (1900), 14,522, of whom 1700 were foreign-born and 480 were negroes.

Middletown, a city of Butler county, Ohio, U.S.A., on the Miami river, on the Miami and Erie Canal, and on the Cincinnati, Hamilton and Dayton, the Cincinnati Northern, the Cleveland, Cincinnati, Chicago and St Louis, and the Middletown and Cincinnati railways, in the south-western part of the state, at an altitude of 667 feet. It has varied manufactures, among which the making of paper is prominent. Population (1890), 7681; (1900), 9215, of whom 769 were foreign-born and 314 were negroes.

Middletown, a borough of Dauphin county, Pennsylvania, U.S.A., on the east bank of the Susquehanna river, 9 miles below Harrisburg, and on the Pennsylvania and the Philadelphia and Reading railways, towards the south-eastern part of the state, at an altitude of 546 feet. Its manufactures are largely of iron and steel. Population (1890), 5080; (1900), 5608, of whom 340 were foreign-born and 289 were negroes.

Midhat Pasha (1822–1884), Turkish statesman, the son of a civil judge, was born at Constantinople in 1822. His father, a declared partisan of reform, trained him for an administrative career, and at the age of twenty-two he was attached as secretary to Faïk Effendi, whom he accompanied in Syria for three years. On his return to Constantinople Midhat was appointed Chief Director of Confidential Reports, and after a new financial mission in Syria was made second secretary of the Grand Council. His enemies, however, succeeded in ousting him from this post, and caused him to be entrusted with the apparently impossible task of settling the revolt and brigandage rampant in Rumelia. His measures were drastic and their success was startling, and the Government made him an official of the first rank and restored him to his place in the Grand Council. In similar vigorous fashion he restored order in Bulgaria in 1857. In 1860 he was made vizier and pasha, and entrusted with the government of Nisch, where his reforms were so beneficial that the Sultan charged him, in conjunction with Fuad Pasha and Ali Pasha, to prepare the scheme for adapting them to the empire which was afterwards known as the law of the viláyets. After further administrative work in his province, he was ordered to organize the Council of State in 1866, and was then made governor of Baghdad, where his success was as decisive as at Nisch, but attended with much greater difficulties. In 1871 the anti-reform influence of the Grand Vizier, Mahmoud Nedim, seemed to Midhat a danger to the country, and in a personal interview he boldly stated his views to the Sultan, who was so struck with their force and entire disinterestedness that he appointed Midhat Grand Vizier in place of Mahmoud. Too independent, however, for the Court, Midhat remained in power only three months, and after a short governorship of Salonica he lived apart from affairs at Constantinople until 1875.

From this time forward, however, Midhat Pasha's career resolved itself into a series of strange and almost romantic adventures. While sympathizing with the ideas and aims of the "Young Turkey" party, he was anxious to restrain its impatience, but the Sultan's obduracy led to a coalition between the Grand Vizier, the War Minister, and Midhat Pasha, which deposed him in May 1876, and he was murdered in the following month. His nephew Murad V. was in turn deposed in the following August and replaced by his brother, Abdul Hamid II. Midhat Pasha now became Grand Vizier, reforms were freely promised, and the Ottoman Parliament was inaugurated with a great flourish. In the following February, however, Midhat was dismissed and banished for supposed complicity in the murder of Abdul Aziz. He then visited various European capitals, and remained for some time in London, where he carefully studied the procedure in the House of Commons. Again recalled in 1878, he was appointed governor of Syria, and in August 1888 exchanged offices with the governor of Smyrna. But in the following May the Sultan again ordered him to be arrested, and although he effected his escape and appealed to the Powers, he shortly afterwards saw fit to surrender, claiming a fair hearing. The trial accordingly took place in June, when Midhat and the others were sentenced to death. It was, however, generally regarded as a mockery, and on the intercession of the British Government the sentence was commuted to banishment. The remaining three years of his life were consequently spent in exile at Taif in Arabia, where he died, probably by violence, 8th May 1884. To great ability, wide sympathies, and undoubted patriotism he added absolute honesty, that rare quality in a vizier, for he left office as poor as when he entered it. (G. F. B.)

Midlothian. See Edinburghshire.

Midnapore, a town and district of British India, in the Burdwan division of Bengal. The town is 68 miles west of Calcutta; it has a railway station. Population (1881), 31,491; (1891), 32,264. It is an important centre of trade, being the terminus of a navigable canal to Calcutta, and also the junction for the Sini branch of the Bengal–Nagpur railway. There are manufactures of brass and copper wire. It has an American mission, a municipal college, with 31 students in 1896–97, a collegiate high school, nine printing-presses, issuing one vernacular journal, and a public library, founded in 1852.

The district of Midnapore has an area of 5186 square miles; population (1881), 2,515,565; (1891), 2,631,516; and (1901), 2,792,953, showing an increase of 5 per cent. between 1881 and 1891, and of 6·2 between 1891 and 1901; average density, 538 persons per square mile. Classified according to religion, Hindus in 1891 numbered 2,321,424; Mahommedans, 171,412; Christians, 1545, of whom 73 were Europeans; aborigines, 137,135. The land revenue and rates in 1897–98 were Rs.25,96,556; number of police, 861; number of boys at school (1896–97), 115,516, being 58·8 per cent. of the male population of school-going age, compared with 28 per cent. for the province generally; registered death-rate (1897), 28·3 per thousand. Both silk and indigo are decaying industries. There are 31 indigo factories, with an out-turn of 700 maunds, valued at Rs.1,00,000. The navigable canal irrigates 70,000 acres. The district is traversed by the Bengal–Nagpur railway towards Orissa, with a branch to Chota Nagpur. (J. S. CO.)

Mieres, an industrial and mining centre in the province of Oviedo, Spain, 12 miles south of Oviedo by rail, on the river Candal or Lena. It has a mining school, a sanctuary of the Virgin del Carmen, a fine parish church, a town hall, and the palaces of three distinguished families. There is an active trade in agricultural products and in ores. There are also important iron, coal, and copper mines in the neighbourhood; and 3 miles to the north some thriving works which employ 2000 hands and turn out 40,000 tons of iron annually. The population in 1897 was 17,144.

Migration.—Under this title will be considered movements of men with intention of changing their residence or domicile. Such migration may be either external—that is, from one country to another, including emigration from mother country to colony; or it may be internal—that is, within the limits of a single country. Under external migration is comprised emigration and immigration, denoting simply direction from and to. The emigrants are at the same time the immigrants; that is, the material of the movement is the same, but the effect upon the country giving up and the country receiving the migrant requires separate treatment. Hence it is proper to separate emigration from immigration. Temporary migration, or travel for purposes of business, enterprise, or pleasure, will be considered only incidentally, and because in some cases it is difficult to distinguish between such movements and permanent migration.

Migration in general may be described as a natural function of social development. It has taken place at all times and in the greatest variety of circumstances. It has been tribal, national, class, and individual. Its causes have been political, economic, religious, or mere love of adventure. Its causes and results are fundamental for the study of ethnology (formation and mixture of races), of political and social history (formation of states and survival of institutions), and of political economy (mobility of labour and utilization of productive forces). Under the form of conquest it makes the grand epochs in history (*e.g.*, the fall of the Roman Empire); under the form of colonization it has transformed the world (*e.g.*, the settlement of America); under free initiative it is the most powerful factor in social adjustment (*e.g.*, the growth of urban population). It must suffice here to indicate the character of the principal movements in the past, and then describe certain aspects of modern migration. The early movements may be grouped as follows:—(*a*) Prehistoric migrations. Among savage and nomadic nations the whole tribe often moves into new territory, either occupying it for the first time or exterminating or driving out the indigenous inhabitants. We have only vague knowledge of these early movements, laboriously gleaned from archæology, anthropology, and philology. The cause has been commonly said to be the pressure of population on the food-supply. A more probable explanation is the love of booty and the desire of the stronger to take possession of the lands of the weaker. (*b*) Greek and Roman colonization. Both of these ancient civilizations extended their influence through migration of individual families and the planting of colonies. The motive seems to have been primarily commercial—that is, the love of gain. It may have been partly a sort of "swarming" process, caused by pressure of population at home. In some cases it had a political motive, as the planting of military colonies or providing new homes for the proletariat. The consequences were of course momentous. (*c*) The German Conquest. Beginning about the 5th century, the Roman Empire was overthrown by German tribes from the north of the river Danube and east of the river Rhine. This *Völkerwanderung*, as it is called by German historians, again transformed the face of Europe, resulting in the establishment of independent kingdoms and a great mixture of races and institutions. It was coincident with the building-out of the feudal system. The conquered in many cases could be left as serfs and tillers of the soil, while the conquerors seized the higher positions of administration and power. (*d*) The later Middle Ages saw many minor migratory movements, such as those accompanying the Crusades, the pushing of German colonization among the Slavs, and the introduction of Flemish weavers into England. The religious reformation caused a considerable amount of expatriation, culminating in the expulsion of the Huguenots from France. (*e*) The Period of Discovery and Colonization. This opened up a new era for migration. The first expeditions were for adventure and booty, especially the discovery of gold and silver. Then came the establishment of commercial posts or factories for the purposes of trade. Finally came colonization proper—that is, the settlement of new countries by Europeans intending to remain there permanently, but still retaining their connexion with the mother country. This meant the opening up of the world to commerce and the extension of European civilization to vast areas formerly peopled by savages or half-civilized peoples. It meant a great outlet for the spirit of enterprise and adventure, relief from over-population, an enormous increase in wealth and power, and a struggle for supremacy among the nations of Europe. Colonization and colonial policy excited immense attention in Europe; and this extended even into the 19th century (*e.g.*, Wakefield's plans for colonization, and the various colonization societies of modern times). The colonial policy proper was broken down by the revolt of the North American colonies from Great Britain, and later of Mexico and Central and South America from Spain. (*f*) The movement of population, however, has continued under the form of emigration. This movement is characterized firstly by its magnitude; secondly, by the fact that the emigrant changes his political allegiance, for by far the greater part of modern emigration is to independent countries, and even where it is to colonies, the colonies are largely self-governing and self-regarding; and thirdly, it is a movement of individuals seeking their own good, without State direction or aid. This is 19th-century emigration, differing from all preceding forms and having an importance of its own.

Statistics of Emigration.—The direction of the modern movement is from Europe to America, Australia, and South Africa, as shown in the following table:—

Emigration from Certain States of Europe, 1890–99.[1]

Year.	Italy.	France.	Belgium.	Holland.	Spain.[2]	Portugal.	Austria-Hungary.	Switzerland.	Germany.
1890	115,595	20,560	2976	3526	37,025	28,945	74,002	6693	97,103
1891	189,746	6,217	3456	4075	37,721	33,234	81,407	6521	120,089
1892	116,642	5,528	5174	6290	30,190	20,772	74,947	6689	116,339
1893	142,269	5,586	3881	4820	38,707	30,093	65,554	5229	87,677
1894	114,566	..	1267	1146	34,102	26,656	25,536	2863	40,964
1895	187,908		1318	1314	36,220	44,420	63,552	3107	37,498
1896	197,554	.	1429	1387	45,317	27,625	66,547	2441	32,152
1897	174,545	..	760	792	39,366	21,369	35,634	1778	23,249
1898	139,188		928	851	..	23,280	53,947	1694	20,966
1899	145,440	..	..	1347	..	..	..	1701	22,114

Year.	Sweden.	Norway.	Russia.[3]	Denmark.	Great Britain and Ireland.			
					England and Wales.	Scotland.	Ireland.	Total United Kingdom.
1890	30,128	10,991	85,548	10,298	139,979	20,653	57,484	218,116
1891	38,318	13,341	109,415	10,882	137,881	22,190	58,446	218,517
1892	41,275	17,049	74,681	10,442	133,815	23,325	52,902	210,042
1893	37,504	18,778	40,545	9,150	134,045	22,637	52,132	208,814
1894	9,678	5,642	17,792	4,105	99,590	14,432	42,008	156,030
1895	15,104	6,207	36,725	3,607	112,588	18,294	54,349	185,181
1896	12,919	6,679	32,127	2,876	102,837	16,866	42,222	161,925
1897	8,926	4,669	18,107	2,260	94,658	16,124	35,678	146,460
1898	7,321	4,859	27,853	2,340	90,679	15,570	34,395	140,644
1899	..	..	..	2,799	87,400	16,072	42,890	146,362

Since 1820 over twenty million persons have emigrated from Europe to countries beyond the sea. The greater part of this emigration has been to the United States of North America. The history of emigration is well shown in the following table of emigration from Great Britain and Ireland. Down to 1853 the figures include all emigrants from British ports; after 1853 emigrants of British and Irish origin only.

Emigration from Great Britain and Ireland, 1815–99.

All Emigrants.					
	To British North America.	To United States.	To Australia.	To other Places.	Total.
1815–20 (5 years) . .	70,438	50,359	..	2,731	123,528
1821–30 10 ,, .	139,269	99,801	9,036	1,805	249,911
1831–40 ,, ,,	322,485	308,247	67,882	4,536	703,150
1841–50 ,, ,, .	429,044	1,094,556	127,124	34,168	1,684,892
1851–52 2 ,, .	75,478	511,618	109,413	8,221	704,730
1815–52 (37 years) . .	1,036,714	2,064,581	313,455	51,461	3,466,211
Emigrants of British and Irish Origin.					
1853–60 (8 years) .	123,408	805,596	365,307	18,372	1,312,683
1861–70 10 ,, . .	130,310	1,132,626	267,358	41,535	1,571,829
1871–80 ,, ,, .	177,976	1,087,872	303,367	110,204	1,678,919
1881–90 ,, ,, .	301,922	1,713,953	372,744	169,916[4]	2,558,535
1891–99 9 ,, . .	168,533	1,042,707	112,759	249,566[5]	1,573,565
1853–99 (47 years) . .	902,149	5,782,254	1,421,535	589,593	8,695,531

The general direction of emigration from Europe is shown in the following table:—

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[1] Compiled by the Italian Bureau of Statistics, with additions from the *Statesman's Year-Book* for 1901. The figures relate only to the emigrants of each nationality emigrating from their own country to countries outside of Europe.

[2] Exclusive of emigrants to Spanish colonies.

[3] Russian emigrants from German ports.

[4] Of these, 77,409 went to the Cape of Good Hope and Natal.

[5] Of these, 145,380 went to the Cape of Good Hope and Natal.

Emigration from Various Countries of Europe.

Country.	Country of Destination.							Total.
	United States.	British North America.	Brazil.	Argentine.	Australasia.	Africa.	All other.	
Great Britain and Ireland, 1897	85,324	15,571	...	...	12,061	21,109	12,395	146,460
Norway, 1895	6,584	22	...	...	10	...	63	6,679
Sweden, 1894	9,529	...	13	...	48	...	88	9,678
Denmark, 1896	2,479	81	...	...	47	...	269	2,876
Germany, 1896	29,007	634	1,001	...	174	1,346	1,662	33,824
Holland, 1896	12,611	...	...	...	51	...	125	12,787
Belgium, 1893	2,431	1,326	...	...	10	1	113	3,881
France, 1892	2,798		192	2,106	...	93	339	5,528
Portugal, 1895	...	...	...	...	...	1,239	43,180	44,419
Spain, 1895	13	...	10,355	7,732	4	15,727	...	33,831
Italy, 1895	37,851	783	98,090	41,029	154	3,432	6,569	187,908
Switzerland, 1896	2,789		...	499	9	28	5	3,330
Austria-Hungary, 1896	45,754		12,815	1,385	...	...	6,502	66,456

Statistics of Immigration.—The statistics of the United States are the most important and the most complete. The statistics since 1820 are shown in the following table:—

Immigration into the United States, 1820–1900.

Decade ending 30th June	Aggregate Arrivals.	Annual Average.
1830	143,439	14,343
1840	599,125	59,912
1850	1,713,251	171,325
1860	2,598,214	259,821
1870	2,314,824	231,482
1880	2,812,191	281,219
1890	5,246,613	524,661
1900	3,844,422	384,442
Total	19,272,079	

Prior to 1820 there was no official record of immigration, but it is estimated that the total number of immigrants from the close of the Revolutionary War was 250,000. During the decade from 1820 to 1830 the movement was very moderate. From 1830 to 1840 it steadily increased, but never reached 100,000 per annum. In 1846 came the Irish potato famine, and an enormous emigration began, followed by a very large German emigration from similar causes. The Civil War in the United States interrupted the movement, but it was speedily resumed on an enlarged scale owing especially to the improved means of ocean transportation. It culminated in the decade 1880–90, and declined after the commercial crisis of 1893. Later there were signs of another increase (448,572 in 1900).

The relative movement of nationalities is best presented by the statistics of the United States. The nationality (country of origin of immigrants coming to the United States, 1871–95) is shown in the following table:—

Nationality of Immigrants to the United States.

	25 Years 1871–95.	Per cent. of Total Immigration.
Anglo-Saxons, Celts, and Welshmen—		
England and Wales	1,334,817	12·9
Scotland	286,807	2·8
Total	1,621,624	15·7
Irish—Ireland	1,334,635	12·9
Teutons—		
Austria	374,872	3·6
Germany	2,607,562	25·3
Netherlands	96,035	·9
Total	3,078,469	29·8
Latins—		
Belgium	42,447	·4
France	148,683	1·4
Italy	655,104	6·3
Spain	14,292	·2
Portugal	17,108	·2
Total	877,634	8·5
Scandinavians—		
Denmark	159,759	1·5
Norway	331,258	3·2
Sweden	660,193	6·4
Total	1,151,210	11·1
Czechs, Magyars, Slavs—		
Bohemia	77,247	·7
Hungary	256,347	2·5
Poland	141,908	1·4
Rumania	10,377	·1
Russia	500,797	4·8
Total	986,676	9·5
Swiss—Switzerland	135,736	1.3
Greeks—Greece	7,325	·1
Turks—Turkey	3,411	
Europe, not specified	294	
Total Europe	9,197,014	88·9
North America	776,071	7·5
All other countries	366,454	3·6
Grand Total	10,339,539	100·0

A very important transformation has taken place in the proportionate number coming from different countries during the last half of the 19th century. At first the Irish and Germans were most prominent. Of later years the Italians, Czechs, Hungarians, and Russians were numerously represented.

The following table shows the relative number of different nationalities represented in the immigration to the United States:—

Country.	1861–70.	1871–80.	1881–90.	1891–95.
	Per cent.	Per cent.	Per cent.	Per cent.
Great Britain	24·5	16·4	12·5	9·3
Ireland	18·8	15·5	12·5	19·6
Germany	34·0	25·5	27·7	19·1
Austria-Hungary	·3	2·6	6·7	12·4
Norway and Sweden	4·7	7·5	10·8	9·3
Russia and Poland	·2	1·9	5·1	10·4
Italy	·5	2·0	5·9	12·8

Sex and Age.—Of all the immigrants (1871–95), 61·25 per cent. were males and 38·75 per cent. were females. This proportion differed somewhat among different nationalities, as shown in the following table:—

Proportion of Females among Immigrants, 1871–95.

	Per cent.		Per cent.
England and Wales	39·0	Denmark	38·0
Scotland	39·2	Norway	38·3
Ireland	49·5	Sweden	39·5
Austria-Hungary	35·4	Bohemia	47·3
Germany	42·4	Hungary	27·7
Netherlands	39·6	Poland	33.5
Belgium	34·9	Rumania	45·6
France	36·6	Russia	37·8
Italy	21·9	Switzerland	36·3
Portugal	23·4	British N. America	40·1

The emigrants were in the most vigorous period of life, few children and few old people, as shown in the following table:—

Ages of Immigrants to the United States, 1881–90.

Country of Origin.	Under 15.		From 15 to 40.		Over 40 years.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Germany	386,934	26·6	904,002	62·2	162,034	11·2
Ireland .	92,308	14·1	515,089	78·6	48,085	7·3
England .	151,815	23·5	420,308	65·2	73,062	11·3
Sweden and Norway	104,254	18·3	414,609	73·0	49,499	8·7
Italy . .	47,603	15·3	212,475	69·2	47,771	15·5
Russia (including Poland).	65,427	24·7	174,754	65·9	24,907	9·4
Austria . .	50,027	22·1	149,909	66·3	26,109	11·6
Scotland .	36,192	24·2	97,819	65·2	15,858	10·6
Hungary . .	18,785	14·7	95,635	74·9	13,261	10·4

Occupation.—The immigrants are for the most part unskilled labourers. The statistics for the United States show the following figures for the ten years 1881–90:—

Occupation of Immigrants to the United States.

	Males.	Females.	Total.
Professional . .	25,257	1,749	27,006
Skilled . . .	514,552	25,859	540,411
Miscellaneous .	1,833,325	245,810	2,079,135
Not stated . .	73,327	42,830	116,157
Without occupation	759,450	1,724,454	2,483,904
Total . .	3,205,911	2,040,702	5,246,613

Those "without occupation" are mostly women and children. The "miscellaneous" are day labourers. It is probable that about 20 per cent. of the adult males are "skilled."

Immigration to other Countries.—In no other country is immigration so important as in the United States. The statistics are very imperfect. The main figures have already been given in the table of emigration. Australia has an annual immigration of about 250,000, mostly of British origin. This is offset by a very heavy emigration, which sometimes exceeds the immigration in certain of the states. The immigration to Canada for the year 1891 was put down as 82,165, but a portion of this consists of immigrants passing through to the United States. Brazil has had a large immigration (in 1895 equal to 169,524, but in 1898 only 53,822). The Argentine is credited with an immigration in 1899 of 111,083, and Uruguay with an immigration in 1895 of 9185. In all the South American immigration the countries principally represented are those of southern Europe, especially Italy. The majority of the immigrants are adult males and farm labourers.

Balance of Emigration and Immigration.—Even in the case of emigration from Europe to countries beyond the seas there is some return movement. Emigrants who have been successful in business return in order to end their days in the old country. Those who have not succeeded return in order to be cared for by friends and relatives, or simply from home-sickness. Thus, for Great Britain and Ireland, while the emigration of persons of British and Irish origin was, in 1899, 146,362, the immigration of persons of the same category was 100,246, leaving a net emigration of only 46,116. In the United States statistics we cannot distinguish in the outgoing passenger movement emigrants from other persons. But if for a period of ten years we take the total inward passenger movement and subtract from it the total outward passenger movement, we ought to have the net immigration. By this method we arrive at the conclusion that while the gross immigration during the ten years 1881–90 was 5,246,613, the net immigration was only 4,417,337, showing an outward movement of 829,276, or about 15·8 per cent. of the total number of immigrants.

Temporary Emigration.—In many European countries there is not only emigration beyond seas, but a very considerable movement to neighbouring countries in search of work, and generally with the intention of returning. Thus, in Italy the "permanent" emigration (*i.e.*, to countries beyond seas) numbered, in 1894, 101,206; the "temporary" emigration to neighbouring countries amounted to 124,139. This temporary emigration is strongest in the spring, and consists principally of adult males (agriculturists, farm and day labourers, bricklayers and masons) in search of work. It resembles somewhat the movement of Irish labourers into Great Britain at harvest time.

Effects of Emigration.—There are two views with regard to emigration: one unfavourable, viz., that it is a drain on population, reducing its economic strength and disturbing social and political relations; the second looking upon it as a relief from over-population and a congested labour market. As a matter of fact, emigration has not succeeded in diminishing the population of Europe, which, on the contrary, doubled during the 19th century. The one great exception is Ireland, where population has been reduced from 8,175,124 in 1841 to 4,531,051 in 1899. From 1851 to 1899 the total emigration from Ireland was 3,796,131, or 68·6 per cent. of the average population. Emigration, by carrying off the young men and women, has also reduced the Irish marriage- and birth-rates, which are the lowest in Europe. But hitherto the countries of strongest emigration (England, Germany, &c.) have shown practically undiminished birth- and marriage-rates and a steady growth in population.

The intensity of emigration is measured not by the absolute number of emigrants, but by the number of emigrants to the total population. Its effect is shown by comparing the number of emigrants with the excess of births over deaths per 1000 of the population. This is shown in the following table (1892):—

	Excess of Births over Deaths per 1000 Inhabitants.	Emigrants per 1000 Inhabitants.
Great Britain and Ireland .	10·54	5·51
England and Wales . . .	11·50	4·56
Scotland	12·17	5·74
Ireland	3·04	11·39
Germany	11·6	2·23
Switzerland	8·7	2·64
Sweden	9·1	6·87
Norway	11·9	8·53
Denmark	10·1	4·76
Italy	10·1	3·53
France	0·5	0·14

It will be observed that, with the exception of Ireland, wherever there is a heavy emigration, there is at the same time a considerable excess of births over deaths, *i.e.*, natural increase more than makes up for the loss by emigration. Even taking Great Britain and Ireland together, the loss by emigration per annum has not been very large, as is shown by the following table:—

Annual Emigration per 1000 of the Average Population of Great Britain and Ireland.

1853–55 . . .	8·4	1881–90	7·1
1856–60 . . .	4·3	1891–95	5·1
1861–70 . .	5·2	1896 . . .	4·1
1871–80 . . .	5·1	1897	3·7

Even in particular districts where emigration is heavy, the loss is made up by births. For instance, in 1891 the emigration from the provinces of West Prussia and Posen was extraordinarily heavy—10·9 and 10·4 per mille respectively—but the excess of births over deaths was 19·6 per mille. Emigration may give temporary relief to congested districts, but it is not in itself a remedy for so-called over-population.

It is difficult to analyse closely the economic effect of emigration, because so much depends upon the character of the emigrants and the condition of the labour market. The following considerations have been urged at different times:—Although emigration does not diminish population, yet, as the emigrants are in the most productive period of life (15 to 45), the country of emigration loses adults and replaces them with children. It thereby loses the cost of rearing that number of people to adult age, and is left with a disproportionate number of children and old people. The age distribution of the population of Ireland lends some support to this view. In the same vein it is urged that voluntary emigration takes away the cream of the working-classes. It is the man of energy, of some means, of ambition, who takes the chances of success in the new country, leaving the poor, the indolent, the weak, and crippled at home. It is maintained that such emigration institutes a process of selection which is unfavourable to the home country.

On the other side, it is said that the men who are doing well at home are the ones least likely to emigrate, because they have least to gain. Modern means of transportation have made the voyage so cheap that almost any one is able to go. It is therefore the restless, the unsuccessful, or at least those not fitted for the strenuous competition of the older countries, who are tempted to go. Emigration affords a natural outlet for the superfluous labour force of a country. The supply of labour is somewhat reduced, but wages are kept up for those who remain. Those who go find means of bettering their own condition beyond the seas, where they become producers of food and raw material for the home country, and at the same time customers for her manufactured products. Emigration is therefore an economic gain, both directly and indirectly. It is evident from these arguments that no general answer can be given to the question. In some cases it may be an evil; in most, when conducted under normal conditions, it would seem to offer little danger.

The same remark would hold true in regard to the social and political effects of emigration. In some cases, by taking away the strong, self-reliant, and energetic, it may result in the deterioration of the home population. In other cases it allows restless spirits who have failed at home to try again elsewhere. Often in cases of political revolution the members of the defeated party have sought refuge elsewhere, as after the revolutionary movements of 1848. In case of conquest the conquered nationality takes to emigration on an extensive scale, as after the absorption of Alsace-Lorraine by Germany in 1871. The movement may be aided either by the State or by private associations. Of such character have been the *State-aided* emigration from Ireland, and the *assisted* emigration of paupers, criminals, and other persons, in the effort to relieve a congested population, or simply from the desire to get rid of undesirable members of the community. Such efforts fail if the new countries are unwilling to admit these persons. Finally, we have the expulsion of the Jews from Russia as an example of the effort of a community to get rid of an element which has made itself obnoxious to the local sentiment.

Effects of Immigration.—The effects of emigration are negative in character; those of immigration are positive. (*a*) On population: Immigration, of course, is a direct addition to the population of new countries, and greatly accelerates the growth by natural increase, especially as the immigrants are in the most productive ages of manhood and womanhood. In the United States, for instance, out of a population of 76,303,387 (in 1900), there were 26,147,407 persons who were either foreign-born or who had one or both parents foreign-born. This does not mean that the population would have been twenty-six millions less if it had not been for immigration; for the rate of natural increase among the native-born might have maintained itself. Nevertheless, immigration has probably stimulated the growth of population. (*b*) Economic effects: The economic gain of immigration to new countries is evident. It adds directly to their available labour force, that is, to the number of adults engaged in the work of producing wealth.

According to the United States census of 1890, out of 22,735,661 persons engaged in gainful occupations, 5,104,757, or 22·5 per cent., were of foreign birth. If we add to these the native whites of foreign parentage (3,542,408) we have 8,647,165 persons of foreign extraction, or 38 per cent. of the total labour force. The foreign whites alone constituted 14·5 per cent. of the total number of persons engaged in agriculture, fisheries, and mining; 12·1 per cent. of those in professional services; 31·5 per cent. in domestic and personal services; 21·4 per cent. in trade and transportation; and 31·4 per cent. of those engaged in manufacturing and mechanical industries. In addition to these, the native whites of foreign parentage constituted, in agriculture, &c., 8·8 per cent.; in professional service, 16·3 per cent.; in domestic service, 14·2 per cent.; in trade and transportation, 22·1 per cent.; in manufacturing, 24·4 per cent. of all those engaged in those occupations. The labour force of the United States is thus made up very largely of immigrants and the children of immigrants.

Attempts have sometimes been made to put a money value on the economic gain by immigration. The amount of money brought by the immigrants is not large, and is probably more than offset by the money sent back by immigrants for the support of families and friends at home or to aid them in following. The valuable element is the able-bodied immigrant himself as a factor of production. It is said, for instance, that an adult slave used to be valued at from $800 to $1000, so that every adult immigrant may be looked upon as worth that sum to the country. Or, it has been said that an adult immigrant represents what it would cost to bring up a child from infancy to the age say of 15. This has been estimated by Ernst Engel as amounting to $550 for a German child. The most scientific procedure, however, is to calculate the probable earnings of the immigrant during the rest of his lifetime, and deduct therefrom his expenses of living. The remainder represents his net earnings which he will contribute to the well-being of the new country. Farr reckoned this to be, in the case of unskilled English emigrants, about £175. Multiplying the total number of adult immigrants by any one of these figures, we get the annual value of immigration. Such attempts to put a precise money value on immigration are futile. They neglect the question of quality and of opportunity. The immigrant is worth what it has cost to bring him up only if he is able-bodied, honest, and willing to work. If he is diseased, crippled, dishonest, or indolent, he may be a direct loss to the community instead of a gain. So, too, the immigrant is worth his future net earnings to the community only if there is a demand for his labour.

Social and Political Effects of Immigration.—The influx of millions of persons of different nationality, often of a foreign language and generally of the lower classes, would seem to be a danger to the homogeneity of a community. The United States, for instance, has felt some inconvenience from the constant addition of foreigners to its electorate and its population. The foreign-born are more numerously represented among the criminal, defective, and dependent classes than their numerical strength would justify. They also tend to segregate more or less, especially in large cities. Nevertheless, the process of assimilation goes on with great rapidity. Intermarriage with the native-born occurs to a considerable extent. The influence of the physical environment leads to the adoption of the same mode of life. The most powerful influences, however, seem to be social. These are common school education and the adoption of one language (English); participation in political life, which is granted to all adult males after five years' residence; and the general influence of social standards embodied in laws, institutions, and customs already established. Doubtless immigration of the last fifty years of the 19th century has had a modifying effect on American life; but on the whole the power of a modern civilized community working through individual freedom to assimilate elements not differing from it too radically has been displayed to a remarkable degree.

Restriction of Immigration.—New countries have sought to escape certain evils of indiscriminate immigration. These evils were as follows:—(*a*) The immigration of criminals, paupers, persons diseased in mind or body, and persons unable to support themselves. By the Acts of 1882 and 1893 such persons were refused admission to the United States, and, when rejected, the steamship companies that brought them were compelled to take them back. The number rejected in 1899 was 3057. No law of international comity is violated by the refusal to receive these unfortunates. They should be taken care of at home. (*b*) Immigration sometimes increases the competition in the labour market, and thus lowers wages. One case is particularly aggravating, viz., when employers import foreign labourers in order to take the place of their men who are on strike. In 1885 the United States passed what is called the Contract Labour Law, forbidding the landing of any person who is under contract to perform labour in the United States. It is very difficult to discover such cases, and in 1899 only 741 persons were rejected on that account. (*c*) The immigration of men of alien race who refuse to assimilate with the natives is said sometimes to be a danger to the country. This at least is the excuse for the entire exclusion of Chinese labourers from the United States since 1882 (provisions made more severe in 1888 and 1892).

Internal Migration.—In modern times there is constant movement of population within national lines, from section to section, and especially from rural districts to the cities. No record is kept of this, and we can trace it only through the census statistics of birthplace. In the United States, for instance, it was shown in 1890 that more than 21·5 per cent. of the native-born inhabitants were living in a state other than that in which they were born. Still further, it appears that about one-half of the native-born inhabitants had moved out of the county in which they were born. In 1890 there were 1,233,629 natives of the state of New York living in other states. The movement is principally westwards in direction and along parallels of latitude. For instance, New York has made large contributions to the population of Ohio, Michigan, Illinois, Wisconsin, Iowa, and so on. Virginia has contributed largely to the population of West Virginia, Kentucky, Ohio, Indiana, Illinois, and Missouri. In Europe there is a similar movement; but it is difficult to make comparisons, because of the differences in the administrative areas. In England in 1891, 71·6 per cent. of the population were residing in their native county; in Prussia, 69·7 per cent. in the *kreis;* in France, 81·7 per cent. in the department; in Austria, 80·2 per cent. in the *bezirk;* in Switzerland, 82·1 per cent. in the canton where they were born (Weber, *Growth of Cities*, p. 249). The most important phase of internal migration is the movement from the rural districts to the cities. The statistical results are shown in the following table extracted from the admirable work of Weber just quoted:—

Percentage of Population living in Towns of 10,000 and over at Three Periods.

	About 1800 or 1801.	About 1850 or 1851.	About 1890 or 1891.
England and Wales .	21·3	39·5	61·7
Scotland . . .	17·0	32·2	50·0
Australia (7 colonies).	...	...	41·4
Belgium . . .	13·5	20·8	34·8
Netherlands . .	29·5	29·0	31·3
Prussia (1816) . .	7·3	10·6	30·0
United States . .	3·8	12·0	27·6
France . . .	9·5	14·4	25·9
Denmark . . .	10·9	9·6	23·6
Italy	...	...	20·6
Ireland . . .	7·8	10·1	18·0
Norway . . .	3·3	5·3	16·7
Switzerland (1822) .	4·3	7·3	16·5
Austria . . .	4·4	5·8	15·8
Hungary . . .	5·4	9·1	16·1
Sweden . . .	3·9	4·7	13·7
Portugal . . .	12·7	12·9	12·7
Russia	3·7	5·3	9·3

Everywhere the city population is increasing faster than the rural. In the United States the rate of increase per decade was as follows:—

Year.	United States.	In Towns of 8000 and over.	Rural Districts.
	Per cent.	Per cent.	Per cent.
1790–1800	35·1	60	34
1800–1810	36·4	69	35
1810–1820	33·0	33	33
1820–1830	33·6	82	31
1830–1840	32·7	68	30
1840–1850	35·9	99	30
1850–1860	35·6	75	30
1860–1870	22·6	59	15
1870–1880	30·1	40	27
1880–1890	24·9	61	15
1890–1900	20·8	37	14

In England and Wales the rural population is actually decreasing, while the urban is increasing, as shown in the following table:—

Decennial Rate of Increase or Decrease.

Year.	Urban.	Rural.
	Per cent.	Per cent.
1851–61 . . .	+21·9	+1·88
1861–71 . . .	+28·1	−5·86
1871–81 . . .	+25·6	−3·84
1881–91 . . .	+18·5	−2·76

In 271 out of 632 registration districts of England and Wales there was an absolute decrease of population from 1881 to 1891. The same phenomenon is seen in France. According to the census of 1891, not less than 55 out of the 87 departments had decreased in population; and out of the 32 that had increased, 7 showed a decrease in their rural parts when the large towns were deducted. In Germany the towns of 10,000 and over show a much more rapid increase than the rural districts; and the same fact is generally true of the other countries of Europe. This more rapid increase of population in cities is due only in part to migration from the country. Until the 19th century deaths generally exceeded births in cities, so that if it had not been for constant immigration the cities would not only not have grown, but would have decreased in population. Cities grow more rapidly now than formerly, because the excess of deaths over births has been turned into an excess of births over deaths. Thereby the cities are becoming less dependent upon immigration for increase of population than formerly, but the migration still goes on. The causes of migration from country to city are mainly economic. In early stages of culture men are scattered over the country, or at most gathered together in hamlets and villages. Each of these is self-sufficing, having its own artisans and handicraftsmen, and producing what it needs. With the beginning of exchange, commercial centres spring up, situated on navigable streams and especially at points where land and water journey are broken. With the growth of manufactures, industrial centres spring up where the division of labour can be fully provided for. In modern times two factors have accelerated this process, viz.: (1) the building of railways, which have developed commerce to a very great degree and favoured the large towns at the expense of the small; and (2) the invention of machinery, which has greatly increased the possibility of division of labour and manufactures on a large scale. The old handicraftsman has been superseded by machine labour and the village artisan by the factory hand. At the same time improvements in agriculture and the opening up of new countries have enabled the modern community to gain its food and raw material with a less expenditure of labour force, and the surplus agricultural population has gone to the city. The attractive influences upon individuals have been higher wages, greater scope for the ambitious, and the social advantages of city life.

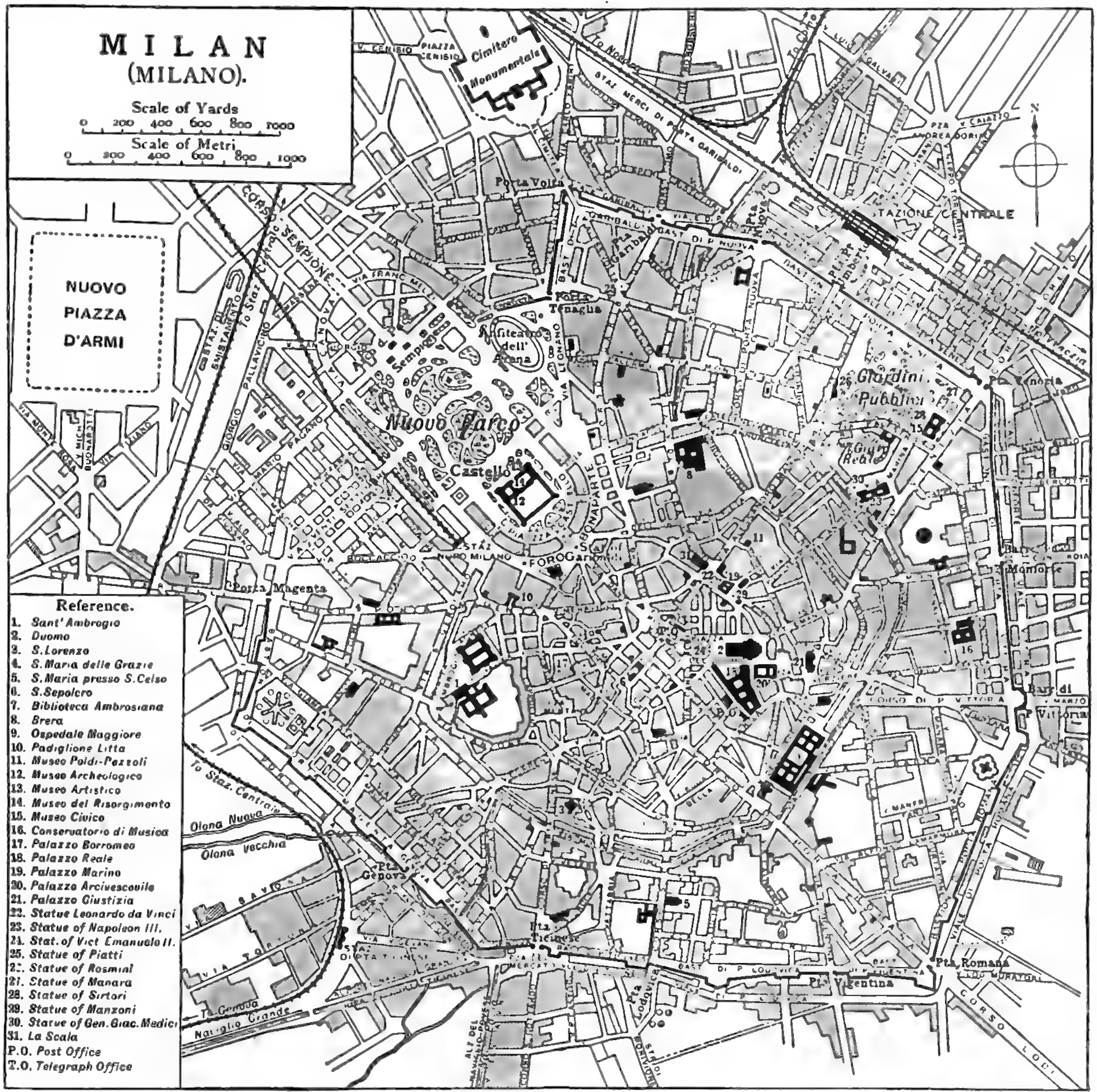
The general laws of internal migration may be summarized (according to Ravenstein) as follows:—

1. The great body of migrants proceed only a short distance.
2. The process of absorption goes on as follows: The inhabitants of the country immediately surrounding a town of rapid growth flock into it; the gaps thus left in the rural population are filled up by migrants from more remote districts, until the attractive force of one of the rapidly-growing cities makes its influence felt, step by step, to the most remote corner of the land. Migrants enumerated in a certain centre of absorption will consequently grow less with the distance, proportionately to the native population which furnishes them.
3. The process of dispersion is the inverse of that of absorption, and exhibits similar features.
4. Each main current of migration produces a compensating countercurrent.
5. Migrants proceeding long distances generally go by preference to one of the great cities of commerce or industry.
6. The natives of towns are less migratory than those of the rural parts of the country.
7. Females are more migratory than males.

AUTHORITIES.—The statistics of migration are to be found in the official returns of different countries, especially the statistical tables relating to emigration and immigration published by the British Board of Trade, and the Reports (annual) of the Commissioner-General of Immigration of the United States. For general discussion see PHILIPPOVICH. *Auswanderung und Auswanderungspolitik.* Leipzig, 1892. Exhaustive bibliography will be found in article by same author, "Auswanderung," in *Handwörterbuch der Staatswissenschaften.*—R. MAYO-SMITH. *Emigration and Immigration* (with bibliography). New York, 1890. For internal migration see WEBER. *Growth of Cities.* New York, 1899.—RAVENSTEIN. "The Laws of Migration," in *Journal of Royal Statistical Society,* 1885 and 1889.
(R. M.-S.)

Mikhailovskaya, a Cossack village of Russia, province of Don Cossacks, 43 miles from Shakhtnaya railway station. It is an important centre for grain export. Population, 17,848.

Milan, capital of the province of Milan, Italy, situated in 45° 28′ N. and 9° 11′ E., on the river Olona. The development of the city, which became noteworthy after the annexation of Lombardy to Piedmont in 1859, continued during the last quarter of the 19th century. The population, which in 1875 numbered 273,079, reached 500,000 in 1900. The customs circle, which prior to 1898 measured $9\frac{1}{2}$ miles, measures now 18 miles. As early as 1880 the increase of the population necessitated the construction of new quarters (Porta Genova, Principe Umberto, Via Solferino, &c.) within the line of bastions erected by the Spaniards towards the middle of the 16th century; while outside the bastions working-class quarters and industrial establishments grew up. The lack of a general building scheme occasioned confusion, however, and in 1885 the municipal authorities were obliged to lay out the lines of new streets for the whole extra-bastion zone. The scheme, known as the *piano regolatore,* was adopted in 1888, together with a *regolamento edilizio* or building regulation designed to fix the length of the streets and the height of houses, and to secure their solidity and proper drainage. Inside the bastions the *piano regolatore* provided for the completion of the Piazza del Duomo (begun in 1865), and for the formation of a new quarter upon the vast areas of Piazza Castello and Piazza d'Armi. The municipality undertook to furnish the military authorities with a new Piazza d'Armi or military exercise ground, to contribute to the cost of the construction of new barracks in compensation for the military quarters in the Castello Sforzesco, which thenceforward became municipal property. In order to provide for direct communication between this quarter and the centre of the city, it was decided in 1887 to cut a new street, Via Dante, through a zone of old houses. Subsequently, it was thought expedient to lay out the whole Piazza d'Armi as a public garden. This variation of the original plan was completed in 1893. It created in the highest zone of Milan a magnificent quarter, with wide streets, spacious gardens, and private villas, in strong contrast to the narrow and irregular thoroughfares of the old part of the city. The growth of municipal expenditure kept pace with the growth of population and with the structural development of the city. The result was increased taxation within the *octroi* circle, until it became almost intolerable, and large loans had to be effected. In 1898, after several years of party struggle, the *octroi* circle was enlarged so as to include the Corpi Santi with their large industrial population. As a result of the change, municipal revenue has increased so considerably as to assure a surplus after meeting ordinary and extraordinary expenditure out of current income; *octroi* on several prime necessaries of life, such as flour, bread, and vegetables, has been abolished, and the collection simplified proportionately. Nevertheless, the agitation connected with this fiscal reform contributed greatly to displace the centre of political gravity in favour of the Anti-monarchical Radicals. Up till 1882 the Moderate or Conservative Monarchical party ruled supreme, both in the municipality and in the parliamentary representation of Milan. In that year the extension of the suffrage and the adoption of the *scrutin de liste* assured to the Radicals four-fifths of the parliamentary representation of the city; and though, after the return to the uninominal ballot, the Conservative party succeeded in regaining four of the six constituencies into which the city was then divided, the Radical, Republican, and Socialist parties, particularly the last, have steadily increased until they secured the whole parliamentary representation of Milan in the general election of June 1900. Similarly, in municipal elections the Socialists and Radicals have gained ground; and though the Moderates continued to hold office, with the help of the Catholic party, until 1899, the municipal elections of December 1899 resulted in a sweeping victory for the Anti-monarchical list, which polled 19,000 votes as compared with 8000 cast for the Conservatives. The success of the popular party was due in part to the defection of the Clericals, but principally to the organization of the working-class vote and railway vote by the Socialists, to the agitation on the *octroi* question, and to the discontent occasioned by the imposition of a new municipal house-rate. The growth of political Radicalism in Milan has further been favoured by the decadence of the Conservative party organization, and by the unsatisfactory condition of Italian public affairs during the last decade of the 19th century. Nevertheless, manifestations of public opinion in connexion with the riots of 1898 (which necessitated severe measures of military repression) and with the assassination of King Humbert at Monza (29th July 1900) proved that the bulk of the Milanese population was by no means disaffected towards existing institutions. The municipal elections of 1902 proved that, though still masters of the city, the Radical parties had lost ground.



Since 1875 great improvements have been effected in the means of communication. The omnibus service, organized in 1862, was largely supplanted in 1881 by horse tramways. In 1893 the first electric tramway was tried, and by degrees electric traction on the overhead system has been applied to the whole service. The transformation, completed in 1898, was carried out on the basis of the lines being laid by the municipality while their working was entrusted to the Edison Company. The municipality, however, reserved for itself a share in the profits, so that it possesses more than 68 miles of electric tramways, from which it derives an annual revenue of more than 1,000,000 lire. The number of passengers annually carried by the tramway company is 50,000,000. Simultaneously with the development of the tram service, the network of railways which makes Milan the most active railway centre of Italy notably increased. In 1882 the important St Gothard line was added to those already converging on the Lombard metropolis from Turin, Venice, Genoa, Piacenza, Como, Varese, and Vigevano. The St Gothard tunnel added immensely to the commerce of Milan by placing it in direct communication with the principal cities of central Europe. At the same time the local railway system has been considerably extended. A further increment of traffic will doubtless follow the opening of the Simplon tunnel in 1905, although even now Milan outdistances all other Italian cities, including Rome, in respect of passenger and goods traffic and of the postal and telegraphic services. Two other public services, namely, the water supply and the sewer system, have been completely transformed since 1880. The old system of water supply was that of piercing a well for every house built. But with the growth of the city the system was found to be inadequate and dangerous. The municipal technical bureau proposed, as an experiment, to adopt the system of mechanical extraction of water from the deeper strata of the subsoil. This was so successful (1889) that the system has been adopted and extended, so that now deep wells furnish 12,000 litres per minute, with a pressure equal to that of a reservoir at a height of 40 metres. By 1899 the length of water-pipes had increased from 5 miles to 78 miles, and the consumption from 146,000 litres to 4,088,000 litres. Since 1888 the drainage has been greatly improved. Milan has now in all 48 miles of sewers worked on the single-channel principle—that is, a channel which receives all kinds of drainage and rain-water. The chief collectors discharge themselves into the Vettabia, which in its turn communicates with the river Lambro near Melegnano. The Vettabia is an ancient river-bed, adapted centuries ago for irrigation. It irrigates a tract of land nearly 7000 acres in extent, and its surplus waters pass over a further zone of low-lying land 20,000 acres in extent. Thus some 27,000 acres of land are available for the sterilization of Milanese sewage. The growth of population obliged the municipality in 1860 to increase burial accommodation by opening a new cemetery, 120,000 metres in extent, known as the Cimitero Monumentale, at first intended to replace the four old cemeteries in the neighbourhood of the bastions. As its insufficiency became apparent, the abolition of the old cemeteries was suspended until, in 1888, a much larger burial-ground was laid out in the commune of Musocco, 3 miles from the city. This new cemetery is the general burying-ground, the Cimitero Monumentale being reserved for the erection of monumental tombs. An electric tramway connects the two cemeteries. It cannot be said that the development of Milanese hospitals has kept pace with the growth of the population. The Ospedale Maggiore, built in 1456, is still the most important. On the other hand, several special institutes and ambulances have been created by private philanthropy since 1880. The Instituto dei Rachitici, for the cure and education of children suffering from rickets; the Instituto Oftalmico, for eye diseases; and the Padiglione Litta, for surgical operations, deserve mention. The institute for the instruction of the blind, the deaf, and the dumb has been renewed and enlarged. The municipality has further provided a hospital for contagious diseases at Dergano, some distance from the city. Philanthropic institutes such as soup-kitchens, public dormitories, and foundling hospitals have also been established. Two small experiments in the construction of workmen's houses have also been carried out, but, either on account of the special conditions of the Milanese working-classes, or of inherent defects, have not been attended with noteworthy success.

The artistic and scientific patrimony has notably increased since 1875. The Gallery of Brera, founded at the end of the 18th century with works of art accumulated during the suppression of the religious orders, has become one of the most important Italian galleries. Since 1880 it has been enriched with pictures by Titian, Tintoretto, Paris Bordone, Antonello, Cossa, Borgognone, &c.; in 1900 the gallery was enlarged, the number of its rooms being doubled. In 1880 an interesting art collection was bequeathed to Milan by a patrician, Poldi Pezzoli, and has since been opened to the public; it contains many pictures of prime value by painters of the Lombard school, besides bronzes, ceramics, old stuffs, jewellery, glasses, and an important collection of ancient weapons. In 1878 the municipality organized an art museum with objects bequeathed to the city; and in 1899 the collection was placed in the Castello Sforzesco, which has been restored by the architect Luca Beltrami. In 1895 the Museo del Risorgimento Nazionale was transported thither; in 1896 the school of art applied to industry was installed there; in 1900 the municipal art and archæological museums were added. In regard to science and scientific collections Milan has made considerable progress. The National Library in the Palace of Brera possesses 250,000 volumes, 126,000 pamphlets, and many manuscripts relating to Lombard history and to the territory of Milan. A Manzoni room has been opened for the collection of all the editions and the autographs of the writings of Alessandro Manzoni, who died in 1873. The Ambrosian Library has continued to receive many important bequests of MSS. and works of art. The reproduction of the *Codice Atlantico* of Leonardo da Vinci, preserved in this library, has reached its eighteenth part; when complete it will constitute a work of more than 1200 plates in heliotype of large form. The civic museum of natural history, founded about 1850 with small resources, has been increased by donations and bequests, notably by that of Count Turati, who presented to the municipality his ornithological collection, one of the richest in Europe. In 1888 the museum was installed in a special edifice in the public gardens, where the mineralogical and fossil collections are displayed to advantage. The Brera Observatory was furnished in 1882 with a large equatorial refractor, having an objective 18 Paris inches in diameter. The Milanese Polytechnic, founded in 1865 by the mathematician Brioschi, has greatly developed. A considerable number of monuments have been erected in the gardens and squares. The principal are the equestrian statues of Victor Emmanuel II., Garibaldi, and the monument commemorative of the insurrection of 1848 against the Austrians. Other statues are those to Alessandro Manzoni, Giuseppe Parini, Antonio Rosmini, G. B. Piatti (inventor of the drills used in boring the Cenis tunnel), Antonio Stoppani, Generals Sirtori and Medici, Luciano Manara, and Francesco Brioschi. The equestrian statue of Napoleon III. is still in the Senate courtyard awaiting its transfer to the position assigned to it in front of the Arco della Pace, through which the allied French and Italian armies entered Milan after the battle of Magenta. The ancient monuments have, on the whole, been well cared for. Besides the above-mentioned restoration of the Castello Sforzesco, works of restoration have been executed in the churches of Santa Maria delle Grazie (in terra-cotta), of Santa Maria presso San Celso, and of San Sepolcro. The belfry of San Gottardo has been repaired, Palazzo Marino (the seat of the municipality) completed, and various repairs carried out in the Palazzo dei Giureconsulti and the Loggia dei Notai. Unfortunately, Milanese archæologists have not succeeded in every case in preventing acts of vandalism during the transformation of the city. Thus, in 1900, the ancient Porta dei Fabbri was demolished—one of the last traces of the walls rebuilt by the Milanese after the destruction of their city by Frederick Barbarossa. Milan has retained its position as musical centre of Italy, and as one of the chief musicial centres of Europe. The Scala Theatre, with a municipal subsidy, maintained its traditions. In 1897 the municipality withdrew its subsidy, and the Scala remained closed during the season 1897–98; but, owing to private initiative, the theatre was reopened for the triennium 1898–1901 with a limited subvention from the commune. The result of this experiment assured the continuance of the traditions of the Scala.

Province of Milan.—The conditions of Lombard agriculture in the Milan district have been somewhat modified by the extension of irrigation and the development of intensive culture. The territory of which Milan forms the centre has been for centuries divided into a dry zone, extending from the Lower Alps to the city, and an irrigated zone, stretching from the city to the Po. In 1860 the Cavour and Villoresi canals extended the irrigated zone towards the north. Milan still remains the centre of the most rationally irrigated districts in Europe. The potentiality of the north Italian canals is surpassed only by that of the great Ganges canal constructed by the British in the second half of the 19th century. The oldest canals lead from Lakes Maggiore and Como; the Muzza canal, leading from the Adda, existed earlier than the year 1000, and has now an average potentiality in the summer season of 90 cubic metres per minute. The Naviglio Grande, begun for purposes of irrigation in 1185, was adapted also for navigation earlier than the 15th century. The Martezana canal was constructed at the end of the 15th century, Leonardo da Vinci taking part in its preparation. These two latter canals, leading respectively from the Ticino and the Adda, discharge themselves into the Pavia canal, which in its turn flows into the Ticino at a short distance from the Po. Besides these great arteries, irrigation is effected with water drawn from springs and wells, which, on account of the natural slope of the Lombard plain, are able to irrigate land at several kilometres' distance. This system is facilitated by the so-called "right of passage" or "right of aqueduct" created in Lombardy, and now included in the civil codes of several nations. The rent of irrigated land varies from 8 to 11 lire per perch (120 to 165 lire per hectare)—scarcely one-half of the rent demanded a few years back. This reduction has led to the intensification of pasturage and grazing products; but these, in their turn, have fallen in price on account of the difficulty of exportation. The Lombard peasants hold a high place amongst Italian agriculturists, and have been instrumental in introducing superior systems of agriculture into Lazio, Apulia, and Sardinia. The dry zone has undergone little change either as regards culture or land tenure. Silkworm rearing is still the chief industry of the region, the land being held on the *mezzadria* or *métayer* system, according to which the products of the soil are divided between landlord and tenant. The fall in prices has caused a diminution in rents and incomes, and has stimulated emigration to South America.

Most noteworthy, too, has been the industrial development of Milan, with its suburbs and neighbouring towns, such as Monza, Gallarate, Saronno, Busto Arsizio, and Legnano. Machine-making on a large scale is carried on by firms widely celebrated for the construction of locomotives, railway trucks and carriages, steam boilers and motors, turbines, pumps, metal bridges and roofs. A number of large turbines for the hydraulic works at Niagara Falls were constructed at Milan in 1900. Minor industries are represented by workshops for the production of surgical, musical, and geodetic instruments; of telephone and telegraph accessories; dynamos, sewing machines, bicycles and automobiles. There is also a large carriage industry. In textile industries silk holds the first place. The amount of silk handled and woven in Milan is greater than that dealt with at Lyons. Milan, indeed, supplies 9,000,000 out of the 24,000,000 kilogrammes produced in Europe. Spinning and twisting (Italy produces 50,000,000 kilogrammes of cocoons, which supply work for 60,000 basins and 1,600,000 spindles) are as highly developed as the weaving industry. Cotton-spinning is represented by 1,000,000 spindles in Lombardy alone. At Milan, headquarters of the industries, cotton weaving, dyeing, and printing are extensively carried on. Linen, flax, jute, and wool are also spun and woven. The Milanese manufactures of articles in caoutchouc and of electric cables have acquired a world-wide reputation. In typography Milan is renowned principally for its musical editions and for its heliotype and zincotype establishments. There is besides a huge production of posters for advertisement. The manufacture of furniture of all kinds is still extensively carried on, Milan being the chief Lombard market and centre of exportation. The towns of Cantu, Meda, Lissone, and Carugo supply Milanese firms with most of their merchandise, the furniture being made by the workmen at their own homes with materials supplied by the Milanese buyers, who also advance the capital necessary for working expenses. House industry is still widely diffused in Milan itself, especially as regards working in gold, silver, vulcanite, bronze, and leather. The motive power for much of the house-industry is supplied by electricity, 7000 kilowatts being thus employed. The electricity is furnished by the hydraulic works at Paderno, 24 miles from Milan. (L. Bi.)

Milan Obrenovitch IV. (1854–1901), king of Servia, was born 22nd August 1854, at Jassy. He was the grandnephew of the famous Milosh, whose brother Jefrem (d. 1856) had a son, Milosh (1829–1861), who married Maria Katardži, a Moldavian. Milan was their son. While still very young, he lost both his parents, and was adopted by his cousin, Michael Obrenovitch, who returned to Servia on the expulsion of the Karageorgevitches in 1858 and became ruling prince on the death of his father, Milosh, in 1860. During the reign of Michael young Milan was educated in Paris, at the Lycée Louis-le-Grand, where he displayed considerable precocity, but he was only fourteen years of age when in 1868 his cousin was assassinated and he succeeded to the throne under a regency. In 1872 he was declared of age, and taking the reins of government into his own hands, soon manifested great intellectual power, coupled with a passionate headstrong character. Eugene Schuyler, who saw him about this time, found him "a very remarkable young man . . . singularly intelligent and well informed." By a careful balancing of the Austrian and Russian parties in Servia, with a judicious leaning towards the former, Prince Milan was enabled in 1878, at the end of the Turkish war, to induce the Porte to acknowledge his independence, and was proclaimed king in 1882. (The history of his reign is told in detail under Servia.) Acting under Austrian influence, King Milan devoted all his energies to the improvement of means of communication and the development of natural resources, but the cost, which was unduly increased by reckless extravagance, led to proportionately heavy taxation. This, coupled with increased military service, rendered King Milan and the Austrian party most unpopular; and his political troubles were further increased by the defeat of the Servians in the war against Bulgaria, 1885–86. In 1885 (September) the union of Rumelia and Bulgaria caused widespread agitation in Servia, and Milan precipitately declared war upon his kinsman Prince Alexander on 15th November. After a short but decisive campaign, the Servians were utterly routed at the battles of Slivinska and Pirot, and Milan's throne was only saved by the direct intervention of Austria. Domestic difficulties now arose which rapidly assumed a political significance. In October 1875 King Milan had married Natalie, the sixteen-years-old daughter of Peter Ivanovich Ketchko, a Moldavian Boyar, who was a colonel in the Russian army, and whose wife, Pulcheria, was by birth Princess Sturdza. A son, Alexander, was born in 1876, but the king and queen soon showed signs of friction. Milan was anything but a faithful husband. Queen Natalie was greatly influenced by Russian sympathies; and the couple, ill-assorted both personally and politically, separated in 1886, when the queen withdrew from the kingdom, taking with her the young prince, Alexander, afterwards king, then ten years of age. While she was residing at Wiesbaden in 1888, King Milan succeeded in recovering the Crown Prince, whom he undertook to educate; and in reply to the queen's remonstrances, he exerted considerable pressure upon the metropolitan, and procured a divorce, which was afterwards annulled as illegal. King Milan now seemed master of the situation, and on 3rd January 1889 promulgated a new constitution much more liberal than the existing one of 1869. Two months later (6th March) he suddenly abdicated in favour of his son, a step for which no satisfactory reason was assigned, and settled as a private individual in Paris. In February 1891 a Radical ministry was formed, Queen Natalie and the ex-metropolitan Michael returned to Belgrade, and Austrian influence began to give way to Russian. Fear of a revolution and of King Milan's return led to a compromise, by which in May 1891 the queen was expelled, and Milan was allowed a million francs from the civil list, on condition of not returning to Servia during his son's minority. Milan in March 1892 renounced all his rights, and even his Servian nationality. The situation altered, however, after the young King Alexander in April 1893 had effected his *coup d'état* and taken the reins of government into his hands. Servian politics began to grow more complicated, and Russian intrigue was rife. In January 1894 Milan suddenly appeared at Belgrade, and his son gladly availed himself of his experience and advice. On 29th April a royal decree reinstated Milan and Natalie, who in the meantime had become ostensibly reconciled, in their position as members of the royal family. On 21st May the constitution of 1869 was restored, and Milan continued to exercise considerable influence over his son. The queen, who had been residing chiefly at Biarritz, returned to Belgrade in May 1895, after four years' absence, and was greeted by the populace with great enthusiasm. In 1897 Milan was appointed commander-in-chief of the Servian army. In this capacity he did some of the best work of his life, and his success in improving the Servian military system was very marked. His relations with the young king also remained good, and for a time it seemed as though all Russian intrigues were being checked. The good relations between father and son were interrupted, however, by the latter's marriage in July 1900. Milan violently opposed the match, and resigned his post as commander-in-chief; and the young king banished him from Servia and threw himself into the arms of Russia.

Milan retired to Vienna, and there he died unexpectedly on 11th February 1901. Milan was an able, though headstrong man, but he lived a scandalously irregular life, and was devoid of moral principle. In considering his relations with his young son, it must be remembered that in the dynastic and political condition of Servia natural feeling was inevitably subordinated in Milan to other considerations.

Milazzo, a seaport town of the province of Messina, Sicily, Italy, 22 miles west of Messina by rail. There is a good harbour, which can be entered by vessels drawing 20 feet, but the trade is decreasing; in 1888 the port was entered by 1523 vessels of 147,150 tons, in 1899 by 515 vessels of 82,600 tons. The exports are wine, tunny, oranges, lemons, and other fruit, and olive oil. Population (1881), 9468; (1899), 13,000.

Miles, Nelson Appleton (1839-——), American soldier, was born in Westminster, Mass., on 8th August 1839. A civilian, and engaged in mercantile pursuits when the Civil War began, he entered service in September 1861 as a lieutenant in the 22nd Massachusetts volunteers, won campaign distinction, and was commissioned, in September 1862, colonel of the 61st New York volunteers. He was advanced to brigadier-general of volunteers in May 1864, and to major-general in October 1865. He fought in most of the great battles of the army of the Potomac, and at the end of the war was appointed (July 1866) a colonel of regulars. Promoted to U.S. brigadier-general (December 1880), and major-general (April 1890), he succeeded to chief army command in 1895. He was successful (1869–86) in suppressing Indian outbreaks, and commanded in Chicago during the railway riots in July 1894. He was in nominal direction of operations during the war with Spain, 1898, though tardily sent to the front. He was raised to the rank of lieutenant-general commanding in June 1900.

Milford, contributory parliamentary borough (Pembroke district) and seaport of Pembrokeshire, Wales, about 8 miles west-north-west of Pembroke on Milford Haven; a terminal station of the Great Western railway. New water storage has been constructed, with a capacity of 3,000,000 gallons. Mackerel are brought here from the Irish coast and despatched by rail to London and other centres. In 1890, 1705 vessels of 350,504 tons entered and 1709 of 350,375 tons cleared; in 1900, 1206 vessels of 272,124 tons entered and 1153 of 265,525 tons cleared. Population (1891), 4070; (1901), 5102.

Milford, a town of Worcester county, Massachusetts, U.S.A., in the southern part of the state. Within its area of 16 square miles are a large rural population and a village of the same name as the town. Three railways traverse the town—the Boston and Albany, the Grafton and Upton, and a branch of the New York, New Haven and Hartford. It manufactures boots and shoes, besides a variety of other goods. Population (1890), 8780; (1900), 11,376, of whom 3342 were foreign-born.

Military Law (see also *Ency. Brit.* vol. xvi.).—

Definition.

Military law is "the law which governs the soldiers in time of peace and in war, at home and abroad. At all times and in all places the conduct of officers and soldiers as such is regulated by military law." This is the definition given in the opening chapter of the *Manual of Military Law*, which is issued under the authority of the War Office, and which is the text-book used by all courts-martial. The definition is, however, somewhat too wide, and places the British soldier on the level of the French soldier, who is amenable to military tribunals at all times and for all breaches of the law, whether of a civil or of a military character. The British system does not exclude in time of peace the action of the civil courts. In time of peace all persons who belong to the military class in France and other Continental countries are judged by military law and by military courts. There is also in most Continental countries an intermediate stage between war and peace known as an *état de siège*, which may be declared for a fixed period for a district, or even a city, by reason of domestic insurrection or the presence of an enemy. It requires legislative enactment. Thirdly comes a state of war, when the military authorities are supreme; and whilst they can call upon the civil power to act in concert with them, the military authority is final. This is a brief summary of the system of military law that prevails in most countries of the Continent. The cardinal point of difference between the British and the Continental systems lies in the fact that in the United Kingdom the soldier is not only a soldier, but a citizen also; and although he may be tried for civil offences by a military tribunal, the power is not exercised in all cases. Thus treason, treason-felony, murder, manslaughter, rape, are brought before a civil court in times of peace, if the offence is committed in the United Kingdom, or if it is committed anywhere else in the king's domains, except Gibraltar, within a hundred miles from a place where the offender can be tried by a civil court. Minor civil offences, when not committed within military lines, or when the person affected by the offence is a civilian, or when it is a case for a jury, or where intricate questions of law may arise, may also be brought before a civil tribunal. But an offence, of whatever nature, committed on active service would be brought before a military tribunal.

Army estimates.

The British army estimates for 1902 provided for a force of 420,000 men, 219,000 being for ordinary army service and 200,300 for war service, as compared with 180,513 in the year before the South African war. Militia, yeomanry, and volunteers have all increased in numbers as well as the regular forces. This increase in all the British military forces has rendered necessary a further development of military law. Martial law has also come into unusual prominence, and it is treated under its own heading.

Field general courts-martial.

The courts-martial in the year preceding the South African war were over 8000 in number. The number in 1901 exceeded 20,000. The number of field general courts-martial greatly increased in consequence of the war, and a field general court-martial has become of special importance. It is convened (1) by any officer in command of a detachment or portion of troops beyond the seas when not on active service, where complaint is made to him that any offence has been committed by any person under his command against the property or person of any inhabitant or resident in that country; or (2) by the commanding officer of an army corps or portion of a corps on active service, or by any officer in immediate command of a body of forces on active service where it appears to him on complaint or otherwise that a person subject to military law has committed an offence. The officer must be satisfied that it is not practicable, with due regard to the public service, to try the person by an ordinary court-martial. The quorum of the court is three, if consistent with military exigencies, and each member must have held a commission for not less than a year. The quorum may be reduced when the public service requires it. The procedure of ordinary courts-martial is observed as far as possible, and the proceedings always should be in writing when possible. But in the circumstances in which these courts are assembled, it is not always possible to adhere to the technical rules which obtain in the ordinary tribunals, although the broad principles are not violated. The evidence on a field general court-martial is taken on oath. The prisoner may cross-examine the witnesses for the prosecution, and may call any available witnesses for his defence. The prisoner is allowed to address the court in his own defence.

Courts of inquiry.

Important changes were made in the system of courts of inquiry by an Army Order of 10th February 1902. A court of inquiry is and has been an assembly of officers directed by a commanding officer to collect evidence and report with respect to a transaction into which he cannot conveniently himself make inquiry. But now, whenever any inquiry affects the character or military reputation of an officer or soldier, full opportunity must be given him of being present at the inquiry and of giving any evidence, or making any statement, or cross-examining adverse witnesses, or producing witnesses on his own behalf. Evidence may now be ordered to be taken on oath if the assembling officer thinks the case requires it. No proceedings of a court of inquiry, no confession, statement, or answer is admissible in a court-martial. But an officer or soldier tried by court-martial in respect of matter which has been the subject of a court of inquiry is entitled to a copy of the proceedings on payment of the cost of the copy. The finding and sentence are only valid after confirmation by the proper military authority. A sentence of death or penal servitude can only be confirmed by the general or field officer in command of the forces with which the prisoner is present. The rule which allows the prisoner and his wife to tender their evidence on oath under the recent Act as regards evidence is applicable to field general courts-martial. It is useful to note that the Army Act, sec. 70, enables His Majesty to make new provisions under the hand of a Secretary of State for, amongst other things, the assembly and procedure of courts of inquiry. The power to make changes by Army Order or rule is only limited by the principle that the rules must not be contrary to or inconsistent with the Act.

Militia.

The Militia Act, 1882 (sec. 12), confined liability to the service of the militia to any part of the United Kingdom, but no part of the militia could be ordered out of the United Kingdom. The Reserve Forces and Militia Act of 1898 now enables them by voluntary offer to extend their services to any place out of the United Kingdom. Under the recent Act the volunteers also can be accepted for service out of the United Kingdom for a period not exceeding one year, whether an order embodying the militia is in force or not at the time. Militia officers are at all times subject to military law, and militiamen during their preliminary training, during their annual training when acting with the regular forces, and during their embodiment. The old system of ballot for militia services (which is generally thought to be the sound basis of a regular army, because it would provide not only a system of home defence, but also reinforcements for the regular forces) would require no addition to the Militia Act, as already there is legislative power to revive the militia ballot.

Yeomanry.

The yeomanry stand on the same footing as the volunteers, and may be considered a cavalry branch of the volunteer force; so these auxiliary forces rank equally in military law. No limit is placed on their number, and they only require the acceptance of their services by the King. They are not held to be effective unless they do a yearly training of five consecutive days, or six days in the year. The yeomanry are included in the Army Act with the militia and volunteers as "auxiliary forces" when employed in military service—that is, they become subject to military law.

The reserve.

The Reserve Forces Act, 1882, established the reserve for the regular forces and the militia. The main object of the Reserve Forces Act at the date of its enactment was to aid the civil power in the preservation of the public peace. But by the Reserve Forces and Militia Act, 1898, any man belonging to the first class of the army reserve whose character on transfer to the army reserve is good shall, if he so agrees in writing, be liable for the first twelve months of his service in that reserve to be called out on permanent service without being called out by proclamation or without the meeting of Parliament; and in case there is a state of war between His Majesty and any foreign power, the service of a reserve man may be prolonged for a further period not exceeding twelve months, or his services may be dispensed with by the competent military authority.

The volunteers.

By the Reserve Forces Act, 1899, if serving out of the United Kingdom, he may at his own request be transferred to the reserve without being required to return to the United Kingdom. Volunteers are a voluntary service, but in case of actual or apprehended invasion of any part of the United Kingdom they may be called out for actual service (Volunteers Act, 1863). They are subject to military law when on actual military service, when being trained or exercised with any portion of the regulars, or with any portion of the militia when subject to military law. But any volunteer may (since 1895) offer himself for active military service whenever an order for the embodiment of the militia is in force.

Continental military law.

In an authoritative report published by the Norwegian Government, and compiled by a trained Norwegian lawyer, who visited the various countries, the systems of twenty-two states are reviewed. The earliest military law still in vigour is found in Norway and Denmark, and dates from 1683, while England and Sweden date from 1881. Sweden has a military penal code, and England is ruled by the Army Act. There are two kinds of military courts of first instance: (1) those belonging to separate military bodies, such as divisions, brigades, regiments; (2) those having jurisdiction in a certain territory, and their seat determined. In times of war the courts must follow the military bodies. In Bavaria and Switzerland a military jury is attached to a court-martial. In several states "auditors," *i.e.*, judicial guides, are attached to courts-martial. In some a military jurisconsult (lawyer) is attached as judge, always a fixed post. This obtains in Sweden, Finland, Austria-Hungary, Switzerland, and Portugal. In Norway, Denmark, Sweden, Finland, Belgium, Great Britain, Germany, Austria, United States, Spain, Würtemberg and Switzerland, the presiding officer is chosen for the single trial. In other states the military judges are appointed for a certain term, usually six months. The quorum of judges required on military courts on the Continent differs. Seven judges sit in Belgium, Holland, France, Spain, Portugal, Greece, Turkey, and Würtemberg; three only, in cases of ordinary offences committed by non-commissioned officers and soldiers in Switzerland, Russia, the United Kingdom, United States, and Bavaria. In grave cases in the United Kingdom five to nine sit, nine in Russia, five to thirteen in the United States. In Norway and Denmark the court is of thirteen up to twenty-five, unless replaced by a commission and a military lawyer.

Summary courts-martial.

In Norway, Denmark, Sweden, Finland, and Bavaria and other places in Germany, special summary courts-martial are held when necessary. Certain forms and legal guarantees are then dispensed with. Such are held in Belgium and Holland "in a town or place in state of siege." *La Prévôté* is a special court of a judge assisted by a registrar, for vagabonds, servants, sutlers, and with a very limited competence over soldiers who have committed a petty offence, held in time of war in France, Rumania, and Greece.

The United Kingdom has a summary court-martial when the regular court-martial cannot be held without injuring the military service. In the United States there are the "field officers' court-martial" and "military commission," consisting of three officers. The second is for judging spies, and some other matters that escape the jurisdiction of the regular courts-martial. A special military tribunal in Germany judges the officials attached to the army. *Courts of Honour* exist in Russia, Germany, Bavaria, Würtemberg, Austria-Hungary, and Spain. Great Britain and the United States have the system of a "court of inquiry." This was only a commission of inquiry, but it is now public, the accused is present, and the witnesses are sworn.

Competence of military courts.

Soldiers not on active service, says the Swedish report, should be answerable for infractions of common law, under the jurisdiction of the civil courts. All infractions of military order or discipline committed by soldiers, whether on active service or no, should be judged by military courts. In time of war, it is equally admitted, military courts must judge all offences, even offences at common law, committed by soldiers forming part of an army on campaign. The difference lies in regard to offences committed in time of peace. Sweden, Great Britain, Italy, and the United States, as a general rule, place offences against the common law (*infractions de droit commun*) *in time of peace* under the jurisdiction of the civil courts. In the United States offences against good order, in Great Britain personal offences (such as drunkenness), are judged by court-martial. In most other states the general rule is that soldiers, even in time of peace, if on actual service, are judged by courts-martial. In the case of complicity between a soldier and a civilian, sometimes one is judged by a military, and the other by a civil court (in Germany, Switzerland, and Spain), sometimes both by a military court (Belgium, France, Italy, Servia, Rumania, and Greece); sometimes it depends on the nature of the crime—in the United Kingdom, United States, Sweden, Finland, Holland, and Portugal. In Norway a mixed tribunal judges them.

Procedure.

The procedure in military courts differs according to the countries. In some systems (*a*) the examination and preparation of evidence are confided to a *juge d'instruction;* (*b*) in other systems they are confided to a special commission of inquiry; (*c*) again, in other places they are left to the court-martial itself that will judge the case. The United Kingdom and the United States follow the last plan. There is no preparatory examination in these two countries. A commission of inquiry for the preparation of evidence is held in Norway, Denmark, Germany, Würtemberg, Austria-Hungary, Servia, Belgium, and Holland. An auditor directs these courts of inquiry. In Russia an officer acts as *juge d'instruction;* in grave cases he must be a military jurisconsult. In France, Italy, Spain, Rumania, Greece, and Turkey an officer acts as *juge d'instruction.*

Publicity.

The proceedings before a court-martial are usually public, except in the case of matters that offend morality, compromise public order, or where publicity is considered injurious to the interests of the service (cases of discipline, disclosing plans, &c.). This does not apply (except in Great Britain and the United States) to the proceedings before the courts charged with preliminary investigation. In several states, *i.e.*, Norway, Denmark, Holland, Austria, Servia, Germany, and Würtemberg, the public prosecutor is also the counsel of the accused. The auditor who directs the court of inquiry fills these offices (except in cases of small importance in Germany and Würtemberg). In other states there is a special office of public prosecutor. In France he is an officer, and in Spain, Portugal, Rumania, Greece, and Turkey. In Russia, Belgium, Bavaria, Switzerland, and Italy he is a military lawyer. In these countries the accused has the right to choose a counsel, or one is assigned him. In the United Kingdom and the United States, when the matter is grave, the direction of the case is put in the hands of a judge-advocate. In the United States the judge-advocate is the public prosecutor.

Appeal, when allowed and to whom.

There is no superior tribunal to which to appeal in Denmark, Great Britain, and the United States. In Denmark the cases are sent to the auditor-general, who can annul if there is error in form, and send back the case to be tried anew. In Great Britain and the United States judgment in ordinary cases must be confirmed by the commanding officer by whose order the court was called. He can lighten the sentence. In certain cases of great gravity it must go on to the head of the State, after passing through the revision of the judge-advocate-general, who is the constitutional adviser of the Crown as regards courts-martial from the point of view of legality. There is also in these two countries a special revision of judgments in the judge-advocate-general's office. This revisional power is the safeguard of military justice, as all decisions are reviewed, and if any illegality is pointed out the proceedings are consequently quashed. The effect of this disapproval is not merely to annul the proceedings, but it also prevents the accruing of any disability or forfeiture. The British judge-advocate's office has been much strengthened. It now consists of—(1) The judge-advocate-general (one of H.M. judges). (2) A deputy judge-advocate-general, who is a trained lawyer. (3) A deputy judge-advocate, also a trained lawyer. (4) A military officer of the rank of colonel who has been called to the Bar. (5) In South Africa (since 1899, and on a five-years appointment from 1902) a colonel who has been called to the Bar.

In Germany there is no appeal except for officials attached to the army. In Austria-Hungary the sentence can be lightened by the commanding officer. It can also be returned for trial by a superior court if it appears to him too light. In Spain all judgments have to be confirmed, and if confirmation is refused, it is carried before the supreme court of the navy and army. The condemned has no power of appeal himself, but all cases of death or life sentences go before the supreme court of the navy and army. Russia only requires the confirmation of the commanding officer. In France, Rumania, and Greece all condemned prisoners in time of peace can demand a court of revision, composed of a general and four superior officers. In time of war the court may be composed of three.

Disciplinary punishments.

Certain forms of punishment, in all countries but the United States, can be given by the superior officer, without judicial intervention, for small purely military offences, where a summary procedure is required. The offender, if he prefers, may be carried before court-martial. The punishment is immediately carried into force, but the person punished can complain to higher military authority. In that case, if the complaint is not admitted, the punishment is enhanced. The commonest of these disciplinary punishments are deprivation of liberty, confined to barracks, arrests and prison. Certain special punishments obtain in certain countries—for instance, imprisonment in Turkey may be accompanied by a bread and water diet; and officers in Finland and Russia may be deprived of advancement.

AUTHORITIES.—*Manual of Military Law.*—*The King's Regulations.* — CLODE. — *Military Forces of the Crown.* — T. GRAM. *Fonctionnement de la Justice Militaire dans les différents États de l'Europe.* Christiania.—*Military Laws of the United States.*—

Commentaire sur le Code de Justice Militaire (PRADIER FODIRI et FAURE). (JNO. S.)

Military Tactics. See TACTICS.

Militia.—The militia of the United Kingdom, commonly so called, is the general or regular militia, as distinguished from the local militia, which was established in the year 1808, and which, though in abeyance, might still legally be raised. It consists of a number of officers, non-commissioned officers, and men, serving under special enactments and regulations, formed into corps or battalions, and trained as soldiers for the purpose of augmenting the military strength of the country in case of national danger or emergency. Although the force is very ancient, being the direct descendant of various levies compulsorily raised for national defence from the earliest times, the title militia first appears in the year 1590, and constantly occurs in parliamentary reports in 1640 and 1641, at which time it was referred to as a new word. The actual origin of the militia is lost in antiquity.

History.

The Roman invasion was stoutly resisted by armed tribes resembling a militia, and possessing both organization and military ability. The inhabitants of Britain are described by historians as a military people, well armed, and adopting tactics in which, by means of chariots, they combined great mobility with the steadiness of foot soldiers. With the advent of the Saxons began the county organization, with which the militia is still closely identified, and the development of a military force called "The Fyrd," easily recognizable as identical in principle with the modern militia. This was the force which King Alfred reorganized. Under this reform was established a general liability to military service on the part of every able-bodied male between the ages of 16 and 60. Although the title of "The Fyrd" survived until long after the Norman Conquest, the force established by King Alfred was known as the general levy, which was bound to appear armed when ordered to aid in suppressing domestic riots as well as in defending the realm against invasion by foreign foes. Service was restricted to the counties except in case of invasion, when it was extended to the whole kingdom. For centuries these remained with little alteration as the principles governing the national forces of the kingdom, and form in effect with certain developments the basis of the modern militia system. The Norman Conquest was immediately followed by the introduction of the feudal levy in addition to the general levy, the distinction between these forces being that while obligation to serve in the latter rested upon every male within certain limits of age, service in the feudal levy depended upon tenure of land under the king as feudal lord. The general levy probably constituted the larger part of the infantry, while the feudal levy consisted of the knights who, with their retainers, mounted and armed, were bound to attend the king at their own expense. Thus early, as in the present day, the question of service abroad as well as at home was raised, with the result that the feudal tenants successfully refused to serve out of the kingdom. Personal service formed the basis of both levies, but service by deputy, or payment in lieu of personal service, and the calling out of a quota only, were allowed from very early times. The feudal levy was discontinued during the Commonwealth and abolished at the Restoration; but liability to serve in the general levy has never been extinguished, but remains in the statutory and practical form of liability to serve both in the general and local militia. Inspections of arms and the assembly and training of the men raised under this national system were secured from time to time by means of "assizes of arms," "views of armour," "commissions of array," and "commissions of musters," dating from early in the 12th century down to the 16th century. The machinery employed to carry out the law formed the basis of the existing procedure for the enforcement of the ballot for the militia, which thus bears a strong resemblance to the means adopted from ancient times. These constitutional powers were frequently abused by "electing" or impressing men to serve out of the kingdom, but this was checked in the year 1327 by an Act of Parliament, which strictly regulated the scope and limits of military service within the kingdom at the charge of the parishes or counties, but provided for service abroad at the charge of the Crown. "Commissions of musters" were a development of preceding measures for raising men and material for military service, under which the commissioners registered and mustered persons liable to serve, sorted them into bands, and trained and exercised them at the charge of the county. These bands became known as train or trained bands, and were mustered annually. With them were associated lieutenants of counties, first appointed in 1549 by Edward VI., subsequently in Queen Mary's reign called lord-lieutenants, and after the Restoration appointed as statutory officers for the militia, their commissions at the present day being issued under the Militia Act. There does not appear to have been any clearly defined regimental organization in existence until these bands or companies were called into active service, but the Acts of the Commonwealth supplied this defect, and initiated a permanent regimental system. One of the earliest attempts to reform the force since the time of King Alfred was made by Charles I. in 1629, when Orders in Council were issued instructing lord-lieutenants to put the militia on a better footing and to fill up vacancies among the officers. Cromwell subsequently issued similar orders couched in strong terms, though under the Commonwealth the duties of lord-lieutenants were not recognized, the militia being raised by commissioners. At the Restoration an Act was passed declaring that the control of the militia was the prerogative of the king, and in the following year another Act, with subsequent amendments, established the militia upon the basis on which it rested until 1757, the year of Pitt's great reform. Charles II. transferred the control of the militia to the lord-lieutenants, but lowered the military status of the force by requiring all offences to be punished by the civil magistrate. To this cause is attributed the disrepute into which the militia fell and the inefficiency it displayed, with the exception of the trained bands of London, until it was reorganized in 1757. Under the Act of 1662 all train bands were discontinued in the counties, but those of London, with their auxiliaries, remained until 1794, when they were reorganized as the City of London militia. In 1688 an Act was passed raising the militia for one year, and for some time this Act became an annual one. In 1690, on the occasion of the French invasion, the militia was embodied; and again in 1715 and 1745 during the troubles caused by the Old and Young Pretenders. In a pamphlet of 1712 the English militia was estimated at 7450 horse and 84,391 foot soldiers. From 1715 until 1734, and again from that year until 1757, with the exception of 1745, no votes were taken in Parliament for the militia.

The foregoing remarks apply only to the English militia and its predecessors. Ireland and Scotland did not furnish any regular militia until 1715 and 1797 respectively, although in Scotland militia existed long before 1797, *e.g.*, in Perthshire in 1684; and in addition corps of fencibles were raised and embodied. The Irish militia when first raised in 1715 was restricted to Protestants between the ages of 16 and 60, who were bound to appear or provide substitutes. The force was not made subject to military law, but various military offences were punishable by fine or imprisonment. Several amendments and other Acts followed until 1793, when a new Act was passed providing for raising a force of militia by ballot among men between the ages of 18 and 45, to serve for four years. Each county was liable to a fine of £5 for each man deficient, and enlistment in the army was prohibited. Other amendments followed from time to time, and notably one in 1797 abolishing religious restrictions for the supplementary militia, and another in 1802 removing the same restrictions in the case of the general militia. Finally, all the Acts were consolidated in 1809 by an Act which fixed establishments, provided for raising the men by ballot, but gave power to the lord-lieutenant to authorize voluntary enlistment by means of bounties, and also to suspend the raising of any regiment. The Scottish militia was at first raised by ballot among men between the ages of 19 and 30. In 1802 former Acts were replaced by an Act providing for the organization of the militia on a basis similar to that on which the militia of England was organized by the Consolidation Act passed in that year.

The immediate cause of the organic reform carried out in 1757 was the disclosure of the inefficiency of the militia during the rebellion of 1745. The Act of 1662 followed the old law by requiring owners of property to furnish men, horses, and arms in proportion to the value of their property, and the liability of persons of small property was to be discharged out of a rate levied in the parish. This was entirely altered in 1757, a liability on the part of the county or parish being substituted for a liability on the part of individuals. Each county was required to furnish a quota apportioned among the various parishes; men were to be chosen by lot to serve for three years (this being the first provision of a fixed term of service) or to provide a substitute, and vacancies were to be filled from time to time by a like process of ballot. The system thus legalized is practically the existing though suspended ballot system. The force was to be annually trained and exercised for a limited period, and in case of invasion or danger thereof, or in case of rebellion, the Crown could order it or any portion of it to be embodied; and during embodiment it was subject to the Mutiny Act. Under this Act 30,000 militiamen were raised by ballot and embodied from 1759 to 1763. This force was exclusively "Protestant," and remained so until 1802. The service of the militia as thus arranged remained nearly in the same state until 1870. Pitt's reform, however, was followed by numerous amendments, new enactments, and other changes, of which the following is a summary in chronological order:—

1758. Volunteers officially recognized as counting towards the quota.

1761. Raising of quota made compulsory on counties under penalty of fines.

Mutiny Act applied to militia when out for training as well as when embodied.

1775. (American War.) Act passed empowering embodiment of militia in case of colonial as well as domestic rebellion.

1786. Charge on parishes for storage of arms, &c., transferred to counties.

1795. Enlistment into regulars encouraged.

1796. Supplementary militia formed, consisting of 63,878 men.

1798. (Irish Rebellion.) English militia volunteered for service in Ireland.

1799. Irish militia volunteered to serve in Great Britain.

15,000 militiamen volunteered to regular army.

1803. 45,492 men raised for militia by ballot, but of these 40,998 were substitutes.

1805. Militia affiliated to line for purposes of recruiting for regulars.

1806. Training Act to raise by ballot 200,000 men to be trained for one whole year, and then to discharge them from training for two years.

1808. Difficulties having arisen under above Act, local militia (which is in effect the old general levy) established in addition to general militia then embodied.

27,000 militiamen volunteered to regular army during preceding twelve months.

1811. English militia, hitherto not liable to serve out of the kingdom, now made liable to serve in any part of the United Kingdom under certain restrictions, which were subsequently (in 1859) removed.

Method of obtaining men from militia for regulars further systematized.

1812. In this year there were 250 regiments of local militia, with an establishment of 240,388 men and 214,418 actually enrolled.

1813. During ten years, from 1803 to 1813, nearly 100,000 militiamen joined the regular army.

Act passed to enable militia to serve abroad as militia with their own officers. Three strong battalions joined the British army in France.

1815. Militiamen recruited in great numbers the army which fought at Waterloo.

Local militia ceased to be raised.

1816. Local militia and Ballot Act suspended.

General militia disembodied.

1820-21-25. Militia called out for training.

1829. Act passed suspending ballot for the general militia.

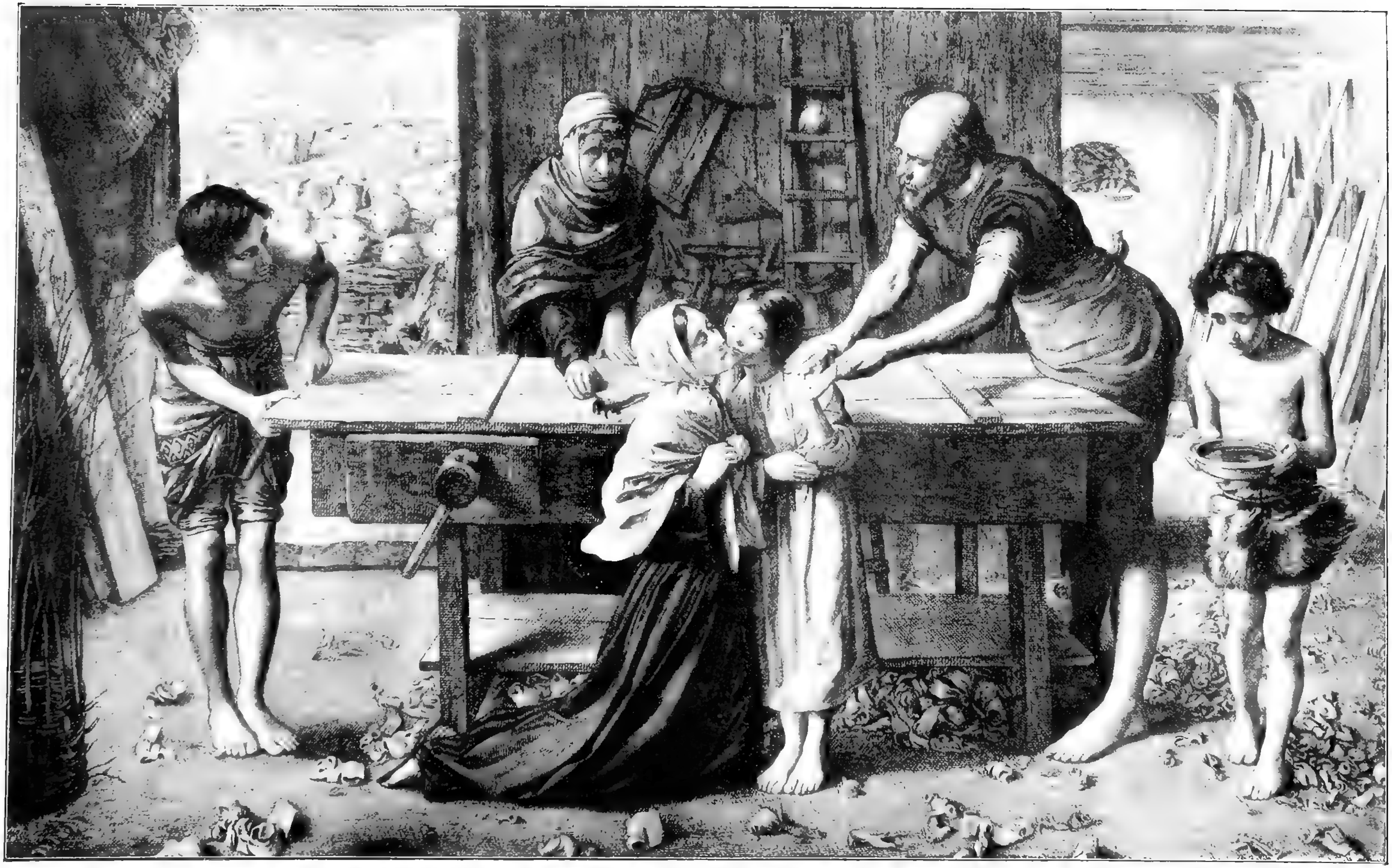
1831. Militiamen raised by ballot in accordance with Order in Council, 27th December 1830. This was the last occasion on which the ballot was put in force.

During the great French war the utility of the militia was most marked, and before passing on to its revival in 1852, after the lapse of nearly forty years, the following summary of its position in the early years of the 19th century in relation to the whole army may be stated :—The tendency of the Government was to use the general militia rather as an offensive force and the local militia as the real defensive force. During the height of the war (in 1812) the relative position of the various branches of the army was as follows :—First line, the standing army ; second line, the general or regular militia, which as the war went on were more and more used abroad ; third line, the local militia, with the survivors of the volunteers, who at that time numbered about 68,000 men. After the peace of 1815 the militia was allowed practically to fall into abeyance, although the permanent staff was maintained. In 1848 the Prime Minister intimated in Parliament his intention to re-establish the militia, but it was not until 1852, after an unsuccessful attempt to resuscitate the local militia, that the general militia of England was reorganized under a system of voluntary enlistment with the ballot in reserve, Scotland and Ireland being included in 1854. The property qualification of officers which had hitherto existed (with exception in favour of ex-officers of the army and navy) was reduced, and after a further reduction in 1854, abolished in 1869. Larger powers respecting the militia were conferred upon the Crown, and during the Crimean war the Queen was authorized to embody the militia whenever a state of war existed with any foreign Power. The acceptance of voluntary offers of service in the Channel Islands and Isle of Man was authorized in 1859, and extended to service in Malta and Gibraltar in 1875. Previously service abroad was only temporarily authorized under certain restrictions, *e.g.*, in 1813, 1855, and 1858. Later enactments will be referred to in their proper place.

Recent changes.

In 1871 the militia was brought more into touch with the regular army, and in 1881 became, with the line, battalions of territorial regiments, the artillery and engineers being also closely associated with the regular services. Various amendments and new enactments followed, all in the direction of increasing the usefulness of the militia, rendering it more efficient and readier for service, and making it more and more a means for supplying recruits, both officers and men, to the regular army. The present position of the force is as follows :—The officers who are commissioned by the Crown are, with the permanent staff, at all times (since 1877) subject to military law. Non-commissioned officers and men are only so subject when embodied or out for training, with extension in the case of men convicted of offences committed during training until the expiration of the punishment. Enlistment is at present voluntary, though compulsory service by ballot is still legal and may be at any time enforced. The minimum age for recruits is 17. Boys from 14 to 16 may be specially enlisted for buglers, drummers, or trumpeters. The period of engagement is for six years. Militiamen up to 45 years of age may re-engage for a further term of four years. Bounties are paid to militiamen at various rates upon enlistment, conclusion of training, re-engagement, enlistment into reserve or special service section, and other special circumstances. Recruit training may be extended to six months, but as a rule will not exceed three months. Recruits are either drilled immediately upon enlistment at any time of the year, which is now the most usual system, or else at preliminary drills (first instituted in 1860), immediately preceding the annual training of the corps. The annual training varies with the different branches of the service and certain special circumstances, but must not exceed 56 days. The usual term for infantry is 27 days, but when on manœuvres this is generally extended to 34 days. Artillery and fortress engineers are trained for 41 days, and submarine mining engineers for 55 days. Trainings now take place for the most part in camp or barracks, and large numbers of militia battalions during recent years have been called upon to take part in field manœuvres. Each branch of the militia service is now incorporated with the corresponding branch of the regular army, the depôts occupy as a rule the same barracks, and officers and men wear (with slight distinctions) the same uniform as the regulars. The militia occupies an important position in the mobilization scheme for national defence. The permanent staff consists of an adjutant, quartermaster, and an establishment of non-commissioned officers, and buglers or drummers, who are all regulars. During the non-training period of the year they are engaged in recruiting, care of arms, clothing, &c., and in drilling recruits. When the militia is embodied or called out for training they are incorporated with their units for executive as well as administrative duties.

The militia ordinarily is liable only for service in the United Kingdom, but by legislation in 1899 may voluntarily serve in any part of the world, including India. During 1899–1900, 22,000 militiamen were thus accepted for service abroad, the bulk of them proceeding to the seat of war in South Africa. The militia may be embodied in case of imminent national danger or great emergency. The procedure is by proclamation of the sovereign, the occasion being communicated to Parliament if sitting, but if not in session, Parliament must be called together within ten days. The militia has been constantly embodied since the reorganization in 1757 as follows :—1756–63, Seven Years' War ; 1778–83, American War ; 1792–1802, threatened invasions and Irish Rebellion ; 1803–16, war with France ; 1854–56, Crimean War, when several battalions served in Mediterranean garrisons ; 1857–59, Indian Mutiny ; 1885, Sudan Campaign ; 1899–1902, South African War, when the whole militia force was embodied, and a large number of units of all branches volunteered for foreign service. The militia reserve consists of men selected from the ranks of the militia for special enlistment for service in the regular army when called upon in emergencies, in the following proportions to the establishments of the various corps :—Artillery, one-third ; engineers and infantry, one-fourth ; medical staff corps, one-half. Special regulations are made as to age, physique, and character. The militia reserve was first formed in 1867, and in 1900 numbered 30,000 men. During an emergency in 1878, 20,000 militia reservists joined the regular army. The term "militia" reserve is therefore a complete misnomer, and the force so called is purely an army reserve. The special service section of the militia was formed by royal warrant in 1898, and consists of (1) militia units and (2) individual militiamen. A militia unit may be registered as available for special service if not less than 75 per cent. of the officers and men present at training make a voluntary offer to engage for special service in any part of the world, and if in the infantry at least 500 and in the artillery at least 250 men are accepted as qualified. Individual militiamen are those who engage to serve either with their militia unit if registered for service, or else for special service with the regular forces. Liability for service will not exceed twelve months. They will not be called out except for service out of the United Kingdom ; age 20 to 34 ; physical requirements as for regular army. Men of the special service section may also belong to the militia reserve, and receive a bounty in addition to that given for the reserve. The result of this special section was not up to 1900 so satisfactory as expected. Very few units could qualify for registration, and the response of individual men was comparatively insignificant.



"CHRIST IN THE HOUSE OF HIS PARENTS." BY SIR JOHN EVERETT MILLAIS.

There is no fixed quota for the militia under present enactments; the numbers vary from year to year, as voted by Parliament. The following figures (showing the state of affairs previous to the Boer war of 1899) relate to the year 1898. The total establishment for the United Kingdom numbered 132,493, divided between England, 87,828; Scotland, 15,695; Ireland, 28,970. Subdivided among the different branches these numbers represented 18,520 artillery, 2060 engineers, 111,300 infantry, and 613 medical staff. The total number actually enrolled was 113,439, thus showing a deficiency of 19,054, made up of 649 officers, 77 permanent staff, and 18,328 non-commissioned officers and men. England was responsible for 14,169 of this deficiency, Scotland for 2011, and Ireland for 2874. Of the total number enrolled (113,439), England provided 73,659; Scotland, 13,684; and Ireland, 26,096. Shown by arms, the artillery mustered 16,886; the engineers, 2098; infantry, 94,114; and medical staff, 341. The religious denominations of the non-commissioned officers and men were thus returned:—Church of England, 53,610; Roman Catholic, 40,496; Presbyterians, 8668; Wesleyans, 3624; other Protestants, 1309; Jews, 46. 40,127 recruits joined the militia during 1898. Of these approximately one-half were 18 years of age and under. 2905 men re-enlisted or rejoined after desertion. The total increase was shown as 43,013. The total decrease from all causes was 44,897 men, of whom 19,808 were discharged, 383 were reported to have died, and 8743 were struck off for desertion or other causes. 15,167 men were transferred to the regular army, and 796 to the Royal Navy and marines. Militia recruiting for the regulars thus shows a large increase compared with preceding years. The net decrease was 1884 men. "Crime" in the militia was represented by 996 offences of the usual military character, which were dealt with by 846 courts-martial. Of these offences, 489 were for absence without leave. None of the others were of a serious nature. 2726 men were fined for drunkenness. 8718 men deserted, of whom nearly half had less than one year's service. 98,042 militiamen were present at annual training; 7240 were absent with leave, 8157 without leave. England produced 63,048 men for training, Scotland 11,520, and Ireland 23,474. These numbers together represented 14,734 artillery, 1864 engineers, 81,161 infantry, and 283 medical staff corps. The ages of the majority of militiamen range from 17 to 35 years. 782 were under 17, and 14,611 over 35 years of age. The heights of the majority of the men range from 5 feet 4 inches to 6 feet. 8997 men were under 5 feet 4 inches, and 909 were over 6 feet in height. A larger number of men approximated to 5 feet 6 inches than to any other height. In the House of Lords, on Friday the 25th May 1900, the marquis of Lansdowne, Secretary of State for War, stated that the grand total of the militia on the 1st May was 99,000 men. Of these 22,000 were abroad, 11,000 belonged (*i.e.*, called up for service with regulars) to the militia reserve, leaving 66,000 militia at home. These figures, presumably correct, thus show a further decrease of 14,000 men since the returns of 1898. On the other hand, Lord Lansdowne was able to announce that a deficiency of 649 officers in 1898 had by the war been turned into an excess of 20 officers above the establishment. The militia in recent years had steadily decreased. In 1881, the year when the militia was practically incorporated with the regular army, there were 127,868 militia of all ranks actually enrolled, and 11,633 wanting to complete. Thus it appears that up to 1898 there had been a loss of 14,429 men, and with the further loss of 14,000 noted above as officially stated in Parliament, the total decrease in the militia in nineteen years was upwards of 28,000 men. This steady depletion of the militia has a most serious bearing upon the military strength of Great Britain.

(A. B. W.)

Millais, Sir John Everett (1829–1896), English painter, was born at Southampton on the 8th June 1829, the son of John William Millais, who belonged to an old Norman family settled in Jersey for many generations, and Emily Mary, *née* Evamy, the widow of a Mr Hodgkinson. After his birth the family returned to Jersey, where the boy soon began to sketch. At the age of eight he drew his maternal grandfather. He went to school for a short time, but showed no inclination for study, and was afterwards educated entirely by his mother. In 1835 the family removed to Dinan in Brittany, where he sketched the French officers, to their great amusement, and in 1837, on the family's return to Jersey, he was taught drawing by a Mr Bissel. In 1838 he came to London, and, on the strong recommendation of Sir Martin Archer Shee, P.R.A., his future was decided. He was sent at once to Sass's school, and entered the Academy schools in 1840. He won a silver medal from the Society of Arts in 1839, and carried off all the prizes at the Royal Academy. He was popular amongst the students, and was called "the child," because he wore his boyish costume till long after the usual age. In 1840 and the immediately succeeding years he made the acquaintance of Wordsworth and other interesting and useful people. He was at this time painting small pictures, &c., for a dealer named Thomas, and defraying a great part of the household expenses in Gower Street, where his family lived. In 1846 he exhibited "Pizarro seizing the Inca of Peru" at the Royal Academy, and in 1847 "Elgiva seized by the Soldiers of Odo." In the latter year he competed unsuccessfully at the exhibition of designs for the decoration of the Houses of Parliament, sending a very large picture of "The Widow's Mite," which was afterwards cut up. In the beginning of 1848 he and W. Holman Hunt, dissatisfied with the theory and practice of British art, which had sunk to its lowest and most conventional level, initiated what is known as the Pre-Raphaelite movement, and were joined by Dante Gabriel Rossetti, and afterwards by five others, altogether forming the Pre-Raphaelite Brotherhood. Rossetti was then engaged, under the technical guidance of Hunt, upon his picture of "The Girlhood of Mary Virgin," which, with Hunt's "Light of the World" and Millais's "Christ in the House of His Parents," forms what has been called the trilogy of Pre-Raphaelite art. According to Millais, the Pre-Raphaelites had but one idea—"to present on canvas what they saw in Nature." Millais's first picture on his new principles was a banquet scene from Keats's "Isabella" (1849), and contains all the characteristics of Pre-Raphaelite work, including minute imitation of nature down to the smallest detail, and the study of all persons and objects directly from the originals. The tale was told with dramatic force, and the expression of most of the heads was excellent. His next important picture, "Christ in the House of His Parents," or "The Carpenter's Shop" (1850), represented a supposed incident in the childhood of our Lord treated in a simply realistic manner, and drew down upon him a storm of abuse from nearly all quarters, religious and artistic. The rest of his more strictly Pre-Raphaelite pictures—"The Return of the Dove to the Ark," "The Woodman's Daughter," and the "Mariana" of 1851, "The Huguenot" and "Ophelia" of 1852, "The Proscribed Royalist" and "The Order of Release" of 1853—met with less opposition, and established his reputation with the public. Indeed, this may be said to have been accomplished by the "Huguenot" and "Ophelia," the refined sentiment and exquisite execution of which appealed to nearly all who were unprejudiced. The public were also greatly influenced by the splendid championship of Ruskin, who, in letters to *The Times*, and in a pamphlet called "Pre-Raphaelitism," enthusiastically espoused the cause of the Brotherhood. In 1851 Millais, who had refused to read *Modern Painters*, where the supposed principles of the Brotherhood were first recommended, became acquainted with Ruskin, and in 1853 went to Scotland with him and Mrs Ruskin, the latter of whom sat for the woman in "The Order of Release." He made several designs for Ruskin, and painted his portrait. In 1855 Millais exhibited "The Rescue," a scene from a fire, which drew great attention, from the frantic expression of the mother and the brilliant painting of the glare. In the Paris Exhibition of this year he was represented by "The Order of Release," "Ophelia," and "The Return of the Dove." This was also the year of his marriage with Mrs Ruskin (Euphemia Chalmers, daughter of Mr George Gray of Bowerswell, Perth), who had obtained a decree of the nullity of her previous marriage. The newly-wedded couple went to live at Annat Lodge, near Bowerswell, where

"Autumn Leaves," described by Ruskin as "the first instance of a perfect twilight," was painted. This and "Peace Concluded" were singled out for special praise by Ruskin in his notes on the Academy Exhibition of 1856, which contained, with other works by Millais, the picture of "A Blind Girl," with a beautiful background of Icklesham and its common. The principal pictures of 1857 were "Sir Isumbras at the Ford," and "The Escape of a Heretic," both of which were violently attacked by Ruskin, who was kinder to the "Apple-blossoms" and "Vale of Rest" of 1859, extolling the power of their painting, but still insisting on the degeneracy of the artist. The "Black Brunswicker" of 1860 was in motive very like the "Huguenot," but it was less refined in expression, and a great deal broader in execution, and may be said to mark the end of the period of transition from his minute Pre-Raphaelite manner to the masterly freedom of his mature style. From 1860 to 1869 the invention of Millais was much employed in illustration, especially of Trollope's novels, beginning with *Framley Parsonage* in the *Cornhill Magazine.* He made altogether eighty-seven drawings for Trollope, and was the cleverest and one of the most prolific of the book illustrators of the 'sixties. He contributed to Moxon's illustrated edition of *Tennyson's Poems*, and made occasional drawings for *Once a Week*, the *Illustrated London News*, *Good Words*, and other periodicals and books. In 1863 he was elected a Royal Academician. The most important pictures of this and the next few years were "The Eve of St Agnes," remarkable for the painting of moonlight, "Romans leaving Britain" (1865), "Jephthah" (1867), "Rosalind and Celia" (1868), "A Flood," and "The Boyhood of Raleigh" (1870). All these were executed in a very broad and masterly manner. In many of his pictures of this period, such as "The Boyhood of Raleigh," his children were his models, and formed the subject of many more, like "My First Sermon," "My Second Sermon," "Sleeping," "Awake," "Sisters," "The First Minuet," and "The Wolf's Den." He now painted many single figures with more or less sentiment, like "Stella," "Vanessa," and "The Gambler's Wife," with occasionally a more important composition, like "Pilgrims to St Paul's," and "Victory, O Lord" (exhibited 1871), representing Aaron and Hur holding up Moses' hands (Exodus xvii. 12). With it was exhibited the first and most popular of his pure landscapes, called "Chill October," which was followed at intervals by several others remarkable for literal truth to nature and fine execution. They were all from Perthshire, where he generally spent the autumn, and included "Scotch Firs" and "Winter Fuel" (painted in 1874), "Over the Hills and Far Away," and "The Fringe of the Moor" (1875), and "The Sound of Many Waters" (1876). A later series was painted in the neighbourhood of Murthly, a village in the parish of Little Dunkeld, Perthshire, where he rented a house and shooting from 1881 to 1891. It was to painting nature and the world around him that he principally devoted himself for the last twenty-five years of his life, abandoning imaginative or didactic themes. To this period belong a number of pictures of children, with fancy titles, like "Cherry Ripe," "Little Miss Muffet," "Bubbles," and others well known by reproductions in black and white and in colour for the illustrated papers; and also some charming studies of girlhood, like "Sweetest eyes were ever seen," and "Cinderella." Amongst his more serious pictures were "The Princes in the Tower" (1878), "The Princess Elizabeth" (1879), two pictures from Scott—"Effie Deans" and "The Master of Ravenswood"—painted for Messrs Agnew in 1877 and 1878, and "The North-West Passage," sometimes regarded as his masterpiece, representing an old mariner (painted from Edward John Trelawney, the friend of Byron) listening to some tale of Arctic exploration in a room overlooking the sea and strewn with charts. "A Yeoman of the Guard" (1877) was perhaps his most splendid piece of colour, and was greatly admired at the Paris Exhibition of 1878, where it was sent with "Chill October" and three others of his pictures. But perhaps the works of his later years by which he will be most remembered are his portraits—especially his three portraits of Gladstone (1879, 1885, and 1890), and those of John Bright, of Lord Tennyson, and of Lord Beaconsfield, which was left unfinished at his death. He also painted the marquess of Salisbury, Lord Rosebery, the dukes of Devonshire and Argyll, Cardinal Newman, Thomas Carlyle, Sir James Paget, Sir Henry Irving, George Grote, Lord Chief Justice Russell, J. C. Hook, R.A., and himself (Uffizi Gallery, Florence). He drew Charles Dickens after his death. Amongst his finer portraits of women were those of Mrs Bischoffsheim, the duchess of Westminster, Lady Campbell, and Mrs Jopling.

Sir John Everett Millais.
(*From a photograph by Elliott and Fry, London.*)

No very serious interruption of his usual life as a prosperous English gentleman occurred in these years, except the death of his second son George in 1878. In 1875 he went to Holland, one of his few visits to the Continent. In 1879 he left Cromwell Place for a house at Palace Gate, Kensington, which he built, and where he died. In 1885 he was created a baronet on the suggestion of Mr Gladstone. In 1892 his health began to break down. After a bad attack of influenza he was troubled with a swelling in his throat, which proved to be due to cancer. He suffered much from depression, but worked when he could, and derived much pleasure in painting several pictures, including "St Stephen," "A Disciple," "Speak! Speak!" (which was bought out of the Chantrey Bequest), and "The Forerunner"—his last exhibited subject picture. His finely-characterized portraits of Mr John Hare, the actor, and Sir Richard Quain, belong also to his last years. In 1895, in consequence of the illness of Lord (then Sir Frederick) Leighton, he was called upon to preside at the annual banquet of the Royal Academy, and on the death of Lord Leighton he was elected to the presidential chair. He died on the 13th August 1896, and was buried in St Paul's Cathedral. The Winter Exhibition of the Royal Academy in 1898 was devoted to his works. The list of his honours at home and abroad is a long one. Millais was one of the greatest painters of his time, and did more than any other to infuse a new and healthy life into British art. He had not the imagination of an idealist, but he could paint what he saw with a force which has seldom been excelled. As a man he was manly, frank, and genial, devoted to his art and his family, and very fond of sport, especially hunting, fishing, and shooting. He was greatly loved by a very large circle of friends. He was singularly handsome, and had a fine presence. The National Gallery of British Art possesses many of his finest works. He is also represented in the National Gallery, in the National Portrait Gallery, the Victoria and Albert Museum, and in the public galleries at Manchester, Liverpool, and Birmingham.

AUTHORITIES.—J. G. MILLAIS. *Life and Letters, &c.*—RUSKIN'S *Modern Painters*, *Notes on Royal Academy Exhibitions*, *Pre-Raphaelitism, &c.*—*Catalogues* of Grosvenor Gallery, summer of 1886; and of Royal Academy, winter of 1898.—M. H. SPIELMANN. *Millais and his Works.* London, 1896.—A. L. BALDRY. *Sir J. E. Millais, his Art and Influence.* London, 1899. (C. MO.)

Millbury, a town of Worcester county, Massachusetts, U.S.A., a few miles south of the city of Worcester. It is traversed by the Boston and Albany and the New York, New Haven, and Hartford railways. It has an area of 17 square miles, composed of hills and valleys, with many small lakes and ponds. The village of Millbury has an irregular plan, and contains many small manufacturing establishments with varied products. The town was separated from Sutton and incorporated in 1813. Population (1890), 4428; (1900), 4460, of whom 1176 were foreign-born.

Milledgeville, a city of Georgia, U.S.A., capital of Baldwin county, on the west bank of the Oconee river, at the head of navigation, and on the Georgia and the Central of Georgia railways, a little north-east of the centre of the state, at an altitude of 276 feet. It is the seat of several educational institutions, and of the state lunatic asylum. It was formerly the state capital. Population (1890), 3322; (1900), 4219, of whom 29 were foreign-born and 2663 were negroes.

Miller, Joaquin [CINCINNATUS HINER] (1841–——), American poet, was born in Indiana, 10th November 1841, and was educated for the law. After some experiences of mining and journalism in Idaho and Oregon, he settled down in 1866 as judge in Grant county, Oregon, and during his four years' tenure of this post he began to write verse. In 1870 he travelled in Europe, and in 1871 he published his first volume of poetry, full of tropical passion, *Songs of the Sierras*, on which his reputation mainly rests. His *Songs of the Sunlands* (1873) followed in the same vein, and after other volumes had appeared, his *Collected Poems* were published in 1882. He also wrote plays, *The Danites* having some success as a sensational melodrama. On his return from Europe he became a journalist in Washington, but in 1887 returned to California. His pen-name, "Joaquin Miller," by which he is known, was assumed by him when he published his first book, in consequence of his having written an article in defence of Joaquin Murietta, the Mexican brigand.

Milligan, William (1821–1892), Scottish commentator and theologian, was born 15th March 1821, and commenced his education at the High School, Edinburgh. When his father was appointed to the charge of the parish of Elie, in Fifeshire, he went to a parish school in the neighbourhood, and proceeded to the University of St Andrews at the age of fourteen. His college career was distinguished, and he graduated in 1839. His divinity studies were carried on partly at St Andrews and partly in Edinburgh. In 1844, a year after the Disruption, he became minister of Cameron in Fifeshire. In 1845, his health having given way, he went to Germany, and studied at the university of Halle. There he became acquainted with the German language and German theology, a fact which greatly influenced his later career. He began, after his return to Scotland and his resumption of his clerical duties, to write articles on Biblical and critical subjects for various reviews. This led to his appointment in 1860 to the professorship of Biblical criticism in the University of Aberdeen. In 1865 he acquired the Syriac tongue. In 1870 he was appointed one of the committee for the revision of the translation of the New Testament. His fervent piety, and his wide interest in educational and social questions, extended his influence far beyond the circle of theologians. His contributions to periodical literature for many years were numerous and valuable; but his celebrity will chiefly rest on his works on the *Resurrection* (1890) and *Ascension of our Lord* (1892), his Baird Lectures (1886), on the *Revelation of St John*, and his *Discussions* (1893) on that book. All these volumes are distinguished by great learning and acuteness, as well as by breadth and originality of view. He died on 11th December 1892. (J. J. L*.)

Millom, a market town in the Egremont parliamentary division of Cumberland, England, 9 miles north by west of Barrow, on the Furness railway. There are blast furnaces and highly productive mines of red hæmatite ore. The deposit lies partly under the foreshore of the river Duddon, and a company has expended upwards of £120,000 upon a sea-wall and embankment to protect the mine from the sea. St Luke's Church (1891), a Baptist chapel and Salvation Army station, are new. Population (1891), 8895; (1901), 10,426.

Millville, a city of Cumberland county, New Jersey, U.S.A., on the Maurice river and on the West Jersey and Seashore railroad, in the southern part of the state, at an altitude of 36 feet. Its site is level and its street plan is regular. It has manufactures of glass, iron, and cotton. Population (1890), 10,002; (1900), 10,583, of whom 598 were foreign-born and 139 were negroes.

Milne-Edwards, Henry (1800–1885), French zoologist, the son of an Englishman, was born in Bruges on 23rd October 1800, but spent most of his life in France. At first he turned his attention to medicine, in which he graduated at Paris in 1823; but his passion for natural history soon prevailed, and he gave himself up to the study of the lower forms of animal life. One of his earliest papers (*Recherches anatomiques sur les Crustacés*), which was presented to the Academy of Sciences in 1829, formed the theme of an elaborate and eulogistic report by Cuvier in the following year. It embodied the results of two dredging expeditions undertaken by him and his friend Audouin during 1826 and 1828, in the neighbourhood of Granville, and was remarkable for clearly distinguishing the marine fauna of that portion of the French coast into four zones. Much of his original work was published in the *Annales des Sciences Naturelles*, with the editorship of which he was associated from 1834. Of his books may be mentioned the *Histoire naturelle de Crustacés* (3 vols., 1837–41), which long remained a standard work; *Histoire naturelle des Coralliaires*, published in 1858–60, but begun many years before; *Leçons sur la physiologie et l'anatomie comparée de l'Homme et des Animaux* (1857–1881), in 14 volumes; and a little work on the elements of zoology, originally published in 1834, but subsequently remodelled, which enjoyed an enormous circulation. He was appointed professor of natural history at the Faculté des Sciences in 1841, and twenty-one years later became professor of zoology at the Museum, where in 1876 he was succeeded by his son Alphonse (b. 1835). The Royal Society in 1856 awarded him the Copley medal in recognition of his zoological investigations. He died in Paris on 29th July 1885.

Milngavie, a police burgh of Dumbartonshire, Scotland, transferred from Stirlingshire in 1891, lies 9½ miles north-north-west of Glasgow by rail. There are bleach-fields, dyeworks, and a paper mill; but the town is rapidly becoming residential for Glasgow business men. Adjacent are two water reservoirs, 60 and 90 acres in extent, belonging to the corporation of Glasgow. There is a burgh hall. Population (1881), 2636; (1901), 3481.

Milton, a town of Norfolk county, Massachusetts, U.S.A., a few miles south of Boston, of which it is practically a suburb, on a branch of the New York, New Haven, and Hartford railroad, in the eastern part of the state. It contains an area of 18 square miles of rolling and hilly country, in which are the villages of Milton, Milton Lower Mills, East Milton, and Milton Upper Mills. It contains the Blue Hills, now a part of the Boston park system, on one of which is situated a meteorological observatory. The town was settled in 1640 and incorporated in 1662. Population (1890), 4278; (1900), 6578, of whom 1840 were foreign-born.

Milton, a borough of Northumberland county, Pennsylvania, U.S.A., on the Susquehanna river, on the Pennsylvania canal, and on the Pennsylvania and the Philadelphia and Reading railways, a little east of the central part of the state, at an altitude of 472 feet. It contains car works, rolling mills, and other iron and steel works. It was founded in 1797, and chartered twenty years later. In 1882 it was in great part destroyed by fire. Population (1890), 5317; (1900), 6175, of whom 168 were foreign-born and 97 were negroes.

Milwaukee, the largest and most important city of Wisconsin, U.S.A., capital of Milwaukee county, on the western shore of Lake Michigan, at the mouth of the Milwaukee river, in the south-eastern part of the state. It is regularly laid out, with broad streets, paved mainly with wooden blocks. Its water-supply is derived from Lake Michigan, and it has an excellent sewer system. Among its newer buildings of note are the Federal Building (housing the Post Office, Custom House, &c.), Court House, City Hall, the Chamber of Commerce, and the Public Library (containing 100,000 volumes). Milwaukee is a lake port of the first importance, having an excellent harbour, improved by breakwaters. Most of its commerce is domestic, and consists mainly of grain and lumber. It is also a large railway centre, being entered by four railways —the Chicago and North-Western, the Chicago, Milwaukee and St Paul, the Pere Marquette, and the Wisconsin Central, giving it a large inland traffic. As a manufacturing city Milwaukee is of great importance. In 1900 it contained 3342 manufacturing establishments, with a total capital of $110,363,854. They employed 48,328 hands (exclusive of 4352 salaried officials, clerks, &c.), to whom was paid in wages $20,240,656. The value of materials used was $65,118,719, and that of the products was $123,786,449. The principal of these products, with their values, were as follows:—flouring and grist-mill products, $6,357,983; foundry and machine-shop products, $14,495,362; iron and steel, $7,410,213; leather (tanned, curried, and finished), $10,267,835; malt liquors, $13,899,390; slaughtering and meat-packing (wholesale), $5,980,340. The city is noted for its extensive breweries, the products of which are distributed to all parts of the country. The assessed valuation of real and personal property in 1900, on a basis of about 60 per cent. of the full value, was $158,174,873; the net debt was $6,576,586, and the average rate of taxation was $23.14 per $1000. The actual income of the city for the fiscal year, exclusive of loans, was $4,349,065, and the expenditures, exclusive of loans repaid, were $4,313,889. Population (1880), 115,587; (1890), 204,468; (1900), 285,315, showing a very rapid growth. Of the total population in 1900, 98,991 were foreign-born (principally Germans) and 862 were negroes. There were 98,802 persons of school age (5 to 20 years inclusive). Out of a total of 75,020 adult males, 34,535 were native-born (of whom only 163 were illiterate, *i.e.*, could not write), and 40,485 were foreign-born (of whom 2896 were illiterate). The death-rate in 1900 was 15·9; in 1890 it was 18·8.

Minas Ceraes, a state of Brazil, situated between 13° 55′ and 23° S. and 39° 37′ and 50° 58′ W., bounded on the N. by the state of Bahia, on the W. by Goyaz, Matto Grosso, and Sao Paulo, on the S. by Sao Paulo and Rio de Janeiro, and on the E. by Espirito Santo and Rio de Janeiro. Its area is 222,160 square miles, and it has the largest population, about 3¼ millions, of any state in Brazil. The capital, Ouro Preto, has a population of over 20,000. Amongst other towns are Diamantina (13,000), Entre Rios (8500), Marianna, Earbacena, Abaeté, Bambuhy, Curvello, &c. The state is well provided with railways, and its mines and agricultural products are rich and varied.

Minbu, a division and district in Upper Burma. The division includes the districts of Thayetmyo, Pakôkku, Minbu, and Magwe. It has a total area of 17,170 square miles, and a population (1891) of 996,873, and (1901) 1,077,978, showing an increase of 8 per cent., and giving a density of 63 inhabitants to the square mile, with 4095 villages paying in 1898–99 a revenue of Rs.23,28,599. It bestrides the Irrawaddy. The district of Minbu has an area of 3297 square miles, and population (1891) of 215,563, and (1901) 236,262, showing an increase of 9·6 per cent. and a density of 71 inhabitants to the square mile, with 1043 villages paying a revenue of Rs.5,99,866. As a whole the district may be said to consist of low plain land towards the Irrawaddy, and of undulating country inland rising higher and higher westwards towards the Arakan hills. Between the plain and the Yoma is a distinct range of hills running north and south, and usually called the Nwa-Madaung hills. The submontane valleys are largely cultivated, but are deadly except to those born in them. The chief streams besides the Irrawaddy are the Môn, the Man, and the Salin, which are largely used for irrigation purposes. At Minbu town the Irrawaddy is 3 miles wide, with numerous islands and sandbanks. There are considerable fisheries along the Irrawaddy and on the Paunglin lake, which is a lagoon fed from the Irrawaddy. The rights are sold yearly by public auction, and realize an average of Rs.15,000. Oil has been discovered near the mud volcanoes of Minbu, but it seems to lie at too great a depth to be profitably worked.

There are 185 square miles of reserved forest in the district. The great bulk of the population is agricultural, and the chief crops raised are paddy, gram, millet, beans, peas, sesamum, and tobacco. The betel-vine is largely cultivated along the Môn river. The district, which was in a chronically disturbed state before the annexation, was not reduced till two years afterwards, many officers losing their lives, among them Phayre, the first deputy-commissioner. The population of the district in 1891 was made up of 206,914 Buddhists, 6867 Chins, 956 Hindus, 691 Mahommedans, and 135 Christians. 173,408 acres were cultivated in 1898–99, and 463,000 acres were available for cultivation; 362,827 acres of current fallow existed, and there were 229,120 acres of forest land, besides 881,771 not cultivable. The annual rainfall varies greatly over the district. It is very considerable on and under the Arakan Yoma, and very slight towards the Irrawaddy. The total in 1898–99 at Minbu was 25·66 inches. The thermometer rises to over 100° in the hot months, and the mean of minimum readings in December is usually about 49°. Minbu, the district headquarters, stands on the Irrawaddy. It had a population of 7270 in 1891. A bank has formed in front of the town, so that the river steamers in the dry season can come no nearer than two miles to the south of the town. (J. G. SC.)

Minden, a town and episcopal see of Prussia, province of Westphalia, on the river Weser, 40 miles west-south-west of Hanover by railway. The churches of St Mary and St Simeon, the synagogue (1864), the post office (1895), the war memorials of 1864–66 and 1870–71, and the classical school (with two large paintings by Thumann) should be mentioned. Population (1885), 18,592; (1900), 24,327.

Minehead, a market town and seaside watering-place of Somersetshire, England, on the Bristol Channel, with a station (branch terminus) on the Great Western railway. It has a tidal harbour and a quay. Minehead is the point of departure for the coaches to Porlock and Lynton. Population, about 3000.

Mineo, a town of the province of Catania, Sicily, Italy, with a station (4 miles distant) on the branch line from Catania (35 miles) to Caltagirone. The ancient *Menœ*, laid out by the Sikelian chief Ducetius, a native of the town, in the middle of the 5th century B.C., it was captured by the Saracens in 840. Four miles to the north is Lake Palici, with strong outflow of carbonic acid, a place of great sanctity and veneration to the ancients, who had there a widely famous temple to the "Palician gods." Population, about 9000.

Minghetti, Marco (1818–1886), Italian patriot and statesman, was born at Bologna on 18th November 1818. In 1846 he signed the petition to the Conclave for the election of a Liberal pope, and was appointed member of the State Council summoned to prepare the constitution for the papal states. In the first constitutional cabinet, presided over by Cardinal Antonelli, Minghetti held the portfolio of public works, but after the allocution pronounced by Pius IX. against the Italian war of independence he resigned office and joined the Piedmontese army with the rank of major. Returning to Rome in September 1848, he refused to form a cabinet after the assassination of Pellegrino Rossi, and, withdrawing from political life, spent the next eight years in study and travel. Summoned to Paris by Cavour in 1856 to prepare the memorandum on the Romagna provinces for the Paris congress, he resumed his public labours for the cause of unity, and was in 1859 appointed by Cavour secretary-general of the Italian Foreign Office. In the same year he was elected president of the assembly of the Romagna after the rejection of pontifical rule by those provinces, and prepared their annexation to Piedmont. Appointed Piedmontese minister of the interior, he resigned office shortly after Cavour's death, but was subsequently chosen to be minister of finance by Farini, whom he succeeded as premier in 1863. With the help of Visconti Venosta he concluded (15th September 1864) a convention with France known as the "September Convention," whereby Napoleon agreed to evacuate Rome and Italy to transfer her capital from Turin to Florence. The convention excited violent opposition and sanguinary disorders at Turin, in consequence of which Minghetti was obliged to resign office. An object of hatred and unjust accusations, he took little part in public life until 1869, when he accepted the portfolio of agriculture in the Menabrea Cabinet. Both in and out of office he exercised his influence against the scheme of an Italo-French alliance and in favour of an immediate advance upon Rome, and in 1870 was sent to London and Vienna by the Lanza-Sella Cabinet to organize a league of neutral powers in consequence of the outbreak of the Franco-Prussian war. In 1873 he overthrew the Lanza-Sella Cabinet and regained the premiership, which, with the portfolio of finance, he held until the fall of the Right from power on 18th March 1876. During his premiership he inaugurated the *rapprochement* between Italy, Austria, and Germany, and before his fall was able, as finance minister, to announce the restoration of equilibrium between expenditure and revenue for the first time since 1860. After the advent of the Left, Minghetti remained for some years in Opposition, but, towards 1884, joined Depretis in creating the parliamentary phenomenon known as "Transformism," which consisted in bringing Conservative support to Liberal cabinets. Minghetti, however, drew from it no personal advantage, and died at Rome on 10th December 1886 without having returned to power. (H. W. S.)

Miniatures.—The word miniature is derived from *minium*, signifying red lead, in consequence of the capital letters, borders around pages, and headings to chapters in ancient manuscripts having been drawn in this material; it was applied originally to the decorations on the pages of such manuscripts. These illuminations were at first executed in red alone, and afterwards in various colours, when later on they took the form of elaborate designs, embracing pictures of saints, portraits of persons, and illustrations of stories and legends, with religious emblems and medallions. By a further development the word came to be applied to such pictures or portraits as were similar in size to these small illuminations on MSS. It is believed that this use of the word came into vogue in the early part of the 18th century, and was applied to such paintings as before then had commonly been called either "limnings" (see the catalogue of the pictures belonging to Charles I.) or else "paintings in little" (see *Pepys' Diary*, 30th March 1668, &c.). The word is now used mainly in this sense, and by a miniature is meant a painting on a very small scale, usually a portrait, painted on ivory, card, or metal, of such a size as can be carried in the pocket.

In Europe the art of painting in miniature is to a great degree distinctively English, and the greater number of the chief masters in the art have been Englishmen or at least have lived in England. Several of the great portrait painters are said to have worked occasionally in miniature, and there are paintings, small in size, which are attributed with reason to Holbein, Antonio More, "Shootes and Betts" (see Lomazzo's *Trattato dell' Arte della Pittura*, Oxford, 1598), Cleef, Stretes, Teerlinck, Zucchero, John and T. Betts, and with less probability even to Van Dyck. The first true miniaturist, however, was Nicholas Hilliard (*circa* 1547–1619), whose work partakes of the character of that seen in illuminated manuscripts. The colours are opaque, gold is used to heighten the brilliant effect, and the paintings are on card. They are often signed, and have frequently also a Latin motto upon them.

Isaac and Peter Oliver (father and son) succeeded Hilliard. Isaac (*circa* 1551–1617) is said to have been the pupil of Hilliard and of Zucchero. Peter (died 1647) was the pupil of Isaac. The two men were the earliest to give roundness and form to the faces they painted, leaving for ever the flat method of the illuminators. They signed their best works by a monogram, and painted not only very small miniatures, but larger ones measuring as much as 10 inches by 9. They copied for Charles I. on a minute scale many of his famous pictures by the old masters. Several of these copies are at Windsor and Montagu House. At about the same date Gerbier, Poelemberg, Jamesone, Penelope Cleyn, and her brothers, were workers in the art. John Hoskins (died 1664) was a far better artist in miniature than those just named, but his greatest claim to recollection consists in his having been the master of Samuel Cooper, the greatest English miniaturist. The work of Hoskins can be specially well studied in the collection at Ham House.

Samuel Cooper (1609–1672) was a nephew of Hoskins. He spent much of his time in Paris and Holland, and very little is known of his career. His work has a superb breadth and dignity. It has been well if paradoxically called "life-size work in little"; and the portraits which he painted of the men of the Puritan epoch are remarkable for their extraordinary merit, for truth to life, and for strength of handling and presentment. He painted upon card, chicken-skin (*pecorella*), or vellum, and on rare occasions upon rough bone. The use of ivory was not introduced until after his time. His work is frequently signed with his initials, generally in gold, and often in the hair of the person depicted. Flatman (died 1688), Alexander Cooper, brother of Samuel Cooper, David Loggan, White, Sadler, Digby, and Faber deserve notice at this period; and they were followed by such artists as Lawrence Crosse (died 1724), Gervase Spencer (died 1763), Lens, Hone, and Meyer, the latter two of whom were notable in connexion with the foundation of the Royal Academy.

The 18th century produced a great number of miniature painters, of whom Richard Cosway (*circa* 1742–1821) is the most famous. His works are of great beauty, and are done with a dash and brilliance which no other artist excelled. The leading miniaturist of his time, Cosway was especially popular in the circle of the Prince Regent. His best work was done about 1799. It is always on ivory, although he also did what were called "stayned drawings." These were drawn in pencil on paper, with the faces coloured. Cosway's finest paintings are signed on the back with a specially pompous signature; there is known but one genuine Cosway miniature which is signed on its face; very few bear even his initials on the front. George Engleheart (1750–1829) was his great rival, and was attached to the court of the king. He painted 4900 miniatures, and his work is stronger and more impressive than that of Cosway; it is often signed "E." or "G. E." Andrew Plimer (1763–1837) was a pupil of Cosway, and both he and his brother Nathaniel, who worked in the same studio, produced some lovely portraits. The brightness of the eyes, wiriness of the hair, and exuberance of colour, combined, however, with drawing which is often very inaccurate, are characteristics of Andrew Plimer's work.

John Smart (1741–1811) was the greatest of Cosway's pupils. His work surpassed that of his master in refinement, power, and delicacy; its silky texture and elaborate finish, and the artist's love for a brown background, distinguish it. Other notable painters were Ozias Humphrey (1742–1810); Nixon (1741–1812); Shelley (*circa* 1750–1808), whose best pictures are groups of two or more persons; William Wood, a Suffolk artist (1768–1808); Edridge (1769–1821); Sullivan, Sheriff, Crosse, Boyle, and Finney. In the 19th century J. C. D. Engleheart (1784–1862; nephew of George), Andrew Robertson (1777–1845), Beaumont, Behnes, Harlow, Heaphy, and Mrs Mee must be mentioned. Sir Thomas Lawrence painted miniatures, but the art may be said to have died out with Sir William Ross, the Chalons, and Newton (although some works by Landseer in this form are in existence). Towards the end of the 19th century there was an attempted revival; but although there have been many miniatures, there have hitherto been no masters. Of modern miniature painters, Alyn Williams best deserves mention.

Many fine miniatures were executed in enamel. Petitot (1607–1691) was the greatest worker in this material, and did his finest portraits in Paris for Louis XIV. His son succeeded him in the same profession. Other artists in enamel were Boit (died 1727), Zincke (died 1767), Hurter (1734–1790), Spicer, Thouron (1737–1789), Prieur, Dinglinger, and Thienpondt. Many of these artists were Swiss, but most of them visited England and worked for a while there. The greatest English enamel portrait painter was Henry Bone (1755–1834), the finest of whose productions are now at Kingston Lacy. A great collection of his small enamel reproductions of celebrated paintings is in Buckingham Palace.

Perhaps the earliest French miniature painter was Jean Clouet (died *circa* 1490), while of a much later date Blarenberghe (born 1719) and Drouais (1699–1767) should also be mentioned; but the most popular artists were Augustin (d. 1832) and Isabey (d. 1855). Their portraits of Napoleon and his court are exceedingly fine.

Hall the Swede and Füger the Austrian were also great miniature painters; and others whose names might be mentioned were Werner (1637–1710), Rosalba Carriera (1675–1757), Chatillon, Pasquier, and Festa.

Miniatures are painted both in oil and in water colour, but by far the greater number are in water colour. A few of Cooper's works are in oil, and these are generally painted on copper. The work of the 18th century is exclusively in water colour. The use of ivory came into general adoption in the early part of the reign of William III., although there are extant miniatures even by Cooper which are painted on a sort of rough bone closely resembling ivory. The work of Snelling, David Loggan, and others was in pencil, used with great effect on vellum. The earliest miniatures are upon card, copper, vellum, or chicken-skin.

The greatest collections of miniatures in England are now (1902) those in the possession of the King, the duke of Buccleuch, the earls of Ilchester, Dysart, Dartrey (notable for enamel work, some examples of which are of the greatest rarity), and Ancaster (especially notable for works by Cosway); of Earl Beauchamp, the Baroness Burdett-Coutts, Sir Gardner Engleheart (notable for works by the Englehearts), Countess Tolstoy, and Messrs. Drake, Digby, J. Pierpont Morgan (noteworthy for the superb series of 18th century portraits and works by Cooper), Senior, E. W. Williams, Whitehead, and Usher of Lincoln. There are also very fine works by Cooper at South Kensington, and in the same gallery, in the Jones collection, some splendid works by Petitot; and there are some famous foreign portraits and picture-miniatures in the Wallace collection, Hertford House, London. The collection at the Louvre, especially as regards the works of Petitot, is of supreme merit; and there are also fine collections at Vienna, Berlin, and Florence.

See also J. J. Foster. *British Miniature Portraits.* London. 1898.—J. L. Propert. *History of Miniature Art.* London, 1887.—G. C. Williamson. *Portrait Miniatures.* London, 1897; *Richard Cosway.* London, 1897; *George Engleheart.* London, 1902; *Andrew Plimer, &c.* London, 1902.—Lacroix. *Revue des Arts*, 1860; *Les Emaux de Petitot du Louvre.* Paris, 1862–64.—Catalogues of the Buccleuch Gallery, Welbeck Gallery, Ward Usher Collection, Bemrose Collection, Morgan Collection, all privately printed, and the catalogue of the collection exhibited at South Kensington, and the privately-issued catalogue at the Burlington Fine Arts Club, with illustrations dated.

(G. C. W.)

Mingrelia. See Caucasus and Kutais.

Mining (see also *Ency. Brit.*, ninth edition, vol. xvi.).

1. *Occurrence.*—In the case of the precious metals several new and interesting discoveries may be mentioned. The three principal are the gold deposits of the Witwatersrand, Cripple Creek, and West Australia. In the year 1885, when first the news came that gold was being found to the south of Pretoria, no one dreamt of the vast importance of the discovery. The metal is there found in several beds of conglomerate, which are interstratified with sandstone and quartzite. The conglomerate consists of quartz pebbles, often the size of a walnut or larger, cemented together in the main by silicious matter and iron pyrites. The gold is contained almost entirely in this cementing material, the quartz pebbles themselves being usually barren. As in the case of other pyritiferous deposits, the parts near the surface are decomposed into oxides, with liberation of the gold, and the easily-worked rusty conglomerate was the source of riches in the earlier days of Johannesburg. The fears that the passage of the oxidized ores into pyrites meant disappearance of the gold are now allayed, and mining engineers do not hesitate to propose to work the pyritiferous beds at a depth of 5000 feet or more. Cripple Creek is a small but rich gold-bearing district in Colorado, where the precious metal occurs largely in combination with tellurium. The tellurides are found in sheets of fissured volcanic or granitic rock altered by mineral solutions. The principal tellurides appear to be calaverite. The state of West Australia attracted little attention until the wonderful discoveries at Coolgardie proclaimed it to be a rich gold-bearing country. The gold occurs native in quartz veins, and also more particularly as a telluride. The so-called "lode formations" of Kalgoorlie are zones of shattered igneous rock, so crushed as to be often schistose in texture, in which tellurides have been deposited. There is no marked sharp plane of division ("wall") separating the auriferous deposits from the surrounding rocks. Here, as at Cripple Creek, we have examples of the doctrine of "selective porosity"—that is to say, certain zones of rock are rich, because the metal-bearing solutions found the fissured portions to be the easiest channels for their passage, and coursed with greater abundance through them. In other words, where the path was easy and the flow abundant, the deposition was copious; impermeable belts of rock received no nourishing currents, and remained barren. This theory may further be advanced as an explanation of the fact that the conglomerates, *i.e.*, coarse or more permeable sediments, in the Transvaal contain payable quantities of gold, whilst the fine sediment, the sandstone, is barren or poor. The Cripple Creek and Kalgoorlie gold deposits are remarkable instances of veins or lodes which are tabular masses of altered rocks, and not merely filled-up fissures.

2. *Prospecting.*—The searcher is now often better equipped for his work by having acquired an elementary knowledge of mineralogy and blowpipe analysis. In some cases a knowledge of geology has had far-reaching effects; the most brilliant example of the result of geological reasoning is the discovery of coal in Kent. Carefully conducted magnetic observations with the Thalen and Tiberg instruments have proved valuable in prospecting for magnetic iron ore. Professor H. Louis has improved the American dipping needle, and finds that it may be usefully applied in searching for deposits of pyrrhotite, which may be rendered valuable by the accompanying nickel or copper ore.

3. *Boring.*—No one process of percussive boring can claim universal adoption. The old Chinese system of boring with the rope has been brought to a high pitch of perfection in the United States, where it has been and is still largely used for drilling oil wells. In Europe rods, either of iron or wood, seem to be preferred, though rope boring is by no means unknown. Fauck of Vienna has introduced an improvement by substituting a quick short stroke for the old-fashioned slow and long stroke; and by combining this method with the water-flushing system he has attained great rapidity and economy in boring. The rods are hollow, and a stream of water is constantly being forced down through them to the very bottom of the hole, as in the case of the diamond drill. The débris are therefore removed as fast as they are produced, and there is no necessity for stoppage for clearing out the hole. If cores are required, Fauck employs a special chisel with a large central hole, and instead of forcing down water through the rods, pumps it up. The cores are sucked up in this manner, and are delivered piece after piece into a receiving box at the surface. Years of experience with the diamond drill have led to the introduction of sundry improvements. Instead of fixing the black diamonds in the crown itself, each separate stone is often set in a piece of steel, which can be let into a suitable recess in the crown. The advantages of this method are, firstly, firmer setting and consequently less danger of loss of the stone; and secondly, the possibility of shifting stones from one crown to another without resetting. A crown with steel teeth, exchangeable with the diamond crown, has been successfully used for the softer strata, as in the Davis calyx system. It has been abundantly proved that bore-holes frequently deviate very considerably from the straight path they were intended or supposed to take, and in some cases it becomes very important to determine the amount and direction of the deviation. McGeorge's clinograph is one of several ingenious appliances which have been used.

4. *Excavation.*—Everywhere there is a growing tendency to substitute power-driven machines for hand tools. The power may be generated on the spot, but in the case of underground excavations it is usually transmitted by water, compressed air, or electricity. The air-compressors most commonly used work dry—that is to say, there is no injection of water. The cooling of the air in the cylinder is affected by an outer jacket with a constant flow of water. Two-stage compressors with an intermediate cooler enable a pressure of 90 ℔ per square inch to be reached without difficulty. The machines used in excavating may be classified as follows:—A. Diggers and dredgers; B. Machines for boring holes for blasting; C. Groove-cutters; D. Tunnelling machines and shaft-sinking machines.

A. The principal types of *mechanical excavators* are the steam navvy, or steam shovel, as it is commonly called in the United States, the grab dredge, and the bucket or ladder dredge. The steam shovel is a huge scoop worked by a small steam engine standing on a truck, which also carries the steam boiler. The whole machine runs upon rails which are laid down as the excavation proceeds. The amount of work done by these machines is enormous. A 90-ton "Vulcan" steam shovel dug up and loaded into railway cars no less than 170,000 gross tons of iron ore in twenty-six days at the Mountain Iron Mine, Minnesota. This type of excavator is employed very largely for stripping off overburden and for quarrying iron ore. It is also seen in some of the open workings for anthracite in Pennsylvania; it is used for loading iron ore from stock piles into railway waggons, and when mounted on a barge it will scoop up auriferous gravel and sand from the bed of a river. Grab dredges are semi-cylindrical or semi-spherical buckets, raised and lowered by cranes, and so constructed that they open on being lowered, fill themselves, and then close on being raised. The bucket is then swung round by the crane and made to drop its contents into a railway waggon or other receptacle. The grab, or "clam-shell" dredge, as it is usually called in the United States, is principally used for excavating under water. Bucket or ladder dredges resemble the well-known machines in common use for deepening river channels and harbours. They find their most important sphere of action in raising gold-bearing sand and gravel from the beds of existing rivers, or from adjacent alluvial flats. New

Zealand has profited greatly by this method of working, and fully one-seventh of the gold produced by this colony is extracted in this manner, which is exceedingly economical. According to an official report published in 1899, the cost of dredging the gravel, washing out the gold, and getting rid of the waste is only from 1d. to 3d. per cubic yard. The addition of the tailings elevator is an important improvement.

B. Of *machine drills* there are two main types, viz., rotary and percussive. Rotary drills worked by water, compressed air, or electricity are in common use. Brandt's hydraulic drill, with a toothed steel crown, has increased its reputation by enabling two of the "ends" of the Simplon tunnel to be driven at the enormous speed of 22 feet per day through hard rock. Motors driven by compressed air or electricity can easily be made to communicate rotary motion to a twist drill, and machines of this description are to be found in various mines in which comparatively soft materials, such as coal and ironstone, are being excavated. Percussive drills are worked by compressed air or by electricity · of the former kind two principal varieties may be distinguished, according as the cutting chisel is attached to the moving piston-rod or receives blows from a mechanical hammer in imitation of the hand tool. The former type is by far the more common, and in fact at the present time is the one almost universally adopted. The machines, though called by various names, have often very much in common, and are distinguished merely by some slight difference in the valve. The hammer-action machines more or less resemble the caulking, chipping, and riveting tools of the ship-yard, and are mechanical hammers which strike several thousand blows per minute upon the head of the chisel. There appears to be a great future for appliances of this kind, in which the extreme rapidity of the stroke makes up for the want of power of each particular blow. A most important point in their favour is their lightness. The Franke drill of the Mansfeld mines, which is held in the hand, weighs only 16 ℔; the small Schmucker drill weighs 35 ℔, and the large one 80 ℔. The Schmucker drills require stands, but they are far lighter and more easily handled than the percussive drills in common use. The new Leyner drill, a heavier machine with a less rapid stroke, is distinguished by its good water-flushing arrangement. Electrically-driven percussive drills are not yet largely employed, in spite of the urgent need which exists of a suitable machine. The problem of obtaining a reciprocating motion by means of an electrical current is solved in two ways. The Marvin drill, already used in a few workings, is based upon the principle of the solenoid. The electric current passes alternately through two coils of copper wire, and converts them into magnets sufficiently strong to suck the tool-holder backwards and forwards; the backward stroke compresses a spring, the recoil of which aids the forward blow. The second method consists in employing rotary motors, from which a back-and-forward action is easily obtained by the aid of a crank. Siemens and Halske, who have already supplied several hundred percussive electric drills, keep the motor entirely separate from the striking part. It is placed in a box on the floor of the working place, and its rapidly rotating axle is connected to the drill proper by the aid of flexible shafting. The drill proper is thus rendered much lighter and more easily handled. The same method is followed in the Gardner electric drill.

C. *Groove-cutters.*—Mechanical groove-cutters serve in quarrying stone, and for undercutting beds of coal or other minerals. There are many varieties: mechanical chisels, boring machines mounted on bars along which they can be shifted, travelling jumpers running upon rails, circular saws, endless chain armed with cutting teeth, wire saw, revolving toothed bar, blade with scythe motion. Mechanical chisels are largely employed in coal mines in the United States for the purpose of undercutting (*holing*). The best-known machines are the Harrison, the Ingersoll, and the Sullivan. This type of coal-cutter consists of a strong cylinder, with an air-driven piston, mounted on a couple of wheels, and having handles at the back to enable the operator to turn it in the desired direction. Into the end of the piston-rod is fitted a strong chisel, the blows of which are directed against the bottom of the bed of coal, the underlying shale, or some parting of waste, so as to chip out a groove corresponding to the "holing" of a hand-wielded pick. According to Mellin (*Glückauf*, vol. xxxvi. p. 1057), one-quarter of the bituminous coal raised in the United States in 1900 was undercut mechanically, and 1997 out of a total of 3125 machines in use belonged to the type just described. There is every reason to believe that the rapidity of the rise in the production of coal in the United States is largely due to the introduction of coal-cutting machinery. Franke's small groove-cutter, used at the Mansfeld copper mines, is a chisel which is struck several thousand blows a minute by a pneumatic hammer. There is no reason why tools of this description should not be used for "holing" coal. If a series of holes are bored in a line and almost touching each other, it is easy to make a groove by breaking down the intervening partitions. Several of the well-known manufacturers supply quarry-bars upon which their boring machines can be mounted, so as to bore the necessary set of holes in a vertical or inclined position and produce a severance along any desired plane. In the third type, of which the Wardwell channeller is a good example, compressed air or steam is made to communicate a reciprocating motion to a set of chisels clamped together; the machinery is mounted upon a carriage running upon horizontal rails which are laid upon the surface of the bed of stone to be cut. The chisels cut a vertical groove, which can be prolonged indefinitely as the machine travels. Other machines will cut an inclined groove if necessary. The so-called "disc-cutters" are circular saws mounted upon carriages which travel upon rails laid along the working face. The saw is driven by an electric motor or a compressed-air engine, and as the carriage is drawn along automatically, the saw makes a long undercut in the seam of coal or other mineral which has to be worked. The armed endless chain likewise does its work by a sawing action. Upon a frame shaped liked like an isosceles triangle are fixed three pulleys, a driving pulley at the apex and a guiding pulley at each of the other two angles. A chain is kept continually in motion around the frame by means of a compressed-air or electric motor working the driving pulley. The chain is armed with steel teeth at suitable intervals. The short side of the frame opposite its apex is brought against the face of the coal, and when the chain is set in motion its teeth cut a groove parallel to this side; all the time the chain is cutting, its frame is being mechanically fed forwards at right angles to the line of the groove, so that eventually the coal is undercut over a space equal to the width of the frame multiplied by the amount of the forward feed, say 5 feet by 6 feet. The frame is then withdrawn, and the machine shifted sideways so as to begin a new cut. This kind of machine requires a considerable amount of open space at the working face, and therefore it cannot be used unless the roof is strong enough to remain without supporting timber for some distance. It is chiefly used for "pillar and stall" workings. The wire-saw may be regarded as a kind of band saw. It is an endless strand composed of three steel wires, which is kept moving upon the rock while sand and water are fed to it. The grains of hard sand are caught in the spaces between the wires, dragged along, and so made to abrade the stone and cut a groove. The wire is kept constantly pressed against the bottom of the groove by the aid of two pulleys, one at each end of the cut. In the case of a vertical cut these pulleys are placed upon suitable frames in small pits, and are so arranged that they can be fed downwards by the aid of screws. The wire-saw is employed in various open marble quarries for making long cuts in the live rock and for subdividing the blocks afterwards, and it has also been applied to the "getting" of slate in underground slate quarries. It is made to cut a horizontal groove over a space 170 feet long by 39 feet wide, and the work is done at a cost of only 16d. per square yard. This application of the wire-saw to horizontal cutting may have very far-reaching effects. Monticolo has introduced what he calls a "penetrating pulley," which enables the terminal pits to be dispensed with, or rather to be replaced by two inexpensive bore-holes. The mode of action of the revolving toothed bar will be understood by looking upon the cutting tool as a gigantic round rasp standing at right angles to the working face, and revolving rapidly, while the frame, which carries it and its driving machinery, is made to travel upon temporary rails laid parallel to the working face. Fayol's coal-cutter is a toothed blade to which a scythe-like motion is imparted by a compressed-air motor. Like the disc-cutters, these two last machines require a small amount of free space, and may be made to travel for an unlimited distance along an uninterrupted face of long-wall workings, cutting a continuous groove.

D. *Tunnellers* are machines which cut out a drift in one operation, or, at all events, an annular groove which will render the completion of the drift a very easy matter. Stanley's "heading" machine consists of a strong axle standing in the centre line of the drift and made to revolve by the aid of compressed-air engines. It carries a cross-head with large teeth at each end; these cut an annular groove as they revolve, and in soft rocks, such as coal, the work of complete excavation is speedily accomplished with the pick. The machine cuts a circular tunnel 5 feet in diameter. It has been proposed to apply this principle of mechanically cutting an annular groove to the case of sinking shafts through fairly hard ground, but no large undertaking of this kind has been carried out at present. On the other hand, shafts are being sunk on the Continent by several ingenious rotary boring processes in soft ground or through quicksands.

5. *Explosives.*—In no branch of mining has more progress been made than in the manufacture of mining explosives, particularly with the object of supplying materials which can be used with safety in collieries. A conviction has gradually come over the mining world that many of the worst explosions in collieries have been due to the ignition of gas, or of a fine coal dust floating in the atmosphere, by the flame of the explosive used in blasting, especially when the shot, instead of rending the coal, blows out the tamping like a ball from a cannon. It is to the French Firedamp Commission that we are specially indebted for early scientific investigations upon the subject. They ascertained that if the gases given

off by an explosion have a temperature exceeding 2200° C., they are liable to ignite firedamp, and a law was made prohibiting the use of gunpowder altogether and permitting only such explosives as have a temperature of detonation considerably below the limit just named. Austria, Belgium, Germany, and Great Britain have followed the example of France in endeavouring to supply the miner with explosives possessing a reasonable amount of safety, and a special statute (59 and 60 Vict. c. 43) was passed in Great Britain in 1896 to give the Secretary of State full statutory powers for dealing with the question. An official testing station has been erected at Woolwich; the explosives which pass the test are placed upon what is known as the "Permitted List," and their use is then sanctioned. In order to enable mine-owners to ascertain which are the safer of the explosives in this list, which includes some that barely succeed in satisfying its conditions, the British Government has instituted a "Special Test," which is far more severe than the first. Not only in explosives themselves, but also in the means of firing them, much progress has been made. Cheap and trustworthy electric fuzes are now manufactured on a very large scale, both on the high- and the low-tension systems, and are used with advantage instead of the ordinary safety fuze. Where it is necessary to delay the ignition of certain shots until others have been exploded, electric time fuzes are available. In Austria several other methods of ignition have received the approval of the authorities, such as Tirmann's percussion fuze, Lauer's friction fuze, and Jarolimek's lime fuze. Though the old process of fire-setting is extinct save on a small scale in very out-of-the-way districts, the agency of heat is invoked by the miner for the purpose of thawing ice-bound auriferous alluvium and so facilitating the process of excavation. Prospectors in Siberia have long been accustomed to sink their shafts by the aid of heat generated by burning billets of wood. In the Klondike district this process of thawing has been largely replaced by the use of steam. A boiler is erected at the surface and steam is taken down the shaft in a pipe, a hose from which conducts it to the working place. At the end of the hose is a piece of iron pipe terminating in a small hole. Steam is turned on, and the pipe is passed into the frozen gravel and left there. After the lapse of three or four hours a large mass of gravel has been thawed, and can easily be worked away with the pick.

6. *Principles of employment of mining labour.*—Persons employed at mines are still paid by time, by work accomplished or calculated by measuring or weighing, or by some settled proportion of the value of the mineral excavated, as described in the ninth edition of this work (vol. xvi. p. 449).

7. *Support.*—Three kinds of supporting materials are still in use, viz., timber, metal, and masonry, the last heading including both brickwork and concrete.

In order to reduce the expense of cutting the somewhat complicated joints required for "square sets," mines now use special machines consisting of circular saws so arranged as to make the necessary cuts. Machines like huge pencil-sharpeners are employed for tapering the ends of props when Hepplewhite's system is adopted. Preservatives against dry rot are not commonly used, in spite of the advantage of prolonging the life of the timber and rendering it less inflammable. Aitken's process of impregnating the timber with a solution of the chlorides of sodium and magnesium has been found very effective at certain collieries in Scotland. Steel is becoming a favourite supporting material in many countries, and especially for permanent levels and shafts. It possesses many advantages, especially durability, small size compared with timber and consequent increase of ventilating area, and is free from danger from fire. The H-section is usually adopted, and two bars suitably bent into an arched form at the top, which can be quickly and firmly united by fish-plates, form an admirable lining for a level. The ground between two adjacent frames may be further supported by small rods of square section. This kind of support is common in many French collieries. Where the bottom of a level is liable to rise, from the pressure upon it, the steel lining is sometimes made of two semicircles suitably joined by sleeves. Shafts are lined with circular frames of channel steel, each frame consisting of two or more segments united by suitable fish-plates and bolts; the space between two successive frames is lined with planks or with bars of steel. The commonest permanent lining for round shafts in Great Britain is brickwork; but concrete is gradually coming to the front, on account of its two great advantages, viz., speed of execution and economy in price. In northern France, where cast-iron lining (*tubbing*) is common, it is usual to employ segments with *internal* flanges which are bolted together. The stanchness of the joint is secured by interposing thin sheet lead. The Poetsch method of sinking in water-bearing strata by artificially freezing the ground (see Coal) was successfully applied in many instances at the end of the 19th century, and the boring processes associated with the names of Kind and Chaudron, which afford another solution of the problem of putting down a shaft through water-bearing rocks, have been considerably simplified in some of their later applications. The moss-box and equilibrium pipe have been dispensed with, and the engineers have relied upon very carefully placed concrete for making a stanch joint at the base of the tubbing.

8. *Exploitation.*—The methods of working away minerals have been arranged by Haton de la Goupillière in three great classes, according as the original excavation is left open permanently, is allowed to "cave" in of itself, or is artificially filled up with rubbish. On the whole, it may be said that the third method is gaining ground, and is being largely employed, not only in collieries, but also in working beds of slate and wide mineral veins. Though hydraulic mining in principle remains as it was, attention may be drawn to some successful applications in Australia, where alluvial flats are being worked with great success under conditions which would make the process impossible if carried out in the typical Californian manner. The necessary pressure for the powerful jet of water is obtained not by its natural fall, but by a steam pump; the stream of mud, sand, and gravel coming away from the working face is raised by a centrifugal pump, passed along gold-catching sluices, and, when deprived of its gold, is run into a part of the excavation whence the gold has already been extracted, and gradually fills it up. The steam boiler, the pump which generates the pressure, and the centrifugal pump are all carried upon a barge of very shallow draught, so that when work is finished at a given spot it is easy to float the plant to a short distance and repeat the operation until the whole flat has been treated.

9. *Haulage.*—More and more attention is being paid to the substitution of mechanical power for animal power in mines. In addition to the older process of haulage by wire rope or chain, the mine-owner now has at his disposal successful methods of doing the work by electricity and compressed air. Electric locomotives are usually operated by overhead wires with trolleys connecting them with the motor. Accumulators have been little used, though they have been adopted at the Vicoigne and Nœux collieries in the Pas de Calais. The compressed-air locomotive is adopted in fiery mines in order to secure freedom from sparks. The Porter locomotive is supplied from a large reservoir which is charged with air at a pressure of 600 ℔ per square inch.

10. *Winding.*—Flat ropes made of the so-called aloe fibre are still largely employed in France and Belgium, but hoisting is generally performed by round ropes of steel wire of a high tensile strain, often capable of supporting no less than 180 kilos per square millimetre, or, speaking roughly, 120 tons per square inch. Ropes with the so-called Lang's lay, in which the spirals of the strands are turned in the same direction as the spirals of the individual wires, have proved by long practice to last longer than ropes made upon the old principle. In order to make the surface of the rope more nearly approach that of a cylinder, and so to throw the wear upon a large number of wires, the strands are sometimes made oval by employing flat wire for the core. These "flattened strand ropes" have given good results. Casting aside entirely the principle of making wire ropes of separate strands, we come to the so-called locked coil ropes. Specially-shaped wires—V-shaped or S-shaped, for instance—are used, and in section the rope is seen to consist of several successive concentric sheaths, each composed of interlocking wires. The outer surface of the rope is cylindrical; no space is wasted, and a rope of given diameter is able to support a greater weight than one made in the old way. The carefully kept statistics concerning the life and wear of winding ropes in Westphalia are not, however, favourable

to the locked coil variety for hoisting purposes. The clumsy kibble hanging loose in the pit, or sliding along a bed of planks or poles in an inclined shaft, is fast disappearing, and in mines worked on a large scale the material is hoisted either in a cage, which carries the waggon, or in a steel box called a skip. Both cage and skip are properly guided. Efforts are constantly being made to increase the rapidity of hoisting. Machinery is employed to push the waggons from the cage, or the cage is so arranged that its floor is tilted automatically on reaching the surface, and causes the waggons to empty themselves without leaving the cage. The skips, whether hoisted up inclined or vertical shafts, are made to turn over automatically on reaching the surface, discharge their contents, and return to their original position without the aid of a workman (see Coal). For the prevention of accidents in winding, speed indicators and automatic speed-checking appliances have been introduced in various mines. Less reliance than formerly is placed upon safety catches, and especially in Great Britain, where, on the whole, they are regarded with little favour. No progress has been made in pneumatic hoisting, for the colliery where Blanchet's apparatus was in use had to be abandoned for lack of coal, and the system has not been tried elsewhere.

11. *Drainage.*—The most important drainage tunnel in course of construction at the present time is that which is being driven from Marseilles to unwater the Gardanne lignite mines, situated at a distance of more than 9 miles (15 kilometres) from the sea. The importance of this gigantic undertaking may be measured by the fact that the total cost is estimated at about a quarter of a million sterling. The work was to be finished by the end of 1902. It is calculated that the great adit will unwater 40,000,000 tons of lignite, besides enabling more than 100,000,000 tons to be worked from depths not exceeding 300 metres below it. When pumps have to be employed, the tendency is to abandon the old Cornish method of raising water, which consists in employing a slow-working single-acting beam engine with a ponderous main-rod to transmit power from the surface to a series of force pumps in the shaft, which step by step raise the water to the top. Nowadays the main pump is frequently placed in a chamber near the bottom of the shaft, and is made to force the water to the surface in one continuous column. The force-pumps are driven (*a*) by steam engines, the steam for which is usually generated at the surface and piped down the shaft; (*b*) by hydraulic engines driven by water under pressure brought down in pipes from the surface; (*c*) by compressed-air engines; (*d*) by electric motors connected by wires with dynamos on the surface. A type of electric pump in common use consists of three plungers actuated by a three-throw crank, driven by a quick-running motor, with suitable intermediate gearing or a belt for reducing the speed. Now engineers have gone further, and by diminishing the length of stroke of the plungers they have found it possible to run them at such a speed that the intermediate gearing is dispensed with entirely and the crank shaft coupled direct to that of the motor. Riedler and Stumpf's "Express" pumps are driven directly from electric motors or other high-speed prime movers making 200 to 300 revolutions a minute, and are employed for forcing considerable quantities of water to a maximum height of 1886 feet (575 m.). Ehrhardt and Sehmer likewise make mine pumps with the crank coupled directly to the shaft of an electric motor running at 200 to 300 revolutions a minute, and forcing 200 to 300 gallons (1 to 1½ cb.m.) of water per minute to heights of 800 to 1000 feet (250 to 300 m.), the cranks running in oil. They contend that mechanically controlled valves, a special feature of Riedler's pumps, can be dispensed with. It is manifestly unfair that one mine should be saddled with the expense of pumping more than its share of water because it happens to be deeper than its neighbours, and the difficulty is sometimes met by establishing a drainage board—*i.e.*, a corporate body whose sole business it is to drain the water from a definite area and make each mine pay a share of the expense. The scheme has worked well in South Staffordshire, where, in addition to maintaining large pumping engines, the Drainage Commissioners have done excellent work by preventing surface water from finding its way into the mines. At Mansfield also measures have been taken to prevent surface percolation.

12. *Ventilation.*—Though many mines, and especially workings on mineral veins, are dependent for their supply of air solely upon natural currents, the standard method of ventilation is by centrifugal fans, which have to a large extent entirely replaced the old furnaces, with great advantages of economy and safety. The main fan is placed at the surface, and acts almost invariably by exhausting the foul air from the mine. Sometimes certain working places in the mine are specially ventilated by small fans driven by electric motors or compressed-air engines. The fans most in use are those of Capell, Geissler, Guibal, Mortier, Rateau, Schiele, Ser, and Waddle. Murgue has devised an ingenious appliance, which shows the volume of air passing through a mine at any given moment, and registers it upon a scroll of paper placed around a cylinder, which revolves by clockwork. The curve which is traced resembles that of a self-registering aneroid barometer, and affords a useful check upon the mine officials, besides forming an important record in case of any disputes. Murgue has also done good work by pointing out the large amount of power expended in overcoming the friction of the air currents against the sides of mine passages, especially those which are timbered, and by explaining the manner in which such friction can be reduced. The means of testing the air of mines have been improved. Instead of depending upon the indications of an oil lamp, the searcher for fire-damp may now avail himself of the far more delicate alcohol flame. Chesneau's lamp, largely used in French collieries, burns alcohol containing chloride of copper, and the flame tinged by the metallic salt gives an indication of fire-damp when the amount of gas exceeds 0·1 per cent. Stokes has brought out a lamp with a detachable alcohol reservoir, which enables the oil flame or an alcohol flame to be used at pleasure. Le Chatelier's laboratory method of determining the amount of fire-damp in a sample by the limit of inflammability of a mixture of the gas and air, is regularly employed in some collieries. Shaw's more cumbrous apparatus depends upon the same principle. (Also see Coal.)

13. *Lighting.*—The safety lamp most largely used at the present day is that of Marsaut, though the name of the eminent French engineer is often ignored by manufacturers. It is a safety lamp with two or more gauzes and an outer shield capable of resisting strong air-currents with safety. The use of mineral oil in place of vegetable oil is spreading. Many safety lamps are now lighted electrically, with a great economy of time and trouble. An appliance for relighting a safety lamp which has gone out accidentally is largely used at some collieries on the Continent, and is considered by many engineers to be a valuable addition. A roll of paper, with little spots of a material ignitible by friction or a blow, is fitted close to the top of the wick and is rubbed or struck without opening the lamp, the flame so produced igniting the wick. The commonest method of preventing the illegal opening of safety lamps underground is by the lead plug; the magnetic lock finds favour in

some collieries; and the ingenious cuvelier, or water-pressure lock, is not without adherents. Much labour has been expended in endeavouring to devise a portable electric lamp for use in mines, but, so far, the Sussmann lamp is the only one which can claim to have been introduced on a large scale. Several thousands of these lamps are employed at collieries in England and Belgium.

14. *Ascent and Descent.*—The standard method of descent into mines and ascent therefrom is by the cage or the skip; even in the most conservative ore-mining districts managers are recognizing the absurdity of making a miner waste his strength and endanger his health by excessive ladder-climbing, and this mode of reaching and leaving the workings is disappearing. The man-engine, which has done good work in its day, is likewise doomed to extinction, now that strong steel ropes enable cages to be raised and lowered with so much rapidity and safety. (See ORE-DRESSING.)

15. *Legislation.*—Laws for rendering the miner's calling less dangerous are found in most civilized countries, and the amount of legislation in recent years has been great. The Acts of Parliament in the United Kingdom, and the mining law of the late South African Republic, may be taken as typical examples of laws for regulating the working of coal and ore mines respectively. The mines of coal, fire-clay, shale, and stratified ironstone in Great Britain are governed in the main by the Coal Mines Regulation Act of 1887 (50 and 51 Vict. c. 58). The Coal Mines Regulation Act of 1896 (59 and 60 Vict. c. 43) was passed with the prime object of giving the Secretary of State power to regulate the use of explosives in mines where blasting might cause dangerous explosions by igniting fire-damp or an atmosphere charged with coal dust. All the mines in the United Kingdom not covered by the Coal Mines Act are governed by the Metalliferous Mines Regulation Act, 1872 (35 and 36 Vict. c. 77). Its title is bad, as it regulates not only ore mines, but all underground workings for salt, slate, stone, &c. The Transvaal Law (Law No. 12, 1896) was a general mining statute dealing with many questions besides the safety of the workman. It was far ahead of the British Metalliferous Mines Act. Mine managers were required to give proof of their competency by passing an examination, plans had to be kept up by competent surveyors, and far more complete statistics of output had to be furnished than was the case in Great Britain.

16. *Accidents.*—It is a matter of great congratulation that mining is every year becoming a less dangerous occupation, and this assertion can be proved by reference to official statistics which are so abundantly furnished by many countries. One point in preparing these statistics is sometimes forgotten, viz., the necessity of calculating the death-rates of the underground workers separately. If the death-rate of the true miner is watered down by mixing it up with that of surface workers, who have a comparatively small risk, conclusions will be erroneous.

TABLE I.—*Death-rate from Accidents in and about the Mines of the United Kingdom per 1000 Persons employed, in 1891 and 1900.*

YEAR.	Death-rate from Accidents per 1000 Persons.						
	Underground Workers taken separately.					Surface Workers taken separately.	General Death-rate of all persons employed both Above and Under Ground.
	Explosions of Fire-damp or Coal-dust.	Falls of Ground.	Shaft Accidents.	Miscellaneous.	All Causes Underground.		
1891	·091	·894	·236	·438	1·660	·864	1·493
1900	·070	·790	·133	·452	1·445	·699	1·289
Average for 10 years	·175	·791	·158	·463	1·586	·800	1·423

In the early 'fifties the underground death-rate was more than 5 per 1000, whilst, taking all the mines together, both under the Coal Mines Acts and Metalliferous Mines Acts, the average death-rate of the underground workers in 1900 was only 1·445; this is slightly higher than the corresponding figures for the two previous years, though lower than the average for the previous decade, which was 1·586. The general decline in the death-rate from accidents in Great Britain is shown graphically for the years 1873–1900 by Figs. 1 and 2, and numerically for 1891 and 1900 by Table I. Fig. 3 shows the proportions in which each class of accident swelled the total during the last half of the 19th century. The small importance of explosions, compared with falls of ground, is very striking. What can be done to combat falls has been shown by the Courrières Colliery Company in France. By systematic timbering, increased supervision, and the employment of iron bars as temporary supports to the roof in advance of the last row of props, the death-rate from falls at Courrières has been reduced to 0·15 per 1000, or ⅓ of what it used to be, and ⅕ of the British death-rate from falls in 1900. Without indulging in optimistic hopes, it may fairly be assumed that the general death-rate of miners from accidents can be brought down below 1 per 1000 per annum, a figure which may be conveniently taken to denote the borderland between hazardous and non-hazardous occupations. British statistics point to the attainment of this desirable goal in the early years of the 20th century. In some other countries such a result will be delayed on account of the employment of unskilled labourers, fearless to a fault, and imperfectly acquainted with the language of their masters and some of their companions. Thus the death-rate from accidents at the diamond mines of Kimberley, and the gold mines of the Transvaal and Mysore, far exceeds that in Great Britain.

17. *Mineral Statistics.*—The output of mines and quarries of the United Kingdom in 1900 was as follows:—

TABLE II.—*General Summary of Mineral Produce.*

Description of Mineral.	Quantity.	Value at the Mines and Quarries.
	Tons.	£
Alum Shale	1,308	164
Arsenical Pyrites	9,573	8,710
Arsenic	4,081	67,028
Barytes	29,456	29,244
Bauxite	5,779	1,350
Bog Ore	4,153	1,038
Chalk	4,373,331	208,032
Chert and Flint	77,693	13,900
Clay	14,049,694	1,571,043
Coal	225,181,300	121,652,596
Copper Ore	9,108	34,503
Copper Precipitate	380	2,450
Fluor Spar	1,448	1,604
Gold Ore	20,802	42,925
Gravel and Sand	1,837,202	138,163
Gypsum	208,038	69,642
Igneous Rocks	4,634,301	1,238,747
Iron Ore	14,028,208	4,224,400
Iron Pyrites	12,279	5,788
Lead Ore	32,010	349,094
Limestone (other than Chalk)	11,905,477	1,300,314
Manganese Ore	1,362	675
Mica	...	...
Ochre, Umber, &c.	15,200	13,398
Oil Shale	2,282,221	627,844
Petroleum	...	...
Phosphate of Lime	620	1,085
Salt	1,861,347	611,920
Sandstone	5,019,874	1,586,045
Slate	585,859	1,528,336
Strontium Sulphate	9,121	4,560
Tin Ore (*Dressed*)	6,800	523,604
Uranium Ore	41	1,517
Wolfram	9	351
Zinc Ore	24,675	97,606
Totals	286,232,750	£135,957,676

TABLE III.—*Summary of the Metals obtainable by Smelting from the Ores in Table II.*

Description of Metal.	Quantity.	Value at the Average Market Price.
Aluminium	560 tons	£72,800
Copper	765 ,,	59,995
Gold	14,004 oz.	52,147
Iron	4,666,942 tons	19,596,910
Lead	24,364 ,,	418,960
Silver	190,850 oz.	22,465
Sodium	250 tons	31,000
Tin	4,268 ,,	587,869
Zinc	9,066 ,,	188,573
Total value		£21,030,719

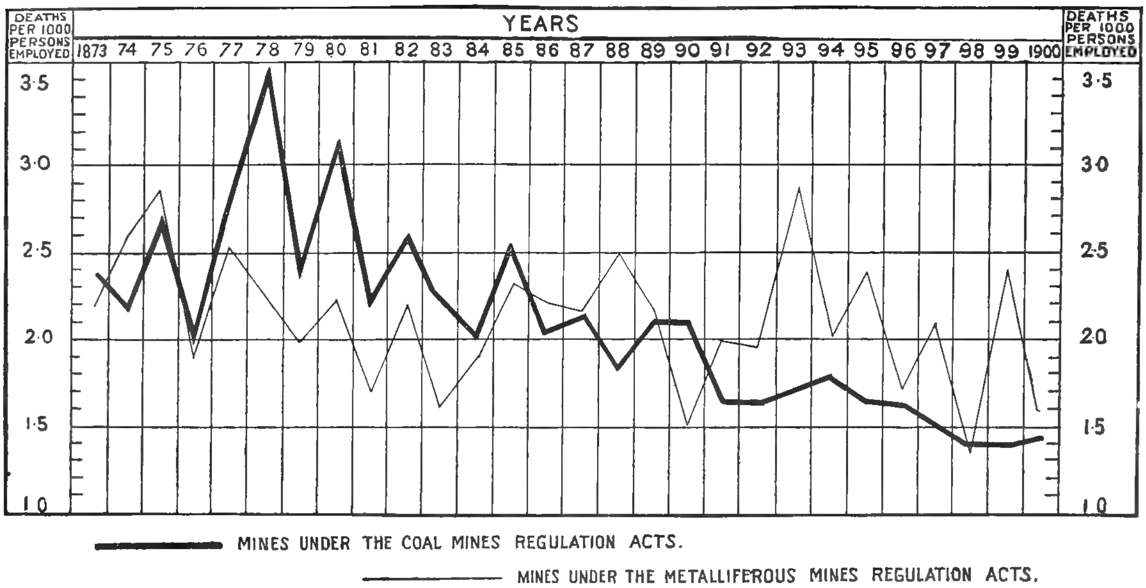


FIG. 1.—Death-rate from accidents underground per 1000 persons employed in mines in the United Kingdom, under the Coal and Metalliferous Mines Regulation Acts, from 1873 to 1900.

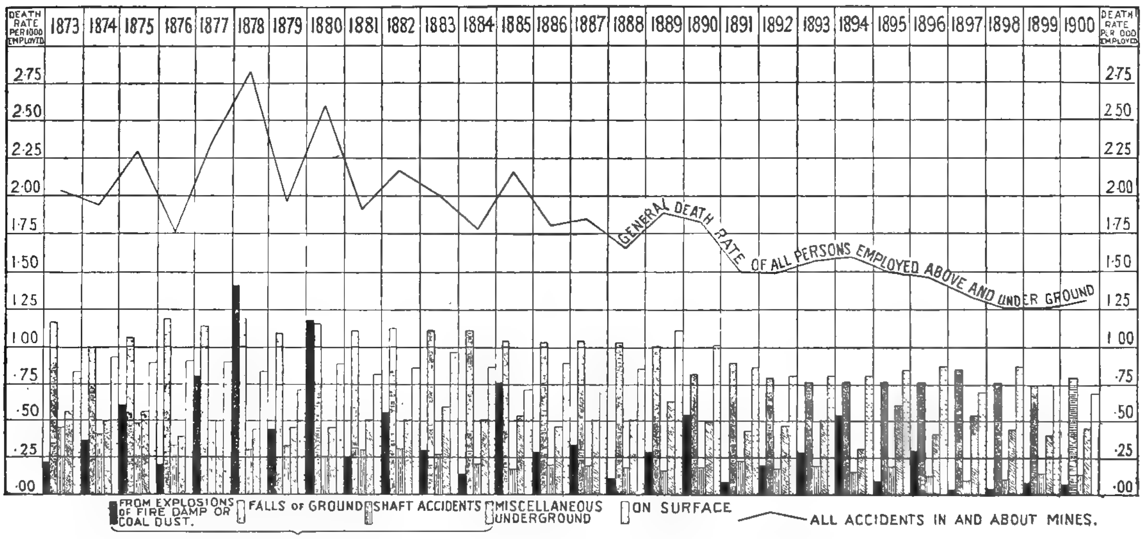


FIG. 2.—Death-rate from various classes of accidents in and about all mines in the United Kingdom from 1873 to 1900.

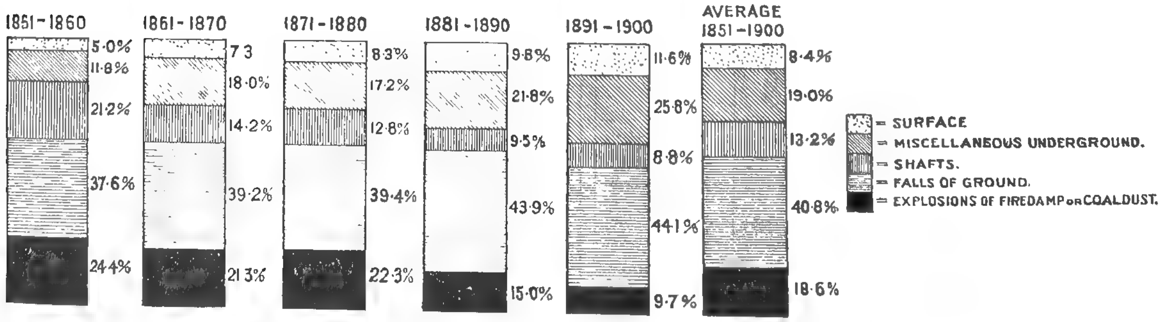


FIG. 3.—Proportion of deaths from different classes of accidents in and about mines in the United Kingdom, 1881–1900.

TABLE VI.—*Summary of Output of Certain Minerals and Metals in the British Empire and in Foreign Countries during the Year 1900.*

Country.	Coal.	Copper.	Fine Gold	Iron.	Lead.	Petroleum.	Salt.	Fine Silver.	Tin.	Zinc.
	Metric Tons.	Metric Tons.	Kilos.	Metric Tons.	Metric Tons.	Metric Tons.	Metric Tons.	Kilos.	Metric Tons.	Metric Tons.
GREAT BRITAIN AND IRELAND	228,794,919	777	415	4,741,835	24,755	..	1,891,217	5,936	4,336	9,211
BRITISH COLONIES, DEPENDENCIES, AND POSSESSIONS :—										
Aden	..	..		..	..	..	50,562	..	..	..
Bahamas	..	..	..	..	..		1,759	..	..	..
Barbados	..	..	..	..	..	..	..	..	..	..
Bechuanaland Protectorate	..	..	..	..	..	..	..		..	..
British Borneo	51,257		684	..	..	..	..	..	..	..
British Central Africa Protectorate	..	..	..	..	..	..		..	..	..
British Guiana	..	..	3,002		..	..	.	..	..	..
British New Guinea	..	..	238	..	..	..	..	..	..	..
British Solomon Islands	..	..	..	..	..	..	..	..	..	..
Canada	4,837,291	8,582	41,700	32,103	28,654	89,798 [1]	56,295	138,302	..	97
Cape Colony	201,636	6,700[1]	4	..	..	..	11,833	..	..	..
Ceylon[2]	..	..	..	..	..	..	5,053	..	..	..
Channel Islands	..	..	..	..	..	..	..	..	.	..
Cyprus[2]	..	20[1]	..	..	..	..	3,175	..	..	..
Federated Malay States	..		478 [1]	..	..	..	..	..	43,123	..
Gold Coast	..	..	374 [1]	..	..	..	..	..	..	
India	6,216,882	2[1]	13,852	25,500 [1]	..	151,546 [1]	1,021,426	..	45 [1]	..
Malta	..	..	..	.	..	..		..	..	..
Natal (including Zululand)	245,203	..	..	..	..	..		..	..	
Newfoundland	..	2,928	75	180,434	..	..		..	..	..
New South Wales	5,595,879	6,310[1]	8,746 [1]	..	4,888	..		315,261	925	4,100[1]
New Zealand	1,111,546	1[1]	10,541	..	.	..	..	10,154	..	
Nigeria	..	..	..	..	..	..	..		..	
Orange River	..	..	..	..	.	..	..	..	..	..
Queensland	505,110	340[1]	21,027	..	208	..	..	3,514	742 [1]	..
Redonda	..	..	..	..	..	..	..	..		..
Rhodesia			2,860	..	..	..	..	..	.	..
Somali Coast Protectorate		..	..	..	..		..	..		..
South Australia	..	5,400[1]	603	..	1,300[1]	..	33,961	311 [1]	8 [1]	9
Tasmania[3]	43,700	9,766[1]	2,244	1,549 [1]	13,347[1]	..	..	108,560 [1]	1,832 [1]	..
Transvaal	..		14,704 [4]		..	..	..	..	.	..
Trinidad	..		..	..	..	..	..	..	..	..
Turks and Caicos Islands	..	..	..		..	..	55,615	..	..	..
Victoria	214,992	..	23,647	..	..	..	.	..	45 [1]	..
West Australia	120,310	630[1]	43,297	6,220 [1]	51	..	133	894	568 [1]	..
Total for British Empire	247,938,725	41,456	188,491	4,987,641	73,203	241,344	3,131,029	582,932	51,624	13,417
FOREIGN COUNTRIES :—										
Abyssinia	..	..	969	..	..	..	14,000 [1]	84	..	..
Argentine Republic	..	76	66	..	..	..	..	11,930 [5]	..	..
Austria-Hungary	39,029,729	1,062	3,343	1,445,763	12,681	311,697 [6]	519,639	50,765	39	6,741
Bosnia and Herzegovina	394,515	500	.	70,063 [1]	..	.	15,790	..	..	..
Belgium	23,462,817	..		90,480 [1]	170[1]	..	..	..	..	3,225[1]
Bolivia	..	.. [7]	2	..	2,884[1]	..	..	496,480 [8]	6,720 [1]	..
Brazil	..		3,529 [1]	..	..	..	..	..	.	..
Bulgaria[2]	102,000	..	..	..	..	.	..	..	.	..
Chile	325,042	26,000[9]	1,592 [1]	..	13[1]		10,000 [3]	69,700 [8]	.	..
China	..	..	8,387 [2]	..	..	..		..		..
Colombia	..	..	2,723 [2]	..	..		..	109,555 [2]	..	..
Corea	..	..	2,660 [1]	.	..	..	..	..	..	..
Costa Rica	..	..	234	..	..	..	..	..	..	..
Cuba	..	..	..	224,945 [2]	..	..		..	..	.
Ecuador	..	..	72 [2]	..	..	..	..	240 [2]	..	..
France	33,403,736	201[1]	1 [1]	1,772,000 [1]	16,993[1]	..	1,088,634	15,100 [1]	..	31,500[1]
Algeria	400	..	..	330,983 [1]	80[1]	..	18,325	260 [1]	..	10,600
French Guiana	.	..	2,089	..	..	..	..		..	..
French Sudan[2]	..	..	84	..		..	..	..	..	..
Indo-China	194,441	..	..	..		..	..	..	..	..
Madagascar	..	..	1,350	..		..	..	..	..	..
New Caledonia	..	1[1]	..	..		..	..	..	.	..
Senegal[10]	..	.	113	..	..	..	..	..		..
Tunis	..	..	..	..	4,118[1]	..	9,160	..	.	5,800[1]
German Empire	149,788,256	30,929	99	4,605,500 [1]	121,513	50,375	1,514,027	168,349	16 [1]	153,350
Greece[2]	11,363	..	..	329,969 [1]	6,427[1]		20,000	32,137 [1]	..	9,038
Holland	320,225		..	..	..	..	..	..	..	..
Dutch East Indies[11]	196,206	..	..	..	..	127,610 [1]	..	..	18,201	.
Dutch Guiana	..	..	732 [1]	..	..		..	..	..	..
Dutch West Indies	..	..	..	..	..		11,958	..	..	.
Honduras[2]	..	..	17 [1]	..	..	.	501 [1]	16,670 [1]	..	..
Italy	480,859	4,182	88	147,186 [1]	18,254	1,683	367,255	13,156	..	48,888
Japan	7,429,457	25,304	2,130	21,299	1,877	86,200 [1]	659,118	58,953	12	..
Luxemburg	..	..	..	2,221,643 [1]	..	..	.	..	..	..
Mexico	38,676	22,000[1]	12,201	..	75,413	..	1,518	1,923,331	..	180[1]
Nicaragua	..	..	1,045 [1]	..	..	..	..	..	..	..
Norway[2]	..	4,406[1]	4	2,448	..	..	..	4,598		137[1]
Peru	47,500	8,500[1]	1,815	..	180[1]	36,640 [1]	15,000	265,700	..	..
Portugal[2]	22,199	9,933[1]	1	7,841 [1]	2,167[1]	..	..	..	21 [1]	15[1]
Portuguese East Africa	..	..	41 [1]	..	..	..	..	..	..	..
Rumania	86,000	..	..	..	..	385,000	92,000	..	..	..
Russia	16,151,557	6,941	38,868[10]	2,907,299	229	9,827,822	1,506,836[10]	3,493	..	5,967
Servia[2]	112,237	270	..	..	283	..	..	..	..	.
Siam	..	..	..	..	..		..		4,000 [1]	..
Spain	2,674,105	74,739[1]	19 [1]	5,626,410 [1]	203,744[1]	..	450,059	176,800 [1]	10 [1]	20,678[1]
Sweden	252,320	827[1]	..	1,617,890 [1]	1,855[1]	..	..	2,200 [1]	..	24,418[1]
Switzerland[12]	2,000	..	..	3,600 [1]	..		49,284		..	..
Turkey	270,000	2,400	..	..	..	..	203,128[13]	..	..	..
United States	244,901,839	275,008	119,913	14,014,475	245,757	7,485,579	2,650,075	1,862,829	..	112,419
Uruguay	..	..	49	..	..		..	22	..	..
Venezuela	..	..	468	..	..	..	224,740[10]		..	..
Total for Foreign Countries	519,697,479	493,279	204,705	35,439,794	714,638	18,312,606	9,441,047	5,291,352	29,019	432,956
Total for the World	767,636,204	534,735	393,196	40,427,435	787,841	18,553,950	12,572,076	5,874,284	80,643	446,373

[1] Estimated.

[2] Figures for 1899.

[3] Figures for year ending June 1901.

[4] Output of Witwatersraand district from November 1899 to May 1900.

[5] Figures for 1897.

[6] Figures for Austria for 1899.

[7] Included with Chilè.

[8] Converted into fine silver, on the total value of ingots, matte, ore, and sulphide exported.

[9] Including Bolivia.

[10] Figures for 1898.

[11] Output of coal for Sumatra only, and of petroleum for Java for the year 1900 and for Sumatra for the year 1899.

[12] Figures (except those for salt) for 1896.

[13] Figures for 1894.

TABLE IV.—*Summary of the Output of Iron Ore from Mines and Quarries in the United Kingdom, and the Quantity and Value of Pig Iron obtainable therefrom, in 1900.*

	Iron Ore			Pig Iron obtainable.	
	Quantity.	Comparison with Preceding Year.	Value.	Quantity.	Value.
	Tons.	Tons.	£	Tons.	£
From Mines .	9,531,292	−200,372	3,704,161	3,235,791	19,596,910
From Quarries	4,496,916	−232,750	520,239	1,431,151	
Totals .	14,028,208	−433,122	4,224,400	4,666,942	19,596,910

Tables V. and VI. give a general idea of the number of persons employed at mines and quarries and of the output of certain minerals and metals in the British Empire and foreign countries during the year 1900

TABLE V.—*Summary of the Number of Persons employed at Mines, Quarries, and other Mineral Workings in the British Empire and in Foreign Countries during the year 1900.*

GREAT BRITAIN AND IRELAND . .	908,412
BRITISH COLONIES, DEPENDENCIES, AND POSSESSIONS:—	
Aden	...[1]
Bahamas	400
Barbados	100[2]
Bechuanaland Protectorate	...[1]
British Borneo	...[1]
British Central Africa Protectorate	...[1]
British Guiana	5,616
British New Guinea	325[3]
British Solomon Islands	...[1]
Canada[4]	29,864[5]
Cape Colony	14,645
Ceylon	189,930[6]
Channel Islands	1,200
Cyprus	...[1]
Federated Malay States	168,000
Gold Coast	2,913[2]
India	133,951[7]
Malta	...[1]
Natal (including Zululand)	1,602
Newfoundland	1,352
New South Wales	43,745
New Zealand	15,962
Nigeria	...[1]
Orange River	...[1]
Queensland	13,572
Redonda	146
Rhodesia	...[1]
Somali Coast Protectorate	...[1]
South Australia	5,986[6]
Tasmania	6,834
Transvaal	...[1]
Trinidad	...[1]
Turks and Caicos Islands	...[1]
Victoria	29,865
Western Australia	17,735
Total for the British Empire .	1,592,155
FOREIGN COUNTRIES:—	
Austria-Hungary	226,330[5]
Bosnia and Herzegovina	2,029
Belgium	171,467
Chile	19,672[8]
Corea	1,286
Denmark	...
Greenland	75
France	309,815
Algeria	5,919
New Caledonia	5,090[2]
German Empire	733,683
Greece	9,346[6]
Holland	3,806
Dutch East Indies	25,383[5]
Italy	102,728
Japan	119,667[6]
Luxemburg	6,207
Mexico	106,536[6]
Norway	2,457[6]
Peru	105,000
Portugal	9,421[6]
Rumania	...[1]
FOREIGN COUNTRIES, *continued*:—	
Russia	286,983[2]
Servia	2,070[6]
Siam	22,000[6]
Spain	83,662
Sweden	13,861
Switzerland	1,877[6]
United States	506,830[9]
Total for Foreign Countries .	2,883,200
Total for the World . . .	4,475,355

[1] Information not available. [2] Figures for 1898. [3] Figures for 1897.
[4] For British Columbia, Nova Scotia, Ontario, and Quebec only.
[5] Including some figures for 1899. [6] Figures for 1899.
[7] Returns incomplete. [8] Persons employed in saltpetre works only.
[9] Coal miners only, and ore miners of Colorado, Montana, and Tennessee.

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(C. L. N. F.)

Minneapolis, the capital and leading city of Minnesota, U.S.A., situated on both banks of the Mississippi river at the Falls of St Anthony. With the "twin" city of St Paul it constitutes the centre of the commercial life of the north-west, sharing the termini of the Northern Pacific, Great Northern, Canadian Pacific ("Soo" Line), St Paul and Duluth, Chicago and North-Western, Chicago and Great Western, Minneapolis and St Louis; Chicago, Burlington, and Quincy; Chicago, Milwaukee, and St Paul; and the Wisconsin Central Railways. Dams are being constructed by the Federal Government below the city, which will make Minneapolis the head of navigation on the Mississippi. Communication with St Paul is secured, besides the steam railways, by an electric line. Minneapolis possesses a street-car system of some 120 miles of tracks. Its population in 1895 was 192,833, and in 1900, 202,718, of whom 61,021 were foreign-born (largely Scandinavian) and 1548 were negroes. The birth-rate is 13·54 per 1000, and the death-rate (1900) only 10·8. The public school system has 59 buildings, 4 of which are high schools, and there are 782 teachers. The school attendance in 1899 was 34,863. In 1900 the United States census reported 60,377 persons of school age (5 to 20 years inclusive). Out of 63,711 males of voting age, 1205 were illiterate (unable to write), of whom 1065 were foreign-born. In addition to the public schools, there are three preparatory schools, a medical college, an art school, and a conservatoire of music. The higher institutions of learning are the Augsburg theological seminary and the University of Minnesota. The public life of the city is indicated in its library of 106,000 volumes, art gallery, park system, 18 miles of boulevards, 170 churches, 3 theatres, 4 daily newspapers, 43 weekly, 6 semi-monthly, 27 monthly, and 2 quarterly periodicals. In finance and manufacturing Minneapolis has made rapid progress. There are 6 national banks, 6 state and savings banks, and 4 trust companies with a combined capital of $8,536,000. In 1899 the bank clearings reached the sum of $539,400,176. The deposits in these banks in the same year amounted to $34,604,720. During 1899 buildings to the value of $3,052,500 were erected. In 1900 there were 2368 manufacturing establishments, with a capital of $57,708,204, and products valued at $110,943,043. There were 26,608 wage-earners employed (exclusive of 2606 salaried officials, clerks, &c.), who received in wages $12,708,523. The principal output consisted of lumber and timber products, valued at $12,285,305, and flouring and grist-mill products, valued at $49,673,568. In 1899 the jobbing or wholesale business amounted to $100,000,000. The assessed valuation of real and personal property in 1900, on a basis of about 60 per cent. of the full value, was $99,492,054, and the rate of taxation $27.40 per $1000. The bonded indebtedness was $8,550,000, but there was a sinking fund of $1,872,115. The cost of the city government was $2,882,719. (F. L. McV.)

Minnesota, one of the north-central states of the United States, situated between 43° 30′ and 49° 25′ N. and 89° 29′ and 97° 5′ W. In 1885 the population was 1,117,896, an addition in five years of 43 per cent.; in 1890 it was 1,301,826, or 16·4 persons to the square mile; and in 1900 it was 1,751,394, and the density 22·1 per square mile. In 1895 the population comprised 1,057,084 native-born persons and 517,535 foreign-born. Of these 119,554 were born in Sweden, 107,319 in Norway, 133,768 in Germany, 49,831 in Canada, 26,106 in Ireland, and 70,957 in other countries. Of the total population in 1900, 932,490 (53·2 per cent.) were males and 818,904 (46·8 per cent.) females; 1,246,076 native-born and 505,318 (28·9 per cent.) foreign-born; 1,737,036 were white and 14,358 (0·8 per cent.) coloured, of whom 4959 were negroes, 166 Chinese, 51 Japanese, and 9182 Indians. The death-rate in 1900 was about 9·7 per cent. The urban population, classing as such all persons in cities of 8000 inhabitants or over, was 470,046, or 26·8 per cent. of the total population, as against 28·2 per cent. in 1890. In 1890 the population of the forty cities and villages with over 2000 inhabitants was 456,214; but in 1900 it had increased to 52 with a combined population of 629,398. Since 1880 the three largest cities have had a rapid growth. In 1880 Minneapolis had a population of 46,887, St Paul 41,473, and Duluth 838. In 1890 the respective figures were 164,738, 133,156, and 33,115. In 1900 the populations were as follows: Minneapolis 202,718, St Paul 163,065, and Duluth 52,969.

Religion.—In 1890 there were thirteen denominations with over 5000 members. Of these the Roman Catholics had 271,319 members; the Lutherans (of all denominations), 136,914; the Methodists, 30,387; the Baptists, 14,698; the Presbyterians, 13,734; the Congregationalists, 13,624; and the Episcopalians, 11,142.

Charities and Corrections.—In 1860 there were in the state institutions 23 inmates, or one to every 8826 of the population. In 1898 the number had increased to 5671, or one for every 306. The expense of maintaining these was $2,829,723. The insane asylums are at St Peter, Rochester, Fergus Falls, Anoka, and Hastings, and the schools for the deaf, dumb, blind, and imbecile at Faribault. The soldiers' home is at Minnehaha Falls, and the school for neglected and dependent children at Owatonna. Young boys and girls under sixteen are sent for certain offences to the training school at Red Wing. Young men between sixteen and thirty are committed to the state reformatory at St Cloud for the first offences. Criminals are sent to the state prison at Stillwater. Under the Act of 2nd March 1883 the Legislature created a board of six persons to supervise the entire system of public charities and correctional institutions, which was appointed by the governor, and served without recompense. By Act of the Legislature in 1901, however, its work and powers were placed in the hands of three persons known as the Board of Control. The members are appointed by the governor, and hold office for six years.

Education.—Illiteracy had fallen to 5·9 per cent. in 1890. This was due to the public school system, which includes a series of closely associated institutions from the primary school to the university. The schools proper are under the general supervision of a high school board consisting of a principal of an independent state high school appointed by the governor, the president of the university, and the superintendent of public instruction. The Legislature in 1899 made an appropriation for the aid of the schools of the state, which has been apportioned by the high school board. Rural schools receive $75 per year; semi-graded schools, $100; graded schools, $200; and high schools, $800. The number of pupils enrolled in 1898 was 364,063. At that time there were 6415 common schools, 151 independent schools, 25 special, 97 state high, and 110 state graded schools. The value of the school houses and apparatus was $15,277,500. The support of the public schools comes from two sources, taxation and the interest from a permanent school fund now amounting to $12,087,627. There are five normal schools at Winona, Mankato, St Cloud, Moorhead, and Duluth, with an attendance in 1898 of 3052. Regular appropriations are made for their support by the state legislature. The State University in Minneapolis has faculties of literature, science, and art; of agriculture, of law, of medicine, and of engineering, and the schools of chemistry and mines. The attendance is 3400; the income—derived from a $\frac{23}{100}$ mill tax, from students' fees, from United States appropriations, and from interest on endowment—is about $380,000 per annum. The Legislature has supplemented the public school work by creating a system of travelling libraries, farmers' institutes, and local option free text-books. In 1900 the number of persons of school age (5 to 20 years inclusive) was 612,990. Out of 506,794 males of voting age, 20,785 were illiterate (unable to write), of whom 16,780 were foreign-born and 1378 Indians.

Banks.—The banks on the 1st of February 1899 were divided as follows:—National 72, capital $13,750,000; state banks 149, capital $6,500,000; savings banks 14, with deposits of $11,000,000, and 47,328 depositors; trust companies 8, capital $3,664,226; and 206 private banks with a capital of $3,975,500. With the exception of the private banks, all are under the supervision of the state examiner.

Finances.—The income is derived from twenty different sources, and in the year ending 31st July 1898 amounted to $5,429,240, while the expenditure was $5,298,942. There was a balance in the treasury of $2,184,612. The expenditure for 1899 and 1900 was estimated at $3,086,660 and $2,607,812. The state debt is $1,475,647. In 1899 the total valuation of all classes of property was $585,083,328. On this amount taxes were levied to the amount of $14,539,285, the state receiving $2,026,774. The principal source of income, outside the personal and property taxes, is a 4 per cent. tax on the gross earnings of railway, express, telephone, telegraph, fast-freight and sleeping-car companies. The total tax levied for all purposes averaged for the whole state 24·85 mills.

Agriculture.—In 1900 there were in the state 154,659 farms, containing 26,248,498 acres, of which 70·3 per cent. were improved land. The total value of farm property was $788,684,642, made up as follows:—Land, improvements and buildings, $669,522,315; implements and machinery, $30,099,230; live stock, $89,063,097. The increase in the total value of farm property during the decade 1890–1900 was $373,983,016, or over 90 per cent. Of the total number of farms, 82·7 per cent. were worked by owners, 3·3 per cent. by cash tenants, and 14 per cent. by share tenants. The total value of farm products for the year 1899 was $161,217,304. Statistics of the principal crops are given in the following table:—

Crops.	Acres	Quantity.	Value.
Indian corn .	1,441,580	47,256,920 bushels	$11,337,105
Wheat . .	6,560,707	95,278,660 ,,	50,601,948
Oats . .	2,201,325	74,054,150 ,,	15,829,804
Barley . .	877,845	24,314,240 ,,	7,220,739
Flax seed .	566,801	5,895,479 ,,	5,898,556
Hay and forage	3,157,690	4,411,667 tons	14,585,281
Potatoes . .	146,659	14,643,327 bushels	3,408,997
Miscellaneous vegetables .	27,438	...	1,372,907
Forest products	...	...	2,602,335

The number and value of the most important domestic animals were as follows:—753,632 dairy cows, $21,513,337; 1,117,693 other neat cattle, $14,735,621; 696,469 horses, $42,255,044; 8500 mules and asses, $498,055; 359,328 sheep (not including lambs), $1,329,531; 1,440,806 swine, $5,865,590.

Mining.—In 1884 the great iron ranges were little known; only 62,124 tons had been taken out of the Vermilion range. The Mesabi range mines were opened in 1892, and in 1898 the two ranges produced 5,878,908 tons of ore. The total tonnage since 1884 is 28,492,256. Several valuable mines have been leased to private companies on terms that require payment in advance and a second payment on the execution of the contract. Up to 31st July 1898 the state had made 2520 prospecting leases, twenty-six of which are in force. There are also eighty-six mining contracts in force. The royalties paid into the state treasury from such contracts in 1897 and 1898 amounted to nearly $51,447. The private mines are largely controlled by eastern syndicates. The ore is shipped to Ashtabula, Cleveland, Buffalo, and Erie from Two Harbors, Duluth, and West Superior by way of the great lakes.

Manufactures.—The general statistics of manufactures in 1890 and 1900 are shown in the following table:—

	1890.	1900.	Per cent. of Increase.
Number of establishments	7,505	11,114	48·1
Capital	$127,686,618	$165,832,246	29·9
Salaried officials, clerks, &c.	9,839[1]	7,319	25·6[2]
Salaries	$7,818,116[1]	$6,554,424	16·2[2]
Wage-earners (average number)	69,790	77,234	10·7
Total wages	$30,371,123	$35,484,825	16·8
Miscellaneous expenses	$12,136,612	$13,273,648	9·4
Cost of material used	$118,481,941	$173,425,615	46·4
Value of products	$192,033,478	$262,655,881	36·8

The principal industry is milling. In 1900 the manufacturing establishments for flouring and grist-mill products numbered 512, and employed an average number of 4086 wage-earners. The capital invested in this industry amounted to $24,125,781. The products were valued at $83,877,709, or 15 per cent. of the total value of the flouring and grist-mill products of the United States. Not only did Minnesota lead in this industry among the states of the Union, but the like products in the state next in rank (New York) amounted in value to only a little more than half as much. A very large export trade in flour has been built up, amounting in 1898 to 4,000,000 barrels. Lumber and timber products rank next in importance, being valued in 1900 at $43,585,161. In this industry there were 438 establishments, with a total capital of $52,095,923, and employing 15,140 wage-earners. The lumber product in 1898 was 1,687,762,000 feet of board lumber, 440,511,000 shingles, and 315,869,000 lath. It is estimated that there is still standing in the state 13,000,000,000 feet of pine. At the present rate of cutting this would disappear within a few years, but undoubtedly the cut will decline each year. The products of slaughtering and meat-packing (wholesale) amounted in 1900 to $6,803,112, and the value of cheese, butter, and condensed milk produced at factories amounted to $8,479,896. The leading manufacturing centre in the state is Minneapolis.

Commerce.—The jobbing or wholesale trade is estimated at $600,000,000. The two customs districts with ports of entry at Duluth and Minnesota City, recorded $4,410,303 worth of exports, and $1,743,204 of imports in 1899.

Railways.—The facilities for transportation are exceptionally good. The railway mileage in 1899 was 6338. Three trunk lines cross the state to the Pacific coast, six lines extend from the twin cities to Chicago, and a number run from north to south. In 1898 the capital stock and bonds of these railways were $1,157,061,160. Minnesota's proportion on a mileage basis was $264,326,776. The gross earnings of the railways for that year, inside the state, amounted to $43,903,818. The Federal Government has given these railways 17,621,952 acres, and the state 3,548,719 acres—a total of 21,170,671 acres. Of this 10,234,598 acres have been patented by the state to the railways.

History and Politics.—The state has been undisturbed by strife, with the exception of the rise of the Pillager Indians in October 1898, which was quelled by the United States army. The immediate cause of the outbreak was the attempt to arrest certain Indians who were engaged in the illegal sale of whisky within the reservation. The arrest was resisted by the Indians, and led to disturbance. But the resistance was intensified by injustice done to the Indians in connexion with the sale of their lands, and made the incident from their point of view an effort towards vindication. In politics the Republican party controlled state elections for forty years after the admission of the state into the Union. In 1898 this long history was broken by the fusion of the forces of the Democrats and Populists, which elected their candidate for governor. The Democratic-Populist candidate received 131,980 votes, while the Republican received only 111,706. In the presidential election of 1900, out of a total vote of 313,087, McKinley (Republican) received 190,461 votes, and Bryan (Democratic) 112,901.

Constitutional Changes.—Important changes have been made in the constitution since 1880. The requirements of citizenship are more rigorous; only full citizens of the United States are permitted to exercise the franchise, and these only after a residence of six months in the state and thirty days in the district. Special legislation was restricted by constitutional amendment in 1891, as a result of which it was impossible for cities to obtain any revision of their charters except by general Act. It was therefore necessary to amend the constitution so as to permit citizens to frame charters for their respective municipalities. This was done in 1896. Any city of over 1000 inhabitants may secure a new charter by appointing a charter commission to draw such an instrument. The charter must be submitted to the people within six months after the appointment. A four-sevenths vote makes it the basis of the city organization. The session of the Legislature has been increased to ninety days. In civil actions a jury after six hours' deliberation may render a verdict by a five-sixths vote. Combinations against trade are prohibited by the constitution. The governor may veto a part of a money Bill without invalidating the remainder.

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Minorca or MENORCA. See BALEARIC ISLANDS.

Minsk, a government of western Russia, bounded on the N. and E. by Vilna, Vitebsk, and Moghilev; on the S. and W. by Chernigov, Kieff, Volhynia, and Grodno. Area, 35,293 square miles. Its population in 1897 was 2,156,123, of whom 1,078,466 were women, and 228,822 lived in towns. They were distributed as follows, according to religion:—Greek Orthodox, 71·3 per cent.; Jews, 17·3; Catholics, 10·1; Greek Nonconformists, 0·8; Mussulmans, 0·3; Protestants, 0·2 per cent. The peasants constitute 65 per cent. of the population. The average yearly crops of 1893–98 were: rye 6,720,000 cwt., wheat 1,507,000 cwt., oats 3,314,300 cwt.; all cereals 13,067,000 cwt. Gardening is carried on in some districts. There were in 1895, 259,000 horses, 690,000 horned cattle, and 560,000 sheep. The chief industrial establishments are distilleries, breweries, steam flour-mills, tobacco, and various factories for dealing with forestry produce. Their aggregate returns amounted in 1897 to £1,742,700. Archæological finds of great value, dating from the Neolithic and subsequent ages, have lately been made. Of schools there were, in 1897, 1827 and 726 Jewish *heders*, with an aggregate of 67,130 pupils (8580 girls). The government is divided into nine districts, of which the chief towns and populations are: Minsk, capital of the government, 91,494 inhabitants in 1897; Bobruisk (35,177), Igumeñ (4579), Mozyr (10,762), Novogrudek (7700), Pinsk (27,938), Ryechitsa (9322), and Slutsk (14,180).

Minster, or MINSTER IN SHEPPEY, a parish and village in the Isle of Sheppey, Kent, England, 3 miles south-east of Sheerness. The church of SS. Mary and Sexburga was formerly part of an ancient convent church. In 1894 the parish was reduced by the formation out of it of the civil parish of Sheerness. It is connected with Queenborough by a light railway, opened in 1901. Population (1891), 1307; (1901), 1292.

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[1] Includes proprietors and firm members, with their salaries.

[2] Decrease.

Minto, William (1845–1893), Scottish man of letters, was born at Auchintoul, Aberdeenshire, in 1845, and educated at Aberdeen University and Merton College, Oxford, winning high honours in classics, mathematics, and philosophy. He was assistant professor under Alexander Bain at Aberdeen for some years, and between 1874 and 1878 was editor of the *Examiner;* he subsequently wrote for various newspapers, and in 1880 was made full professor of logic and English at Aberdeen. In 1872 he published a *Manual of English Prose Literature,* which was very successful, and was distinguished by sound judgment and sympathetic appreciation; and his *Characteristics of English Poets* (1874) showed the same high qualities. He contributed *Daniel Defoe* (1879) to the "English Men of Letters" series, and was also the author of two novels, *The Crack of Doom* (1886) and *The Mediation of Ralph Hardelot* (1888). He died in 1893.

Minusinsk, a district town of Russia, East Siberia, government of Yeniseisk, 220 miles south of Achinsk railway station, 5 miles from the right bank of the Yenisei, situated in a fertile prairie region. It is a centre for trade (annual value, £100,000) with the native populations of the Sayans and north-western Mongolia. It has one gymnasium for girls, and an excellent natural history, ethnographical, and archæological museum (1877), with a library and a meteorological station. The industry is chiefly agricultural; large herds of cattle are kept, but there is a variety of small trades. Population (1897), 10,255.

Miquel, Johann von (1829–1901), German statesman, was born at Neuenhaus, Hanover, on 21st February 1829. He sprang from a French family which had emigrated during the Revolution. He learnt law at the universities of Heidelberg and Göttingen, and at an early age studied the writings of Karl Marx. For a time he became a convert to the extreme revolutionary, socialistic, and atheistic creed; but though he entered into correspondence with Marx, with the object of starting a revolutionary movement, he does not appear to have taken any overt part in the events of 1848–49. Further study of political economy soon enabled him to pass out of this phase, and in 1850 he settled down to practise as an advocate at Göttingen. He acquired repute as an able lawyer and a rising politician, was one of the founders of the National-Verein, and in 1864 was elected member of the Hanoverian Parliament as a Liberal and opponent of the Government. He accepted the annexation of Hanover by Prussia without that regret felt even by many Liberals who belonged to older Hanoverian families, and was one of the three Hanoverians whose brilliant parliamentary abilities at once won a commanding position in the Prussian and German Parliaments. For some reason, perhaps because Bismarck did not entirely trust him, he did not at this time attain quite so influential a position as might have been anticipated; he was chairman of the parliamentary committee by which in 1876 the new rules of legal procedure were drafted, but he found scope for his great administrative abilities in the post of burgomaster of Osnabrück (1865–1870 and 1876–80), and was also from 1870 to 1873 a director of the Discontogesellschaft, the most important of German banks. In 1880 he was elected burgomaster of Frankfort-on-Main, where he gained great reputation for the energy with which he dealt with social questions, especially that of the housing of the poor. Probably owing to his early study of Socialism, he had never adopted the economic as well as the political doctrines of Liberalism, and he was very ready to support the new State Socialism of Bismarck. He was the chief agent in the reorganization of the National Liberal party in 1887. After Bismarck's fall he was chosen as Prussian minister of finance, and held this post for ten years. He distinguished himself by his reform of the Prussian system of taxation, an important series of measures to which the financial prosperity of Prussia is largely attributed, and the one really successful measure of the new reign in internal affairs. An attempt to reform the system of imperial finance in 1893–94 failed, and much injured his reputation. In all the political controversies and intrigues of the time he took a leading part, but it is impossible to explain here the course of his policy, which was not always clear. He had entirely given up his Liberalism, and aimed at practical measures for improving the condition of the people irrespective of the party programmes; some of his measures, such as that for taxing "Waarenhäuser," *i.e.,* stores, were of a very injudicious nature. He professed to aim at a union of parties on the basis of the satisfaction of material interests, a policy to which the name of *Sammlung* was given; but his enemies accused him of constantly intriguing against the three Chancellors under whom he served, and of himself attempting to secure the first place in the State. The sympathy which he expressed for the Agrarians increased his unpopularity among Liberals and industrials, and added to the difficulties of the Administration to which he belonged; but he pointed out that the State, which for half a century had done everything to help manufactures, might now attempt to support the failing industry of agriculture. In June 1901 the rejection of the canal Bill led to a crisis which probably took the form of a trial of strength between him and Bülow, and he was obliged to send in his resignation. His health was already failing, and he died on 8th September of the same year at his house in Frankfort. He left the reputation of a statesman in ability second to none of those who had risen to power under the Empire, who only failed to reach the highest rank because of a restless ambition and an uncertainty in action which prevented men from depending on him whether as leader or colleague.

Miraj, a native state of India, in the Deccan division of Bombay, forming part of the southern Mahratta Jagirs. Since 1820 it has been subdivided between a senior and a junior branch. The territory of both is widely scattered among other native states and British districts. Area of the senior branch, 339 square miles; population (1891), 88,343; average density, 260 persons per square mile; gross revenue (1897–98), Rs.2,81,883, of which Rs.86,605 was expended on public works and Rs.32,808 on famine relief; tribute, Rs.12,558; number of police, 335; 29 schools, with 2691 pupils. Area of the junior branch, 225 square miles; population (1891), 35,487; gross revenue, Rs.3,47,657, of which Rs.46,431 was expended on public works; tribute, Rs.6412; number of police, 137; 31 schools, with 1362 pupils. The chiefs are Brahmans by caste, of the Patwardhan family. The town of MIRAJ, at which both chiefs have their residence, is situated in 16° 49′ N. and 74° 41′ E., near the river Kistna; it is a junction on the Southern Mahratta railway for the branch to Kolhapur. It has a high school, with 244 pupils in 1897–98, and two state printing-presses. Population (1881), 20,616; (1891), 26,060.

Mirgorod, a district town of Little Russia, government of Poltava, 90 miles north-west of the town of Poltava, 14 miles from the Kharkoff–Nikolaeff railway. It is an old town, which played an important part in the wars between Little Russia and Poland. Population, (1897), 10,023.

Mirzapur, a city and district of British India, in the Benares division of the North-West Provinces. The city is on the right bank of the Ganges; a station on the East Indian railway, about half-way between Allahabad and Benares, 509 miles north-west from Calcutta. Population (1881), 85,362; (1891), 84,130; and (1901), 79,787; municipal income (1897–98), Rs.60,360, almost entirely from octroi; incidence of taxation, nearly 10 annas per head; registered death-rate (1897), 60·86 per thousand. Formerly it was the emporium of trade between northern and central India, which has now been diverted to the railways. It has two European and 39 native lac factories, the latter employing 2400 hands, with an out-turn valued at Rs.9,72,000. The London Mission manages a high school. There are three printing-presses, one of which issues a newspaper in vernacular and English.

The district of MIRZAPUR extends into the Sone valley. Area, 5223 square miles; population (1881), 1,136,796; (1891), 1,161,508; (1901), 1,082,706; showing an increase of 2 per cent. between 1881 and 1891, but a decrease of 6·8 between 1891 and 1901; average density, 207 persons per square mile. The land revenue and rates are Rs.9,71,735, the incidence of assessment being less than 8 annas per acre; cultivated area (1897–98), 385,808 acres, of which 45,495 were irrigated from wells, &c.; number of police, 2156; number of vernacular schools, 103, with 4856 pupils; registered death-rate (1897), 51·7 per thousand. The district is permanently settled, and comprises a large part of the hereditary domains of the Raja of Benares, which are revenue-free. It is traversed, near the Ganges, by the main line of the East Indian railway for 53 miles. The Great Southern road used to start from Mirzapur city. There are no Government canals.

Mishawaka, a city of St Joseph county, Indiana, U.S.A., on the St Joseph river, at the intersection of the Grand Trunk and Michigan Southern railways, in the northern part of the state. Its manufactures consist largely of agricultural tools and machines. Population (1890), 3371; (1900), 5560, of whom 821 were foreign-born and 21 were negroes.

Misiones, a territory of the Argentine Republic, bounded on the E. by Brazil, from which it is separated by the rivers Pepiri (also called Pepiri-Guazu) and San Antonio, on the S. by Brazil, on the N. by Brazil, and on the W. by Paraguay and the Argentine province of Corrientes. The official area at the census of 1895 was 11,282 square miles; and in 1895 the population was 33,163. The capital, Posadas, was founded in 1865. The territory is divided into fourteen administrative divisions. In 1895 there were 2519 farms in the territory, and 15,630 acres planted in cereals; 70,259 head of cattle, and 25,002 horses.

Miskolcz, a corporate town of Hungary, capital of the county of Borsod, with 32,288 inhabitants in 1891, and 43,096 in 1900. It has two gymnasia, a commercial school, an orphanage, a hospital, and is an important centre of trade and traffic.

Missions.—This article is mainly devoted to the extension of missionary work since 1881, with some reference to previous events not fully dealt with in the article on the subject in the earlier volumes of this work.

Anglican and other Protestant Missions. 1. British.

It is generally agreed that the years since 1885 have witnessed a very marked increase of missionary zeal and interest in Great Britain, both in the Church of England and among the Nonconformists. The improvement, indeed, dates back somewhat earlier. So far as the Church of England is concerned, it may fairly be said to have started afresh in the year following the first observance of the Day of Intercession for Missions, 20th December 1872. Both the Society for the Propagation of the Gospel and the Church Missionary Society were at that time suffering from a general coldness which, in the case of the latter society, had led in that very year to the committee reporting "a failing treasury and a scanty supply of men." The observance of that first Day of Intercession was followed by an immediate change, and unquestionably there has been progress ever since. Then, less than five months afterwards, David Livingstone died at Ilala; and no event of the whole century did so much to wake up Protestant Christendom. Most of the Missions in Central Africa owe their origin to the spirit it aroused. But the year 1884, from which the present survey mainly starts, was also an epoch to be marked. In that year Bishop Hannington went to Africa; and his murder in 1885 (first reported in England on New Year's Day, 1886) deeply touched the Christian conscience. The speedy publication of Mr Dawson's biography of him worked a revolution in the circulation of missionary literature. Not only was the sale of the book itself large, but it encouraged publishers to bring out other works on Missions. Another event of 1884–85 was the going forth to China of the men known as the Cambridge Seven, in connexion with the China Inland Mission. All were men of good family; some of them went at their own charges; and among them were the stroke-oar of the University Eight (Mr Stanley Smith) and the captain of the University Eleven (Mr C. T. Studd). Probably no event of recent years has exercised a wider influence in the cause of Missions. In particular, university graduates have since then gone out as missionaries in much larger numbers than before. There are now five Missions definitely linked with the universities. The Central African Mission (1858), indeed, is not for the most part manned by graduates, though it is led by them; but the Cambridge Mission at Delhi (1878), the Oxford Mission at Calcutta (1880), and the Dublin Missions in Chota Nagpore (Society for the Propagation of the Gospel, 1891) and the Fuh-Kien Province of China (Church Missionary Society, 1887) consist of university men. Moreover, the older and larger societies have much increased the proportion of graduates on their staffs, the Society for the Propagation of the Gospel and Church Missionary Society having between them about 300 engaged in actual missionary work among the heathen (besides the S.P.G. colonial clergy).

The cause of Missions in the universities has been fostered in the last few years by the Student Volunteer Missionary Movement, initiated in America in 1886, and organized in England in 1892. Between 1892 and 1902 no less than 1880 students in colleges in the United Kingdom (including theological colleges and medical schools) signed a declaration expressing their purpose, "if God permit," to be foreign missionaries; and of these, 733 had sailed by February 1902 in connexion with various societies, Anglican and Nonconformist. The Student Volunteer Missionary Union has adopted as its watchword, "The Evangelization of the World in this Generation"; and this motto has been approved by several bishops and other Christian leaders. Another influence upon university men and others who have taken holy orders is that of the Younger Clergy Union of the Church Missionary Society (1885), and the Junior Clergy Association of the Society for the Propagation of the Gospel (1891). Some 4000 clergymen have joined one or other of these organizations, and while more than 100 have gone out as missionaries, the members generally have been incited to the study of Missions and to efforts for their support. At the same time there has been a great accession of men to the missionary ranks from among other classes of society. The Anglican societies and the regular and older Nonconformist societies (Methodist, Baptist, Presbyterian, and the London Missionary Society, which is virtually Congregationalist) have shared in these humbler recruits; but a large proportion of them have joined several younger "non-denominational" or "inter-denominational" Missions.

Of these the China Inland Mission is the largest and most influential; and while it has sent forth many of this class, it has also enrolled not a few men and women of considerable wealth, education, and social status. The South Africa General Mission, the North Africa Mission, and the Congo Balolo Mission come next in importance; but there are several smaller bodies working in different countries. The Salvation Army also has missions in India, Ceylon, and Japan; but these cannot be called "non-denominational," because the Army has gradually become a very strict denomination itself. There is one Anglican society working, like some of those just mentioned, in one particular field, viz., the South American Missionary Society, founded in 1844. Many foreign dioceses also have associations in England for their help and support. Medical men have come forward in increasing numbers for missionary service, and Medical Missions are now regarded as a very important branch of the work of evangelization. They are especially valuable in Mahommedan countries, where open preaching is difficult and sometimes impossible, and also in works of mercy among barbarous tribes; while in China, which comes under neither of these two categories, they have been largely developed. About 500 fully qualified doctors are labouring in British and American Missions; and in 1898 it was calculated that the in-patients in British Mission hospitals exceeded 30,000, while the visits of out-patients in a year were nearly a million and a half. In several of the great London hospitals there are missionary associations, the members of which are medical students; but a chief source of supply in the past has been the Edinburgh Medical Mission, founded in 1841, which, while working among the poor in that city, has trained many young doctors for missionary service. Of course the total number is only a small fraction of the whole body of medical men; but the same remark applies to other classes of missionaries, clerical and lay.

The most remarkable development of missionary enterprise has been the employment of women. From an early date many of the wives of missionaries have done good service; but the going forth of single women in any appreciable number has only been encouraged by the societies in the last quarter of the 19th century. The Society for Promoting Female Education in the East (now absorbed by others, chiefly by the Church Missionary Society) was founded in 1834; the Scottish Ladies' Association for the Advancement of Female Education in India (which subsequently became two associations, for more general work, in connexion with the Established and Free Churches of Scotland respectively) in 1837; the Indian Female Normal School Society (now the Zenana Bible and Medical Mission) in 1861 (taking over an association dating from 1852); the Wesleyan Ladies' Auxiliary in 1859; the Women's Association of the Society for the Propagation of the Gospel, and the Baptist Zenana Mission, in 1867; the London Society's Female Branch, in 1875; the Church of England Zenana Society (an offshoot from the Indian Female Society) in 1880. But the earlier of these organizations only contemplated employing women for educational work, on a very small scale. Out of it grew the visitation of Indian zenanas. The employment of women in general evangelistic work, such as village itineration, house-to-house visiting in towns, classes for female inquirers, training of native female workers, &c., although recent, has rapidly extended. The Church Missionary Society, besides relying on the above-named Zenana Bible and Medical Mission and Church of England Zenana Missionary Society for women's work at several of its stations in India and China, sent out 500 single women in the fifteen years ending 1900; and the non-denominational Missions above referred to have (including wives) more women than men engaged in their work,—especially the China Inland Mission, which has sent out several hundreds to China, and in 1900 had just 300 (unmarried) on the roll. Women's work and medical work are combined in the persons of about eighty fully-qualified lady doctors in various Missions. Although nearly half the male missionaries (Protestant) are unmarried, these are exceeded in number by the unmarried women; and consequently, the husbands and wives being equal, the aggregate of women in the Missions is greater than the aggregate of men. If the total number of British missionaries, including wives, is taken at 7000, the married men would stand at about 1900, and their wives at 1900, the single men at 1400, and the single women at 1800; but this is an estimate in round figures.

The home organization of Missions is a subject that has been much considered. The bulk of the work has been done by voluntary societies, membership in which depends upon a pecuniary subscription, and the administration of which is entrusted to elected committees. These committees comprise not only real experts, such as retired veteran missionaries, and retired civil and military officers who have been active friends of Missions while on foreign service, but also leading clergymen and laymen who, though not personally acquainted with the mission fields, become almost equal experts by continuous attendance and careful study. In the case of the two leading Church of England societies, the bishops (being members) are *ex officio* on all executive committees; but their labours in other directions prevent their ordinarily attending. The numerous non-denominational Missions previously referred to are differently worked. There is no membership by subscription, nor any elected committee. The "Mission" consists of the missionaries themselves, and they are governed by a "Director," with possibly small advisory councils in the field and at home, the latter undertaking the duty of engaging missionaries and raising funds.

On the other hand, there is a growing sense that Missions should be the work of the Church in its corporate capacity, and not of voluntary associations. This is the system of the Presbyterian Churches, the Missions of which are entirely controlled by the General Assemblies in Edinburgh, Belfast, and London respectively. The Wesleyan Society also is under the authority of the Conference. In the Church of England the question was broached in Convocation, shortly after the revival of that body, in 1859; and during the next few years many suggestions were put forth for the establishment of a Board of Missions which should absorb the societies, or at least direct their work. It soon appeared, however, that neither the Society for the Propagation of the Gospel nor the Church Missionary Society was willing to be absorbed; and it was urged by some that in a great comprehensive national Church, comprising persons of widely different views, more zeal was likely to be thrown into voluntary than into official enterprises. Eventually, in 1887, the Canterbury Convocation and Archbishop Benson formed a Board of Missions; and York followed shortly afterwards. These Boards, however, were not to supersede the societies, but to supplement their work, by collecting information, fostering interest, registering results, and acting as referees when required. They have already done some useful work, and will probably do more. Their most active members are men who are also leaders in their respective societies, and have thus gained experience in missionary administration. But the Church of England has not yet put Missions in the prominent place they occupy in the Nonconformist denominations.

When the Baptist Union holds its annual session, the first day is devoted to a review of the Baptist Missions. Convocation has not yet adopted a similar procedure.

The closing years of the 19th century were remarkable for the centenary commemorations of the older missionary societies. The Baptist Society celebrated its centenary in 1892; the London Missionary Society (Congregationalist) did the same in 1895; the Society for Promoting Christian Knowledge kept its bi-centenary in 1898; the Church Missionary Society its centenary in 1899; the Society for the Propagation of the Gospel its bi-centenary in 1900–01; and the British and Foreign Bible Society was founded in 1804. Considerable special funds have been raised in connexion with these commemorations.

2. Colonial.

Colonial Missions next claim attention. By "colonial" is meant not missions to the British colonial population, but Missions from the colonial population to the heathen. The former have been very largely the work of the Society for the Propagation of the Gospel, and, in a smaller degree, of the Colonial Church Society (Church of England) and the Colonial Missionary Society (Nonconformist). Those Missions, however, are more properly an outlying branch of home Missions, being to the professing Christian settlers or their descendants. But these Christian settlers have their own Missions to the heathen—both to the heathen at their doors and to the great heathen lands beyond.

In Canada and Australia, the Anglican, Presbyterian, Methodist, Baptist, and other communities have regular organizations for foreign Missions. The non-Episcopal Missions thus formed and supported are worked quite independently of the home societies of the denominations respectively. The Australian Presbyterians have important agencies in the South Seas and in Korea, the Australian Baptists in Bengal, the Canadians of various denominations in the Far North-West of the Dominion, and in India and China. The Anglican Church in Canada has its Domestic and Foreign Missionary Society, working in the North-West and in Japan; and in Australia it has a Board of Missions, working amongst the Australian aborigines and in New Guinea. The Melanesian Mission, associated with the names of Selwyn and Patteson, is officially connected with the Church of New Zealand, but is also largely supported in Australia. In New South Wales, Victoria, New Zealand, and Canada there are also Church Missionary Associations which supply missionaries, and support them, for the mission fields of the Church Missionary Society.

3. Continental.

The *German* societies are numerous and important, and have increased in number and in vigorous work. The *Moravian Church*, whose Missions are the oldest (1732), is itself a missionary organization in a sense in which no other Christian community rivals it. Its total membership is under 100,000, and it has some 350 missionaries, labouring in the most unpromising fields, Greenland, Labrador, Alaska, Central America, Tibet, and among the Hottentots. The *Basel Society*, with its famous seminary at Basel, which formerly supplied many able German missionaries to the Church Missionary Society, has extensive work in India, West Africa, and South China. The *Berlin Society* and the *Rhenish Society* labour in South Africa and China, the *Hermannsburg Mission* (Hanover) in South Africa and India; *Gossner's Mission* (Berlin) and the *Leipzig Lutherans* in India. At least two of these societies, and other new associations formed for the purpose, and the Moravians, have taken up work in German East Africa. In 1900 German missionaries numbered 986, and their converts were estimated at 370,000. The principal organization in *Holland* is the Netherlands Missionary Society, working in the Dutch East Indies. A *Danish* Society has a mission in South India. The old *Swedish* and *Norwegian* Missionary Societies work in South Africa, Madagascar, and India; but large numbers of Scandinavians have been stirred up in missionary zeal, and have gone out to China in connexion with the China Inland Mission; several were massacred in the Boxer outbreaks. The *French* Protestants support the *Société des Missions Évangeliques*, founded in 1822. Its chief mission has been in Basutoland, since extended to the Zambezi; but it has also followed French colonial extension, establishing missions in Senegambia, the French Congo, Madagascar, and Tahiti.

4. American.

The newer American organizations are, as in England, non-denominational and "free-lance," especially the Christian Alliance under the direction of a popular minister at New York, the Rev. A. B. Simpson, which has sent many missionaries to India and China. The older societies attribute to these new agencies more zeal than discretion, while the newer credit the older with a discretion that cripples zeal. The Student Volunteer Movement, already referred to, has had large influence in the United States, where it arose; and its leaders have proved themselves men of rare intellectual and practical capacity. In a journey round the world in 1895–97, Mr J. R. Mott succeeded in forming students' associations in universities and colleges in several European countries, as well as in Turkey in Asia, Syria, India, Ceylon, China, Japan, and Australia; and all these associations, nearly 100 in number, are now linked together in a great International Student Federation, of which a Swede is chairman and a Japanese vice-chairman. The older American societies, especially the American Board (Congregationalist), the Presbyterian Boards, the Methodist Episcopal Church Society, the Baptist Missionary Union, and the Missionary Society of the Protestant Episcopal Church, have much extended their work. The "Ecumenical Missionary Conference" held at New York in April 1900 was an astonishing revelation to the American public of the greatness of Missions generally, and of the Missions of their own Churches in particular. American missionaries number about 4800.

5. Missions to the Jews.

Missions to the Jews are distinct from Missions to heathen and Mahommedans, and are worked by distinct organizations. There are several societies in England, Scotland, Germany, and America. No special development has to be reported, except the great extension of Mr John Wilkinson's *Mildmay Mission to the Jews*, and its energy in the free distribution of Hebrew New Testaments. Converted Jews are commonly supposed to be very few, and in numbers they do not compare with converted heathen; but they are more numerous than is usually imagined, especially if the second and third generations of Christians of Hebrew race are included. It is estimated, for example, that 250 Anglican clergymen are converted Jews or the sons of converted Jews. The London Society for Promoting Christianity among the Jews includes among its missionaries about 80 who are converts. Professor Delitzsch estimated that 100,000 Jews had embraced Christianity in the first three quarters of the 19th century; and Dr Dalman of Leipzig says that "if all those who have entered the Church and their descendants had remained together, instead of losing themselves among the other peoples, there would now be a believing Israel to be counted by millions, and no one would have ventured to speak of the uselessness of preaching the Gospel to the Jews."

At the beginning of the 19th century the Roman Communion seems to have shared to some extent in the torpor

6. Roman Catholic Missions.

and stagnation as regards Missions that characterized the Protestant Churches. There was little of the zeal which had carried the Franciscans all over Asia in the 13th century, and the Jesuits to South America, India, and Japan in the 16th. But the 19th century has witnessed a great change, and Roman Catholic Missions have been extended *pari passu* with Protestant. The revival was not a little due to the foundation in 1822, by a few earnest but (as they called themselves) "humble and obscure" Catholics at Lyons, of a new voluntary society called the Institution for the Propagation of the Faith. It collected in its first year about £2000 from the shopkeepers and artisans of Lyons. Thirty years later its income was £200,000 a year; and now it is £300,000. It has sent out no missionaries of its own. It merely makes grants to the various missionary parties sent forth, and it has done much in this direction. Roman Missions are carried on both by missionary societies and by religious orders, all under the supreme direction of the Pope, and also more or less under the general supervision of the Congregation de Propaganda Fide at Rome since its foundation in 1622. The Congregation of Lazarists was founded at Paris by St Vincent de Paul in 1632, and the Société des Missions Étrangères, also at Paris, in 1663. This last-named society is the largest Roman Catholic missionary organization, labouring all over eastern Asia and parts of India. It had, in 1899, 34 bishops, 1100 missionaries, 680 native priests, and 1,227,000 native Christians. In that year it baptized 46,000 adult pagans, 41,000 children of Christians, and 155,000 "children of pagans *in articulo mortis*." Several other smaller societies have their headquarters in Belgium, Italy, and Ireland. For the purpose of Missions in Africa several modern congregations have been formed, particularly the Congregation of the Holy Ghost and Heart of Mary, the Lyons Society of African Missions, the Institute of Verona, and the Algerine Congregation for the conversion of Central Africa (White Fathers). An English organization, St Joseph's Foreign Missionary Society, was founded by Cardinal Vaughan at Mill Hill, near London, about 1870. It had in 1900 two bishops and 86 priests in the mission field, and works in Uganda, north and south India, Borneo, and New Zealand. The religious orders are also largely represented in the foreign field. The English Benedictines work in British colonies; the Capuchins in the Levant, Western Asia, North Africa, and South America; the Carmelites in India; the Dominicans in Turkey, Indo-China, North and South America; the Lazarists in China, the Levant, Persia, Abyssinia, Madagascar, and South America; the Franciscans, who have been zealous missionaries since the days of their great founder, in China, in the Philippines and Pacific islands, in North and South America, in Egypt and North Africa, in Palestine (where they are the appointed guardians of the Holy Places), and in many European countries; the Priests of the Sacred Heart in South America and the Pacific Ocean; the Oblates of St Mary in the polar regions of North America; and, lastly, the Jesuits in all quarters of the world, who in 1899 had 116 missionaries in Europe, 233 in Africa, 988 in Asia, 550 in Oceania, 1246 in North America, and 856 in South America; total Jesuit missionaries, 3989. In 1895 the Propaganda returned the number of Catholics in heathendom as 3,606,000. But this did not include North and South America, so that the total would be quite four millions. By far the greater part of the Roman missionary work is done by France. The majority of the missionaries are French (over 7000); the bulk of the money—so far as it is voluntary contribution (but the Propaganda at Rome has large endowments)—is raised in France. The French Government, anti-clerical as it is at home, is the watchful and strenuous protector of the Missions abroad; and it is evident that not a little political influence in foreign countries is gained thereby. *L'Année de l'Eglise*, in reporting on the Missions in all parts of the world, dwells continually on this with satisfaction. Protestant missionaries are opposed, not merely because they are heretical, but because they are English or (if American) English-speaking; and the Greek Church missionaries in Persia and Japan, not only because they are schismatic, but because they are Russian—the Franco-Russian alliance notwithstanding. This is a feature in French Catholic Missions which cannot be overlooked in the briefest account of them.

The Mission Fields.

Africa.—The old Missions on the *West Coast*, of the Church Missionary Society, the Wesleyans, and others, including several American agencies in Liberia, have continued to develop and extend. The native church organizations at Sierra Leone, Lagos, the Niger Delta, &c., are self-supporting, and the Missions proper have advanced into the interior. The professing Christians (Protestant) on the coast probably number not less than 100,000. More than 120 negroes have been ordained to the ministry of the Church of England. There are now four negro bishops, one of them (in Liberia) connected with the American Episcopal Church. Attempts have been made to reach the Mahommedan populations of the Western and Central Sudan, particularly Hausaland, but so far they have been unsuccessful. In the southern half of West Africa, *i.e.*, the *Congo Region*, there are extensive Missions of the English and American Baptist Societies, the Congo Balolo Mission, and others, all founded since 1875. Although still in their early stages, some hundreds of converts have been received. In all these regions there are extensive Roman Catholic Missions, chiefly French, of the Congregation of the Holy Ghost and the Lyons African Mission.

The *South African Colonies*, being the borderlands of native barbarism and European civilization, are among the hardest of mission fields. The Society for the Propagation of the Gospel, the London Missionary Society, the Wesleyans, the United Free Church of Scotland, the South Africa General Mission, the Moravians, the French Protestants, and some German societies, are at work among Kaffirs, Zulus, Pondos, Basutos, Bechuanas, Hottentots, &c., with considerable results, there being probably 150,000 native Christians (Protestants); and several missions now extend northwards to the Zambezi. The Church of England has nine dioceses, in all of which the work is among both colonists and heathen. The American Board (Congregationalist) has begun work on both sides of Africa, a little north of South Africa proper. There are several vicariats and prefectures of the Roman Church, the principal Missions being French, those of the Congregation of the Holy Ghost, and the Oblates of Mary.

East and Central Africa have witnessed great missionary development since 1884. The Scottish Missions in Nyasaland have gained great influence and won many converts. The church at Blantyre, connected with the Mission of the Established Presbyterian Church of Scotland, and built by the natives themselves, is a large and imposing one. The Universities' Mission, with its two bishops, and its cathedral at Zanzibar, also works on Lake Nyasa, and in several other East African districts, with increasing success. In Bishops Steere, Smythies, and Maples it added distinguished names to the roll of Anglican heroes. The London Missionary Society's enterprise on Lake Tanganyika has been disappointing, despite much patient and zealous labour. The German Missions in German East Africa are still in their infancy. Of the several Church Missionary Society Missions, Uganda has proved the most successful. In 1884 the first handful of converts had recently been baptized. There are now 30,000 baptized Christians, 2000 native teachers, 27 native clergymen, 800 churches, all supported by the converts themselves; and under Bishop Tucker's direction the Mission is branching out into the surrounding countries. The Roman Mission in Uganda, begun about two years after the Anglican one, in 1901 reckoned 8000 baptized Christians and about 16,000 catechumens. It was for some years a French Mission only, the White Fathers of Algeria, but there is now an English bishop with English priests from St Joseph's Society at Mill Hill. The Jesuits work on the Zambezi, the White Fathers in the Great Lake region, and the French Congregation of the Holy Ghost and German Benedictines on the Zanzibar coast. The French Mission at Bagamoyo has long been famous for its excellent work.

Moslem States.—*North Africa* and *Egypt* are among the hard Mahommedan fields, and so are the *Turkish Empire*, *Arabia*, and *Persia*. The American Presbyterians and Congregationalists have the largest Protestant Missions in these lands, working, however, mainly for the enlightenment and education of the Oriental Christians. With the same object, though on different lines, the archbishop of Canterbury's Assyrian Mission seeks to influence the Nestorians. The Roman Catholics have extensive Missions in these countries, directed at winning adherents to the unity of the Holy See from the Oriental Churches, which are regarded as schismatic and heretical. In this enterprise there has been great advance in Egypt among the Copts, and in 1899 the Pope signalized "the resurrection of the Church of Alexandria" by appointing a Patriarch for Egypt, Libya, and Nubia. Farther east, on the borders of Turkey and Persia, the Roman and Russo-Greek Churches compete for the adhesion of the Nestorians, Chaldeans, and Armenians. The Franciscans, Dominicans, Lazarists, and Jesuits are engaged in all these works. Direct work among Mahommedans is done, though with small result, by the North African Mission (non-denominational) and the Church Missionary Society. The Egypt, Palestine, and Persia Missions of the latter society have been largely reinforced and extended since 1884, medical work and women's work being especially prominent. Four cities in southern Persia are now occupied. Three Missions just touch the borders of *Arabia*, viz., the United Free Church of Scotland at Aden, founded by the late Hon. Ion Keith-Falconer, Arabic professor at Cambridge; an American Presbyterian Mission on the Persian Gulf; and the Church Missionary Society's Mission at Baghdad.

India.—The India Missions illustrate, as no others do, the diversities of missionary operations—bazaar preaching, village itineration, lectures and conversations, zenana visiting, vernacular schools, high schools and colleges, orphanages and boarding schools, mission hospitals and dispensaries, native church councils, and the quiet labour of linguistic translation. Almost all the great Protestant societies have their India Missions, and these have been largely reinforced. Perhaps the most notable feature is the extensive development of the American agencies, particularly those of the Episcopal Methodists, who are rapidly spreading their organization over many parts of India; but also those of the Presbyterians, Congregationalists, and Baptists. In 1890 the total number of Protestant missionaries was 975. It is probably at least 1300 now, possibly 1500. In the decade 1881–90 the Indian Protestant Christians increased from 417,000 to 559,000. The census of 1891 reported 2,036,000 native Christians, 70 per cent. of whom belonged to the Roman and Syrian Churches. The Church of England claimed 10 per cent., and the other Protestant denominations 18 per cent. The Government figures for the Protestant Christians were higher by 20,000 than those compiled by the missionary societies, showing that the latter had not over-estimated their results. The census of 1901 gives the native Christians as 2,664,359, showing an increase in the decade since 1891 of 628,359. The total is thus made up:—Roman Catholics, 1,122,378; Syro-Romans, 322,583; Jacobite Syrians, 248,737; Anglicans, 305,907; other Protestants, 561,078; miscellaneous and unspecified, 103,676. The Anglicans and other Protestants show a larger relative increase than the Roman Catholics. In 1891 the latter (including Syro-Romans) were 61 per cent. of the whole; now they are 54 per cent. There is no better gauge of real missionary success than ordinations, as they indicate the highest result of Christian training. About 400 natives of India have received Anglican orders, almost all of them since 1850; and very many of those in Presbyterian and other orders have been at least their equals in education and capacity. The large majority of baptisms in India continue to be among the non-caste or "depressed" classes of the population, comprising both the non-Aryan tribes and the lower grades of Hindus; but year by year there are numerous baptisms of Brahmans and other high-caste men, and even of the higher classes of Mahommedans. The missionary colleges and high schools have much increased in efficiency under the spur of Government examinations, and the moral results of the education they impart—even apart from conversions—are acknowledged on all hands. The great United Free Church College at Madras, under Dr W. Miller, confessedly stands in the front rank of all educational institutions. Female education is spreading, though still slowly, and chiefly among the native Christian population. The total number of women who had matriculated at the Indian Universities to 1899 was 1306. The majority were Europeans or Eurasians, but 395 were Indian women, and of these 367 were Christians, 27 Hindus, and one a Mahommedan. Roman Catholicism has made considerable progress in India, particularly in the south, and since the famine of 1877–78; but a large proportion of its adherents are descendants of the converts of the 16th and 17th centuries. The *Missiones Catholicae* in 1895 gave the total as 1,391,000, including Burma and Ceylon. The *Illustrated Catholic Missions* gives it as just over 2,000,000 in 1900. The ecclesiastical organization comprises a Papal delegate at Kandy, 7 archbishops, 21 bishops, and 7 vicars or prefects apostolic; under whom are 800 European missionaries (French, English, German, Italian), 800 Goanese priests, and 700 Indian priests. The various societies and orders do not seem to be more united than the different Protestant denominations. The French Jesuits of Madura and Tinnevelly complain bitterly (in *L'Année de l'Église*) of the opposition of the Goanese as worse even than that of the pagans and Protestants. Prior to 1884 the archbishop of Goa's jurisdiction extended over the whole Roman Church in India, but in that year the Pope confined it to the Portuguese section, abolishing it in British and French territory. *L'Année de l'Église* attributes the progress of the Protestant Missions to their extensive educational work, and urges the Roman missionaries to do likewise, pointing to the success of the Catholic colleges already established.

Indian Ocean.—*Ceylon* is a flourishing mission field. The Anglican Church there is now properly organized, with a constitution of its own. Roman Catholics and Wesleyans are also strong. *Mauritius* is an outpost of India, the work being mainly among Indian coolies. In *Madagascar* the work of the London Missionary Society, which had been among the most successful in the world, and also the work of the Society for the Propagation of the Gospel, and of the Friends' and the Norwegian Missions, have suffered much since the French conquest of the island. Gradually, however, by accepting the situation, and adopting the French language in the schools, the missionaries have conciliated the new rulers, and many difficulties have been removed, while good has resulted from the advent of the French Protestant missionaries. The French Catholic Missions are on an extensive scale, reckoning 94,000 baptized and 267,000 catechumens. *L'Année de l'Église* complains of the favour shown to the Protestant Missions by the French officials, without which, it says, those missions would have disappeared in twenty years; before the war the Protestants had two-thirds of the Christian adherents and the Catholics one-third, but the proportions have since the war been exactly reversed. In the *Malay Archipelago* the principal Missions are Dutch, and the external results are considerable. The Rhenish Society also works in the islands, especially in *Sumatra*. There is an Anglican bishop for the *Straits Settlements* and *Borneo*.

China.—The years since 1880 have been a period of extraordinary extension in the Protestant Missions in China. It was not until after the Chefoo Convention of 1876 that the great pioneer journeys of the China Inland Mission men carried them into almost all the eighteen provinces. In 1878 there were 473 Protestant missionaries in China; in 1890 there were 1300; in 1900 there were 2800 (including wives). Of these, 784 belonged to the China Inland Mission; about the same number to other British societies (Church Missionary Society 189, London Missionary Society 120); about 930 to American societies; and the rest to Continental and colonial associations, or unconnected. There are four English bishops and two American. Women missionaries are especially numerous, and they have travelled with propriety and with safety (all assertions to the contrary notwithstanding) into the remotest provinces. The converts who were communicants numbered 13,000 in 1878; in 1900 they were estimated to be 100,000. The excellence of the converts, upon the whole, is testified to by travellers who really know the case; particularly by Mrs Bishop, who speaks of the "raw material" out of which they are fashioned as "the best stuff in Asia." China has been regarded as the most promising of all mission fields. The whole country has been open, even the long-closed and hostile province of Hunan; the people generally friendly, notwithstanding occasional local riots and outrages, such as the massacre of a clergyman, eight ladies and two children, in Fuh-Kien in 1895; the mandarins often displaying singular fairness in dealing with inevitable difficulties, the Government of Peking becoming more and more liberal under the young Emperor, and English education beginning to attract the upper classes, awakened from their torpor by the issue of the war with Japan. But all this was changed in 1900 by the high-handed proceedings of the Dowager-Empress, the rise of the Boxer fanatics, the struggle at the Peking embassies, the terrible massacres of 133 Protestant and 49 Roman missionaries in the northern provinces, and the withdrawal of some hundreds more from the interior by the peremptory orders of the consuls. Much of the work in the south, however, went on without interruption, and even where the missionaries had withdrawn the Chinese ministers and teachers continued their labours amongst their own countrymen. Since then the viceroys of the northern provinces have themselves invited the missionaries back. Roman Catholic Missions in China have a remarkable history from the 16th century downwards. The scientific and literary attainments of the Jesuit missionaries rendered them famous. The work is now carried on by ten societies or religious orders. There are 39 bishops and 790 European priests (600 of them French). There were 370 native priests in 1895. The Chinese Christians numbered 582,000 in that year, and are now reckoned as 661,000. *L'Année de l'Église* says that the most prominent feature of the work is the large number of baptisms of the children of pagans. In the province of Szechuen alone 85,643 children of heathen parents were baptized in 1899, a large proportion of them being baby girls thrown away by their mothers. In 1898 the Jesuits of the Shanghai mission baptized 41,400 pagan children "at the point of death." An important concession was obtained in 1899 by the French Minister at Peking, with a view to the more effective protection of the Roman Missions. The bishops were declared "equal in rank to the viceroys and governors," and the priests "to the prefects of the first and second class"; and their influence and authority were to correspond. The Anglican bishops agreed to decline these secular powers, as also did the heads of other Protestant Missions. It is alleged by some that the exercise of the powers gained by the Roman hierarchy was one cause of the Boxer outbreaks. Certainly their native adherents had their full share of persecution and massacre.

Japan.—Although effective missionary work on any scale was little more than ten years old in 1884, that was a period of high hopes for the early triumph of Christianity. The Japanese newspapers openly anticipated it, and some of them welcomed the prospect. When the first Parliament, or Diet, of Japan was elected in 1890, out of 300 representatives, all leading men, 14 were Christians; and the president chosen for the Lower House was a member of the Presbyterian Church. But the following decade witnessed a change. A strong tide of national pride and independence set in, and there was less readiness to adopt anything Western. Progress therefore became slower, and there were many apostasies, chiefly from some American Missions regarded as lacking in orthodoxy. The bulk of the Protestant work all along has been American and non-Episcopal, and of the 40,000 Protestant converts three-fourths belong to churches founded by American missionaries. These are rapidly assuming a more or less national character; and similarly, the Anglican Missions have combined with the American Episcopal Church to form the *Nippon Sei-Kokwai*, or Japan Church, with a constitution and synod of its own, and 10,000 members; though for the present it has foreign bishops, four English and two American. The Russo-Greek Church has an important Mission in Japan, under an able bishop. It has enrolled some 25,000 converts. The Roman Church, which achieved such extraordinary success in the 16th century, is again to the front, having 54,000 Christians, about half of whom are the descendants of the small remnant left after the dreadful persecutions of that period. It has an arch-bishop and three bishops, and it works largely through orphanages, hospitals, &c., which methods have not been adopted by Protestant Missions in Japan, as they have been in India. A remarkable article in the *Illustrated Catholic Missions* for October and November 1900 states that while the Protestant Missions have gained many converts from among the educated classes, the Catholic Missions are most successful among the poor. The writer cites an intelligent Japanese as attributing this to the similarity of Roman and Buddhist ritual: educated men, despising the latter, are led to despise the former; but he himself attributes it rather to the fact that Protestantism is the religion of the nations which Japan regards as most progressive, Great Britain, Germany, and the United States. He considers, however, that the Catholic religion will eventually prevail, because it is embraced from "supernatural motives," while the Protestants, being swayed by private judgment, are more likely to become freethinkers.

The Rest of Eastern Asia.—*Burma* is part of British India, although very different in many ways, and Buddhist in religion. The Society for the Propagation of the Gospel, the American Baptists, and the Roman Catholics have large and fruitful Missions there. *Siam* is a field of the American Presbyterians, also with promising fruit. In *French Indo-China* the Roman Missions are very extensive, and have 700,000 converts, notwithstanding violent persecution prior to the French occupation, with terrible massacres of priests and native Christians. The Pope in 1900 "beatified" many of the martyrs. *Mongolia* has been the scene of pioneer efforts by the London Society. In *Manchuria* the Scottish and Irish Presbyterians have had remarkable success, while the Roman yearbook says that, despite Russian influence, the people "are throwing themselves *en masse* into the Catholic Church." This field has been called the Uganda of Asia. *Korea*, opened by Sir H. Parkes's treaty in 1883, has been occupied by American, Canadian, and Australian Presbyterians, and, since 1889, by the Society for the Propagation of the Gospel. The Roman Catholics had Missions there before the opening, and nine missionaries were martyred in 1866, while now there are 36,000 adherents. The *Philippine Islands* have already attracted missionaries from the United States.

The South Seas.—The great archipelagos of the Pacific are old and very fruitful fields of the English Congregationalists and Wesleyans and the Scottish Presbyterians. The Anglican Mission in *Melanesia* has been already mentioned. The *Sandwich Islands* and *Micronesia* are American fields. In the whole Pacific the Roman Missions count 85,000 converts. A more modern field is *New Guinea*. In the British part of that great island there are Missions of the London Society (1871), the Anglican Church of Australia (1892), and the Australian Methodists (1892)—all in the early stages of work.

North America.—Missions among the Red Indian tribes in the North-West Territories of both the United States and Canada have long been carried on by several societies. Bishop Whipple of Minnesota was justly called the Apostle of the Indians, so far as the work of the American Episcopal Church was concerned. In the Canadian North-West the Church Missionary Society's Missions have reached many tribes, up to the shores of the Polar Sea, and made some thousands of converts. Even the wandering Eskimo have supplied a few hundred members to the Christian Church. The one bishopric of those territories in 1872 has since become eleven. The Roman Catholic missionaries also are scattered over these immense territories, and have a large number of Indian adherents. Besides the Oblates before mentioned, many are Jesuits from French Canada. The Russo-Greek Church has a mission in Alaska, dating from the time when it was Russian territory. The total number of Indians in British North America is 99,000, of whom about 27,000 are still pagan, and the rest are about equally divided between the Protestant and Roman Catholic Missions.

Central America and West Indies.—American Missions are at work in Mexico and adjacent countries. In the islands the negro population has been reached by most of the larger British societies.

South America.—The South American Missionary Society, founded by the ill-fated Captain Allen Gardiner, has much extended its work among the Indians of the interior of what has been well called "the Neglected Continent"; and several American Missions are also at work. The Society for the Propagation of the Gospel has an important Mission in British Guiana. But there are numerous heathen tribes never yet reached. The Roman Church, which is dominant throughout the continent, has been engaged in serious struggles with the anti-religious tendencies of the Republican governments, and *L'Année de l'Église* makes no mention of Missions among the Indians. In fact, the Pope in 1897 was obliged to send a severe rebuke to the clergy for their lack of consistency and zeal.

Results of missions.

The Christian Church bases its missionary enterprise upon the command of its Founder, and regards the duty as just the same whether the results be large or small. It appeals to common sense, saying in effect, "If it be a fact that a Divine Person came into the world to bless mankind, all men ought to know it, and have a right to know it. However much or (if you will) little a Buddhist or a Moslem may *need* to know of Christ, he certainly has a *claim* to be told of Him. The responsibility, if there be any, of believing, rests with the individual told; the responsibility of telling him rests with the Christian Church." On this view of the matter, results, however desirable, are no certain test of a Mission doing its work. A Mission in Persia, with its handful of converts, has, on this view, as much right to support and appreciation as a Mission in southern India with its tens of thousands. Again, on the hypothesis that Christianity is true, the statistics at a particular period are no test of success at all. For in them *the dead are not counted;* and the converts who are already dead are—at least in respect of individual salvation—the surest of results. If, however, we are to take statistical returns for what they are worth, it is estimated that the Christians in heathen lands gathered by Protestant Missions probably amount to four millions, and, as above stated, a similar total may be ascribed to Roman Catholic Missions, making eight millions in all. This, however, includes adherents still under instruction for baptism, and their children. The inner circle of communicant members is not more than one-third of the total.

But it has to be carefully borne in mind that Missions are still—to the reproach of the Christian Church on the above hypothesis—in their infancy. In most of the South Sea Islands, and among the Red Indians of North America, the work of evangelization, *i.e.*, of proclaiming the Gospel, may be said to have been fairly completed, but in the great continents of Africa and Asia it is as yet in an early stage. Meanwhile, it is generally acknowledged that a vast preparatory influence is being exercised. In effecting the mighty social changes in India since 1850, Lord Lawrence said that Christian Missions had done more than all other agencies combined. The forward movements in China (prior to the Boxer outbreaks) were largely the direct result of missionary influence. In Japan, leading men fully recognize the importance of that influence.

In Africa, geographical exploration, commercial enterprise, and the extension of European power, have followed in the wake of missionary pioneers. While it is true that very diverse opinions are held concerning Missions, it is indisputable that the most favourable testimonies come from those who have really taken the most pains to examine and understand their work. The one discouraging feature, from the Christian point of view, is the backwardness of Christendom in its great enterprise. If the Churches did their foreign work with the same energy which they throw into their home work, the results would be very different.

Statistics of Protestant Missions.—A very elaborate volume of Protestant missionary statistics at the end of the 19th century has been compiled by Dr Dennis of America, and published in Great Britain by Messrs Oliphant, Anderson, and Ferrier. We take the following condensed figures from its tables:—

There are 558 missionary societies, viz:—

Engaged in direct evangelization	294
Indirectly aiding the work	127
Devoted to specific branches of the work	137
	558

These societies have their headquarters in the following parts of the world:—

Great Britain and Ireland	154
European Continent	82
American Continents	128
Asia	117
Africa	42
Australasia and Oceania	35
	558

The total number of missionaries is stated to be 17,974, but the figure needs considerable reduction, and a more careful analysis gives the following approximate results:—

Ordained	4,800
Physicians: Men	480
,, Women	220
Laymen not physicians	2,000
Unmarried women not physicians	3,600
Married women not physicians	4,400
	15,500

The results of Missions, as represented by living native Christians, are thus given:—

Christian community—including communicants and non-communicants of all ages	4,514,592
Of whom are communicants	1,531,889
Increase of communicants in one year	112,152

The following educational statistics are given:—

Missionary universities and colleges	94
Theological and training schools	375
Boarding and high schools, &c.	879
Industrial training institutions	179
Medical schools	67
Elementary day schools	18,742
Pupils in the higher institutions—	
Males	97,667
Females	42,908
Total pupils—Males	716,741
Females	332,980

Philanthropic institutions:—

Orphanages	247
Leper homes, &c.	100
Homes for blind or deaf mutes	30
Miscellaneous	156
Guilds and associations	118

Medical statistics:—

Mission hospitals	379
,, dispensaries	783
Hospital in-patients, in year	85,169
Individual patients, in year	2,347,780
Total treatments, in year	6,442,427

Literary statistics:—

Missionary Bible translations—	
Of the whole Bible	99
Of the New Testament	121
Of portions	236
Carried forward	456

Brought forward	456
Add transliteral versions	20
	476
Deduct obsolete versions	40
Versions in use	436
Mission publishing houses and printing-presses	159
Periodicals issued by missionaries	379

AUTHORITIES.—The following are a few of the books recommended: J. S. DENNIS. *Centennial Survey of Foreign Missions.* Edinburgh, 1902.—A. T. PIERSON. *New Acts of the Apostles.* New York, 1894.—GEORGE SMITH. *Short History of Christian Missions.* Edinburgh, 1897.—J. LIGGINS. *Great Value and Success of Foreign Missions.* New York, 1894.—GUSTAV WARNECK. *Modern Missions and Culture.* New Edition translated from the German by T. Smith. Edinburgh, 1882.—J. S. DENNIS. *Christian Missions and Social Progress.* Edinburgh, 1897.—A. C. THOMPSON. *Protestant Missions: their Rise and Early Progress.* New York, 1894.—GUSTAV WARNECK. *Outline of a History of Protestant Missions.* Translated by G. Robson. Edinburgh, 1901.—EDWARD STORROW. *Protestant Missions in Pagan Lands.* London, 1888.—J. A. GRAHAM. *Missionary Expansion of the Reformed Church.* London, 1898.—Bishop A. BARRY. *Ecclesiastical Expansion of England in the Growth of the Anglican Communion.* Hulsean Lectures 1894–95. London, 1895.—*A Hundred Years of Missions; or, the Story of Progress since Carey's Beginning.* New York and London, 1895.—R. WARDLAW THOMPSON and A. N. JOHNSON. *British Foreign Missions, 1837–97.* London, 1899.—F. P. NOBLE. *Redemption of Africa: A Story of Civilization*, 2 vols. New York and Chicago, 1899.—R. N. CUST. *Africa Rediviva.* London, 1891.—D. M. THORNTON. *Africa Waiting: or, the Problem of Africa's Evangelization.* London, 1898.—GEORGE SMITH. *Conversion of India from Pantaenus to the Present Time.* London, 1893.—E. M. BLISS (Ed.). *Encyclopædia of Missions.* New York, 1891.—E. HODDER. *Conquests of the Cross*, 3 vols. London, 1893.—*Missionary Year-Book for 1889.* London, R.T.S.—JAMES JOHNSTON (Ed.). *Report of Centenary Conference on the Protestant Missions of the World, 1888.* London, 1888.—G. A. SPOTTISWOODE (Ed.). *Official Report of the Missionary Conference of the Anglican Communion, 1894.* London, 1894.—"*Make Jesus King.*" Report of the Student Volunteer Missionary Union Conference at Liverpool, 1897. London.—*Students and the Missionary Problem.* London, 1899.—EUGENE STOCK. *History of the Church Missionary Society*, 3 vols. London, 1899.—*The Church Missionary Atlas.* Eighth edition. London, 1896.—C. F. PASCOE. *Two Hundred Years of the S.P.G., 1701–1900.* London, 1901.—H. W. TUCKER. *English Church in other Lands.* London, 1886.—Bishop MONTGOMERY. *Foreign Missions.* London, 1902.—A. E. M. ANDERSON MORSHEAD. *History of the Universities' Mission to Central Africa, 1859–96.* London, 1897.—J. B. MYERS (Ed.). *Centenary Volume of the Baptist Missionary Society, 1792–1892.* London, 1892.—R. LOVETT. *History of the London Missionary Society.* 2 vols. London, 1899.—J. M. REID, &c. *Missions and Missionary Society of the Methodist Episcopal Church.* New York, 1896.—CH. EGREMONT. *L'Année de l'Église* [Roman Catholic] 2e année, 1899. Paris and London.—*Missiones Catholicae Cura S. Congregationis de Propaganda Fide descriptae.* [Roman Catholic.] Rome (biennial).—SOCIÉTÉ DES MISSIONS ÉTRANGÈRES [Roman Catholic]. *Compte Rendu des Travaux de 1899.* Paris, 1900. (E. ST.)

Mississippi, one of the southern states of the American Union, situated south of the state of Tennessee, and immediately east of the Mississippi river. It is separated from Tennessee by 35° N. approximately. The 31st parallel forms its southern boundary from the Mississippi river to the Pearl, and the Gulf of Mexico marks its limits from the mouth of this river to the arbitrary line which separates Mississippi from the state of Alabama on the east. The islands within 6 leagues of the coast are included, and the total land area of the state is 46,383 square miles. The state was organized in 1817.

Population.—The census figures have been as follows:—

	Total.	White.	Coloured.	Density per square mile.
1880	1,131,592	479,371	652,221	24·42
1890	1,289,600	544,851	744,749	27·57
1900	1,551,270	642,900	908,370[1]	33·48

[1] Including a small number of Chinese and Indians.

The rate of increase from 1890 to 1900 was 20·3 per cent., as compared with 14·0 per cent. for the preceding decade. The census of 1900 showed 781,451 males and 769,819 females, 1,543,289 native-born and 7981 foreign-born inhabitants. The proportion of whites to the total in 1880 was ·423, in 1890 ·424, and in 1900 ·415. There are about 2200 Indians of the Choctaw tribe still remaining scattered through the central parts of the state. In 1900 there were seven cities and towns having a population of more than 5000 inhabitants each, and an aggregate population of 68,503, and of these only three had a population of over 8000. The urban population was therefore 2·6 per cent. of the total number of inhabitants. The population of the chief cities was, in 1900, Vicksburg, 14,834, Meridian, 14,050, Natchez, 12,210. The population has grown in the last decade of the 19th century chiefly by natural increase.

Education.—Interest in education has been greatly increased, and the public schools have made decided advances. The total number of persons of school age, including all between the ages of 5 and 21 years, in 1900 was 588,275. Of these 167,178 were white and 192,368 coloured. In 1900–01, 387,488 pupils were enrolled in the public schools. The total number of teachers employed was 8515, 5147 white and 3368 coloured. The cost of maintaining these schools, not including the higher institutions, was $1,472,432. The length of the public school term averages 4½ months. Separate schools of all grades are maintained for the two races, affording equal facilities. The State University, near Oxford, has an academic department, and schools of law, engineering, &c. There are 20 instructors and 300 students. Its endowment amounts to $750,000, besides equipment worth $300,000. Its annual income is $50,000. Its endowment comes from the sale of lands given by Congress in trust to the legislature of the state for this use. The State Agricultural College has revenues amounting to $55,000, about 20 instructors, and 300 students. The Industrial Institute and College for Girls has an income of $30,000, and 400 students. These institutions are for white youth. There are corresponding institutions for coloured youth maintained by the state. In all state institutions tuition is free. The number of private schools and endowed colleges, other than state, is small.

Charitable and Penal Institutions.—The state supports two hospitals for the insane, one at Jackson, with 900 patients, and one at Meridian, with 312. It maintains two hospitals, one at Vicksburg and one at Natchez, and schools for the blind and for deaf mutes at Jackson. All of these have liberal provision for support. The state has adopted the policy of keeping the convicts condemned to the state prison at work on farms leased or owned by the state. Under this system abuses have been avoided, eminently humane treatment has been secured, and convict labour in agriculture, chiefly in the raising of cotton, has been quite profitable. The management is under a board of control, consisting of the governor of the state, the attorney-general, and the three railroad commissioners.

Religion.—The chief religious denominations are branches of the Methodists, Baptists, and Presbyterians, having numerical strength in the order named. The population is largely religious.

Agriculture.—Agriculture is the occupation of a very large proportion of the people. Cotton is the chief market crop. The production amounts to about 1,000,000 bales of 500 lb each, the value of which is from $40,000,000 to $50,000,000. The state grows enough grain and hay for domestic use. Stock-raising, particularly the raising of cattle, is an important and growing industry. The southern third part of the state is covered with a heavy growth of yellow pine, representing a value of $250,000,000. The useful timber of other varieties aggregates in value more than this amount. Clays and marls are mined to a small extent. Borings to a depth of from 200 to 500 feet in nearly every county yield an abundance of pure water.

Manufactures.—The following table shows the manufacturing and mechanical industries in 1890 and 1900, with the percentage of increase for the decade:—

	1890.	1900.	Percentage of Increase.
Number of establishments	1,698	4,772	181·0
Capital	$14,896,884	$35,807,419	140·4
Wage-earners, average number	14,465	26,418	82·6
Total wages	$4,191,754	$7,471,886	78·3
Cost of material used	$10,064,897	$21,692,092	115·5
Value of products	$18,705,834	$40,431,386	116·1

The manufacture of lumber, of cotton goods, and of cotton-seed products are the chief industries, and are profitable.

Railways.—The chief railway lines are the Illinois Central and its branches, the Mobile and Ohio, the Southern, and the Louisville and Nashville. The total mileage is 2681. These lines represent a value of about $10,000 per mile. The maritime interests are confined to fishing boats on the coast, where oysters are taken in great quantity for packing. The commercial business is transacted largely through cities in adjoining states, chiefly New Orleans, Mobile, and Memphis.

Internal Improvements.—Under state management a complete system of embankments, or levees, has been completed along the east bank of the Mississippi river from the northern boundary of the state southwards to the vicinity of Vicksburg. These have in the main been efficient in preventing the river from overflowing the rich delta lands situated between the Mississippi and the Yazoo, thus rendering available for agriculture thousands of acres of the most fertile soil. The new capitol building at Jackson will cost at least $1,000,000.

Finances.—The total valuation of property, from assessment rolls, was in 1899: Realty, $113,210,931; personal property, $74,606,004. The state debt was $2,666,048, of which $1,030,946 is payable, and the balance, $1,635,102, represents trust funds for educational purposes, derived from the sale of lands granted by Congress for these purposes.

Banks.—There are 12 national banks; aggregate capital, $780,000; deposits, $2,725,391. There are 107 private banks, with capital amounting to $646,584 and deposits amounting to $11,349,618. There are nine building and loan associations.

History.—Since 1880, and especially during the last decade of the 19th century, the attention of the people has been given to the intellectual, moral, and material advancement of the state. The white race has been dominant in politics since 1875. The legislation passed since that time marks a distinct advance and betterment for all classes. High licence and prohibitory legislation make the sale of intoxicants illegal in all counties except fourteen. The law regulating distribution of school funds gives decided advantages to the counties where blacks largely predominate, and allows in those counties a term of from seven to nine months. The white population pays nine-tenths of the school tax. Railways are required to furnish separate and equally good accommodation for white and coloured passengers. Legislation amply protects the labouring classes in their rights. Liberal inducements in the way of exemption from taxation are offered to investments in manufactures, and full protection is afforded to vested capital. The Constitutional Convention of 1890 changed the organic law in several important particulars. Elections are by secret ballot, each voter marking without assistance the names of the persons voted for. "Every male inhabitant of this state, except idiots, insane persons, and Indians not taxed, who is a citizen of the United States, twenty-one years old and upwards, who has resided in this state two years, and one year in the election district, or in the incorporated city or town in which he offers to vote, and who is duly registered as provided in this article, and who has never been convicted of bribery, burglary, theft, arson, obtaining money or goods under false pretences, perjury, forgery, embezzlement, or bigamy, and who has paid, on or before the 1st day of February of the year in which he shall offer to vote, all taxes which may have been legally required of him, and which he has had an opportunity of paying according to law, for the two preceding years, and who shall produce to the officers holding the election satisfactory evidence that he has paid said taxes, is declared to be a qualified elector; but any minister of the Gospel in charge of an organized church shall be entitled to vote after six months' residence in the election district, if otherwise qualified." (Constitution of 1890, sec. 241.) It is also provided that a uniform poll tax of two dollars, to be used solely in aid of the common schools, shall be imposed on every male inhabitant between the ages of twenty-one and sixty years. Electors must be duly registered at least four months before any election in which they may offer to vote, and "every elector shall, in addition to the foregoing qualifications, be able to read any section of the Constitution of this state; or he shall be able to understand the same when read to him, or give a reasonable interpretation thereof." Elections for state and county officers occur every four years. The governor, state treasurer, state auditor, county sheriffs and treasurers, and certain other officers are not eligible for immediate re-election. Corporations can be formed under general laws only. Property rights of married women are fully protected. While the new qualifications for voting have barred from the polls many illiterates of both races, the state has since 1880 been offering equal school facilities to all, and ample opportunity for becoming qualified. The careful restrictions placed upon the use of the ballot have excluded chiefly unworthy and inconsiderate voters. These laws have evidently allayed political excitement, and promoted among the labouring classes attention to private business and the means afforded for education. The accumulation of property by these classes has been greater during the last decade of the 19th century than during any equal preceding period. This legislation has gone far towards solving the problem of the satisfactory co-existence of the white and black races in the state.

(R. B. F.)

Mississippi River.—A general account of the Mississippi river and of its valley is given in the earlier volumes (ninth edition) of this work (vol. xvi. pp. 518–521). We are here concerned with the history of the improvement works which have been carried out in it since 1880.

The distance from St Paul to St Louis, by the river, is 698 miles. On this portion an attempt is being made to obtain at least 4½ feet of water at all stages, from St Paul to the Missouri river, and 6 feet thence to St Louis. Below St Paul the low-water depths were sometimes not more than 2 feet. The usual methods for regulating rivers are followed: lateral channels are closed, excessive widths are reduced by spurs and closing side channels, caving banks are protected, and dredging is used. At Des Moines a ship canal, with locks, has been built to avoid the rapids, and at Rock Island a channel has been cut in the rock. From St Louis to Cairo, at the mouth of the Ohio, the Mississippi carries all the sediment from the Missouri, at the mouth of which it changes from a clear to a muddy stream. In contraction works here, accordingly, hurdles of piles and brush are used instead of the solid spurs of the upper river. They have had surprising results in building up new banks. Caving banks have been protected by mattresses similar to those used on the lower river, but, partly on account of lesser depths of water, much lighter mattresses can be used. Two pumping dredges with a capacity of 1000 cubic yards of sand per hour have been built, with which it is hoped to maintain low-water depths of 6 feet instead of 3½ or 4 feet. The depth ultimately desired is 8 feet. Above Cairo there had been expended, under the present projects for improving the river, about $17,000,000 up to 1898.

The Ohio. Of the tributaries to the Mississippi, the Ohio is commercially the most important, as it carries coal from Pittsburg to all points below. Works for its improvement, on the same general principles as those for the Upper Mississippi, have been going on for many years, the aim being to get 6 feet of water at low stages. This is impracticable immediately below Pittsburg (1000 miles above the mouth of the Ohio), on account of the small low-water flow. Accordingly locks and movable dams are being constructed to give navigable pools during low water. Six have been completed or are in course of construction, and Congress has required an estimate for twelve more, carrying the system down to Marietta. Each lock and dam costs about $800,000.

The Missouri. The Lower Missouri river has a slope nearly double that of the Mississippi below Cairo; its low-water flow may sink to $\frac{1}{48}$ part of its high-water flow, or to 15,000 cubic feet per second: its average sediment for one year was $\frac{1}{265}$ part by weight of the water, rising to a maximum of $\frac{1}{39}$ part. A good deal of money has been spent in attempting to improve it by works of regulation, but, as might be expected in a river of such characteristics, with limited success.

The principal expenditure for the improvement of the Mississippi river below Cairo has been since 1879 under the control of the Mississippi River Commission, the jurisdiction of which extends from Cairo to the head of the passes, a distance of 1060 miles by the river. The plan adopted by the commission was that usually followed on such rivers, namely, to protect the banks when caving existed or was to be feared, and to build contracting works when the widths exceeded about 3500 feet and the low-water navigation was difficult. The low-water depths were sometimes 4½ or 5 feet; it was proposed to obtain 10. In addition the use of levees was adopted as an important part of "any general and systematic plan for the improvement of the river and the prevention of destructive floods."

Mattresses. In protecting the banks, mattresses of brush or small trees, woven like basket-work, were sunk on the portion of the bank at the time under water, by throwing rubble stone upon them, an excess of stone being used. A common size of mattress was 800 feet long, counted along the bank, by 250 feet wide. Sometimes a width of 300 feet was used, and lengths have reached 2000 feet. The depth of water was often from 60 to 100 feet. At first these mats were light structures, but the loss of large quantities of bank protection by the caving of the bank behind them, or by scour at their channel edges, forced the commission steadily to increase the thickness and strength of the mattress, so that the cost of the linear foot of bank protection, measured along the bank, rose from $8 or $10 to $30 in the later work. The structure of the mattress was also changed, so that its longitudinal strength became that of the strands of wires which replaced the binding poles formerly used, and its thickness that of the fascines which replaced the brush. Even in the stronger types of bank protection there have been failures, and the permanence of the present type is not fully assured. At first the portion of bank out of water was graded to a gentle slope and then covered by a mattress built in place; later, rubble stone was used instead, and was much more satisfactory. When stone is costly, as on the lower river, concrete slabs have been experimented with, both for the upper bank and for sinking mattresses.

Contraction. The contraction works adopted were systems of spurs or pile dykes, running out from the shore nearly to the line of the proposed channel. Each dyke consisted of from one to four parallel rows of piles, the interval between rows being about 20 feet, and between piles in a row 8 or 10 feet. The piles and rows were strongly braced and tied together, and in many cases brush was woven into the upper row, forming a hurdle, in order further to diminish the velocity of the water below the spur. At Baleshed, 540 miles below Cairo, an area of 700 acres was built up 20 feet in a few years by such spurs. Similar dykes were used to close waterways behind islands. This system of contraction works and bank protection was applied to two stretches of the river. The first, at Plum Point, 165 miles below Cairo, was 18 miles long, and was carried well towards completion, the navigable depths being increased from a minimum of 5 feet to 9 or 10 feet in ordinary seasons. The second, at Lake Providence, 542 miles below Cairo, was 19 miles long, and was not nearly completed. At one time a prohibition by Congress of the use of bank revetment, followed by a lack of funds, led to a large loss of work caused by changes in the river. By 1893 there had been expended at Plum Point $3,600,000, and at Lake Providence $3,200,000. It was evident that the cost of the proposed improvement, which had been estimated at $33,000,000 by a majority of the commission in 1881, would really be several times that amount, and that the works would require heavy expense for their maintenance and many years for their execution. Navigation interests demanded more speedy relief.

Dredges. The commission then began building powerful pumping dredges, and in 1900 had nine in operation. Centrifugal pumps are used, the suction pipes being at the bow and the discharge at the stern through a line of pipes about 1000 feet long, supported on pontoons. Water jets or cutters stir up the material to be dredged before it enters the suction pipes. The largest of the dredges had two entirely independent pumps, each having discharge pipes 33 inches in diameter. Its engines had 2000 horse-power. During test trials its average delivery of sand was 4920 cubic yards per hour. It cost $217,000. The later dredges, of a more convenient size, have a capacity of about 1000 cubic yards of sand per hour, the velocity in the 32- to 34-inch discharge pipes being from 10 to 15 feet per second. They cost from $86,000 to $120,000, and their working during a low-water season costs about $20,000. These dredges begin work on a bar where trouble is feared before the river reaches its lowest stage, and make a cut through it. A common cut is 2000 feet long by 250 feet wide, and 3 or 4 feet deep. They have rendered much service to navigation, and the aim now is to maintain with them low-water navigable depths of 9 feet.

Levees. In 1882 occurred one of the greatest floods known on the Mississippi, and extensive measurements of it were made. A maximum flood of 1,900,000 cubic feet per second crossed the latitude of Cairo. Much of it escaped into the bottom lands, which are below the level of great floods, and flowed through them to rejoin the river below. The flow in the river proper at Lake Providence, 542 miles below Cairo, was thus reduced to about 1,000,000 feet per second, while if the river had been confined by levees, the flow between them would have been double, or about 2,000,000 cubic feet per second. The volume of the levees in 1882 was about 33,000,000 cubic yards, and by 30th June 1899 had been increased to about 137,000,000 cubic yards, of which the United States has built about one-half, and has expended on them about $14,000,000. The length of levees is about 1400 miles, and, with the exception of a gap of about 50 miles of broken levees on the west bank below Memphis, is continuous, save where interrupted by tributaries or by high lands, from New Madrid, or 80 miles below Cairo, to Fort Jackson, 1039 miles below Cairo. The width of the interval between levees on the opposite banks of the river varies greatly; in many places the levees are built much nearer the normal margin of the river than is consistent with keeping the flood heights as low as possible. This has arisen from two causes: firstly, to give protection to lands already cultivated, which lie usually near the bank of the river; secondly, to avoid the lower ground, which, owing to the peculiar formation, is found as one goes back from the river. Another ill result of this nearness of the levees to the bank of the river is the loss of levees by caving, which was over 4,000,000 cubic yards in 1898–99, and can only be prevented by bank protection costing $150,000 per mile, to protect a levee perhaps 16 feet high costing about $30,000 per mile. The levees have top widths of 8 feet, side slopes of $\frac{1}{3}$, and banquettes when their heights exceed about 10 feet. The grades of the levees are usually 3 feet above the highest water, and have to be raised from year to year as greater confinement of water gives greater flood heights. When this system is completed, there will probably be hundreds of miles of levee with heights exceeding 14 feet. In 1883 a majority of the Mississippi River Commission estimated the cost of a system of levees from Commerce, Missouri, 38 miles above Cairo, to Fort Jackson, 1039 miles below Cairo, at $11,443,000. In 1899, after about $28,000,000 had been spent on levees by the United States and by the local authorities, the commission submitted an estimate for additional work on levees, amounting to 124,000,000 cubic yards and costing $22,000,000. The effect of the levees has been to increase flood heights. A conspicuous example is that on Lake Providence, where the maximum gauge heights since 1879 have risen from 38·3 feet in 1882 to 44·5 in 1897, or by 6·2 feet. Captain Newcomer, the local engineer, estimates that perfect confinement of the water will increase this maximum gauge reading to 49·5, a total increase of 11·2 feet. Though the Mississippi River Commission was forbidden by Congress to build levees to protect lands from overflow, a majority of its members believed them useful for the purpose of navigation improvement. Since 1882 no less than $28,000,000 has been expended on levees. This enormous expenditure has effected no sensible improvement in the navigation of the river at low stages, and at other stages no improvement was needed for the purposes of navigation. About $37,000,000 has been appropriated for the commission work below Cairo since 1879.

South Pass.

In 1879 Mr J. B. Eads, the contractor for the South Pass jetties, obtained a channel through the pass having a depth of 30 feet, the original depth on the bar having been 9 feet, and thus earned his final payment for the jetties. He used essentially the plan of a Government board of engineers, on which Congress gave him the contract, without competition. His original contract was for a channel 30 feet deep and 350 feet wide, but Congress subsequently removed this restriction on the width without making a corresponding reduction in the price. The works were required to be "permanent works by which said channel may be maintained for all time after their completion." He was entitled by law to $100,000 per annum for maintenance of a channel 26 feet deep and 200 feet wide through the jetties, and a central depth of 30 feet, and of 26 feet deep through the pass, until 1901. By the aid of dredging, this channel has thus far, with interruptions, been maintained; but these interruptions were for 174 days in 1897, and 63 days in 1898. In 1891 a crevasse occurred about 2 miles from the head of South Pass, from Pass à l'Outre to the gulf, and gradually increased until it was 2000 feet wide in 1894. The contractor's heirs made repeated efforts to close it, but in vain, and now the United States has undertaken the work. This crevasse, by lowering the water surface at the head of South Pass, diminished the flow through the pass, which has decreased somewhat in size. At the sea end of the jetties delta-building has gone on, so that dredging has been needed there. Of the curves of depth at the sea end of the jetties, the 60, 70, 80, 90, and 100 feet curves each advanced, between 1877 and 1897, from 92 to 108 feet annually, and the 40 and 50 feet curves advanced respectively about 52 and 62 feet. The difficulties in the South Pass have led Congress to require a plan to be made for improving the South-West Pass, which is much longer, and where the delta-advance at the sea end is much more rapid.

See the Annual Reports of the Chief of Engineers, U.S.A., since 1879. (C. B. C.)

Missolonghi or **Mesolonghi,** a city of Greece, on the north side of the Gulf of Patras, about 7 miles from the coast. It is the chief town of the province of Acarnania and Ætolia. Population about 10,000.

Missoula, a city of Montana, U.S.A., capital of Missoula county, on Clark fork of the Columbia river, at the mouth of the Bitter Root, in the western part of the state, at an altitude of 3197 feet. It is on the main line of the Northern Pacific railway, at the junction of a branch from the Bitter Root valley, and is situated in the level valley, on which the town is regularly laid out. It is the seat of the University of Montana, a non-sectarian institution, founded in 1895. In 1899 this had 12 instructors and was attended by 208 students, of whom 108 were women. Near it is the United States military post of Fort Missoula. Population (1890), 3426; (1900), 4366, of whom 1020 were foreign-born and 34 were negroes.

Missouri, a central state of the American Union, lying between about 36° and 40° 30′ N. and 89° 2′ and 95° 44′ W. Its population in 1890 was 2,679,184, or 39 persons to the square mile. The native-born population in 1890 was 2,444,315; the foreign-born, 234,869. 51·7 per cent. of the population were males. The white population by the same census was 2,528,458, and the coloured, 150,726. There were, in 1890, 705,718 persons entitled to the privilege of voting. The population of the state in 1900 was 3,106,665, giving a density of 45·2 to the square mile, and was made up as follows:—1,595,710 (51·4 per cent.) were males and 1,510,955 (48·6 per cent.) females; 2,890,286 native-born and 216,379 (7·0 per cent.) foreign-born; 2,944,843 were white and 161,822 (5·2 per cent.) coloured, of whom 161,234 were negroes, 449 Chinese, 9 Japanese, and 130 Indians. The death-rate in 1900 was about 12·25 per cent. The urban population, classing as such all persons in cities of 8000 inhabitants or over, was 955,563, or 30·8 per cent. of the total population, as against 26·3 per cent. in 1890. St Louis, the chief city, had in 1880 a population of 350,518; in 1890, 451,770; and in 1900, 575,238. Kansas City, on the western border, next in importance, had in 1880 a population of 55,785; in 1890, 132,716; in 1900, 163,752. St Joseph, in the north-west, had in 1880, 32,431; in 1890, 52,324; in 1900, 102,979. Hannibal, in the north-east, had in 1880, 11,074; in 1890, 12,857; in 1900, 12,780. Springfield, a thriving railway centre in the south-west, had in 1880, 6522; in 1890, 21,850; in 1900, 23,267. Joplin, in the extreme south-west, in the centre of a lead and zinc mining district, had in 1880, 7038; in 1890, 9943; and in 1900, 26,023.

Agriculture.—All the chief cereals, all varieties of fruits, and all varieties of grass are found in abundance. Horses and mules are raised, and the mule market of St Louis is visited by purchasers from every part of the world. For 1899 the cereal products were reported to be as follows: corn, 162,915,064 bushels; wheat, 11,398,702 bushels; and oats, 20,709,000 bushels. A large crop of tobacco is also raised, that for 1899 being estimated at 7,580,000 ℔. The fruit crop for 1899 was valued at $19,500,000. The total number of farms in the state in 1890 was 238,043, with an aggregate acreage of 30,780,290, and a valuation of $109,751,024.

Minerals.—Coal and iron are found in large quantities, as also are clays for fire-brick, marbles, limestone, and sandstone. The most important minerals of late years have been the immense deposits of lead and zinc in the southern and south-eastern sections, the richest of which lie in the counties of Jasper and St François. The output for the year ending 30th June 1899 was 70.829 tons of lead ore, and 181,430 tons of zinc ore, the total valuation of both being $9,120,861. A large increase is made yearly in the lead and zinc product, especially from the south-western part of the state, and the area of mining lands is being greatly extended.

Commerce.—The commerce centres at St Louis in the east and Kansas City in the west. Trade with the south-west and with Mexico has made great strides since 1880. Foreign shipments of flour and grain by railways and river during 1899 were: flour, 743,373 barrels; wheat, 1,006,840 bushels; corn, 12,285,515 bushels; oats, 360,697 bushels. The total amount of freight received at St Louis by rail and river in 1899 was 15,272,482 tons, and the total amount shipped was 8,469,598 tons. The shipments of cotton for 1899 showed 377,513 bales exported, while 612,446 bales went to various parts of the United States. The total value of the gross receipts of cotton for the year was about $15,000,000. Among other receipts at the St Louis market for 1899 were: lumber and logs, 1,148,124,000 feet; wool, 28,491,625 ℔; sugar, 204,322,225 ℔; coal, 109,067,875 bushels; butter, 13,729,188 ℔.

Banks.—There were, in 1898, 494 banks incorporated under the state law. There were also 85 private banks and 70 national banks. The total resources of the banks in the state amounted to $117,009,314, distributed as follows: loans and discounts, $76,161,897; overdrafts by solvent customers, $771,803; U.S. bonds and other bonds and stocks, $6,292,472; real estate, including banking-house, $3,408,262; furniture and fixtures, $578,383; due from other banks, $17,872,944; cheques and other cash items, $1,816,523; U.S. notes of various kinds, $6,092,722; gold coin, $3,201,406; silver and other small coin, $669,421; all other resources, $143,476. The St Louis bank clearings for 1899 reached a total of $1,638,348,203, a gain of more than 65 per cent. in ten years.

Manufactures.—The general statistics of manufactures in 1890 and 1900, with the percentages of increase during the intervening decade, are given in the following table:—

	1890.	1900.	Per cent. Increase.
Number of establishments	14,052	18,754	33·5
Capital	$189,558,546	$249,888,581	31·8
Salaried officials, clerks, &c.	18,936[1]	13,900	26·6[2]
Salaries	$16,773,935[1]	$14,569,606	13·1[2]
Wage-earners, average number . . .	124,203	134,975	8·7
Total wages . . .	$59,643,429	$60,719,429	1·8
Miscellaneous expenses .	$22,885,565	$41,396,905	80·9
Cost of materials used .	$177,582,382	$214,988,018	21·1
Value of products . .	$324,561,993	$385,492,784	18·8

A brief summary of the statistics of thirteen leading industries follows:—

Industry.	Number of Establishments.	Capital.	Value of Products.
Boots and shoes . .	50	$4,183,979	$11,253,202
Carriages and waggons .	377	4,019,087	5,583,364
Cars (steam railway) and general shop construction and repairs by steam railway companies	47	8,176,242	14,246,889
Clothing, men's, factory product . . .	148	4,651,882	8,925,088
Coffee and spice, roasting and grinding . .	27	2,517,482	5,266,264
Confectionery . . .	99	2,842,164	5,554,384
Flouring and grist-mill products . .	1145	11,402,827	26,393,928
Foundry and machine-shop products .	261	11,606,445	15,073,005
Lumber and timber products	1197	11,089,799	11,177,529
Malt liquors . . .	49	25,731,930	13,776,905
Printing and publishing (including newspapers and periodicals) . .	1100	11,149,288	15,355,949
Slaughtering and meat packing (wholesale) .	31	7,844,054	42,229,127
Tobacco and snuff . .	602	8,011,237	27,847,432

The three most important manufacturing centres are St Louis, Kansas City, and St Joseph, in the order named. The products of the first named amounted in value to more than 60 per cent. of the total products of the state. As the foregoing table shows, the most important industry in the state is slaughtering and meat packing; during the decade 1890–1900 the value of its products increased nearly 135 per cent. St Joseph is the principal centre of manufacture for this industry, and St Louis ranks next.

Railways.—Several important trunk lines of railway afford ample accommodation for passenger and freight traffic. Chief among these are the Missouri Pacific; the Iron Mountain; the St Louis and San Francisco; the Wabash; the Chicago, Burlington, and Quincy; the Atchison, Topeka, and Sante Fé; the St Louis South-Western; the Missouri, Kansas, and Texas; and the Kansas City, Fort Scott, and Memphis. The total mileage of railways in Missouri in June 1898 was 6762·56.

Finance.—The financial condition of the state, as shown in a statement prepared by the state auditor, 4th January 1900, is as follows:—

Total valuation of real estate and personal property, as fixed by the State Board of Equalization for 1899 taxes	$987,456,906
Railway, bridge, and telegraph property, including street railway property for 1899 taxes .	102,946,600
Merchants and manufacturers, valuation for 1899 taxes (estimated) . . .	55,125,824
Total	$1,145,529,330

Balance in treasury, 31st December 1898 . .	$897,109
Receipts into the state treasury from all sources, for all purposes, for the year ending 30th December 1899	4,370,249
Expenditure during 1899, for all purposes . .	4,690,351
Balance in treasury, 30th December 1899 . .	577,007

State Bonded Debt, 1st *January* 1900.

5 3½ per cent. 5-20 refunding bonds, due 1st July 1907	$5,000
5 3½ per cent. 5-20 refunding bonds, due 1st October 1907	5,000
2837 3½ per cent. 5-20 refunding bonds, due 1st January 1908	2,837,000
Total bonded debt	$2,847,000

School and Seminary Certificates of Indebtedness.

School certificates, 6 per cent.	$2,909,000
School certificates, 5 per cent.	249,000
	$3,158,000
Seminary certificates, 6 per cent. . . .	$122,000
Seminary certificates, 5 per cent. . . .	1,113,839
	$1,235,839

The rate of taxation in 1898 was 25 cents on every $100 of the valuation.

Education.—Since 1880 the state university at Columbia, having lost its old buildings by fire, has erected new and commodious structures. Its endowment has been increased, its faculty enlarged, and its standard of scholarship raised. The high schools have felt the impulse of the new life of the university, and about 100 of these schools are now able to prepare their pupils for admission to its classes. The number of students enrolled at the university in January 1900 was 1000; the number of instructors 65. Washington University, a non-sectarian endowed institution in St Louis, has increased its endowment funds by nearly $4,000,000, has purchased a tract of 150 acres for a new site, and is erecting new buildings at an immediate cost of $800,000. The number of students during 1899–1900 was 645, of instructors 99. The St Louis University is the oldest and most influential of the Roman Catholic institutions. It was established in 1829, and is controlled by the Order of Jesuits. It occupies a group of commanding buildings, erected at a cost of about $1,000,000. The faculty of government and instruction numbers 25. Other colleges and schools, founded in the interests of various religious bodies, are increasing in strength and influence. The net amount of state school moneys apportioned to the use of the public schools in 1898 was $915,866, and the state school enumeration was 980,422, with 15,259 teachers. The percentage of illiterates is 9·5. In 1900 the number of persons of school age (5 to 20 years inclusive) was 1,105,258. Out of 856,684 males of voting age, of whom 46,418 were negroes, 60,327 were illiterate (unable to write), of whom 14,829 were negroes.

Penal and Charitable Institutions.—The state penitentiary is situated at Jefferson City, the capital. On 1st January 1901 it contained 2116 convicts. Other state institutions are an insane hospital at Fulton, with 566 patients in 1896; one at St Joseph, with 714 inmates; and another at Nevada with 466. There are also the following schools: (1) the Missouri school for the blind, at St Louis, with 116 scholars; a school for the deaf and dumb at Fulton, with 392 scholars; a reform school for boys at Boonville, with 160 boys; a reform school for girls at Chillicothe, with 63 girls.

Religion.—The Roman Catholic Church was, for many years after the early settlement of the state, the only religious organization. Many Protestant bodies, however, now share with that Church in the religious work of the state. In 1896 the number of communicants in the leading denominations was reported as follows: Roman Catholics, 160,000; Methodists, 160,000; Baptists, 150,000; Disciples of Christ, 95,000; Presbyterians, 50,000; Lutherans, 25,000; Episcopalians, 6406. Denominational colleges are supported by most of these sects.

Politics.—Missouri has given a large plurality to the Democratic candidate at every Presidential election since 1872. The vote for President for the elections specified was given as follows:—

1888,	Democratic,	261,974	Republican,	236,257
1892	,,	268,398	,,	226,918
1896	,,	363,667	,,	304,940
1900	,,	351,912	,,	314,091

The vote of St Louis in 1896 was: for Bryan (Democrat), 50,091, and for McKinley (Republican), 65,708; in 1900, for the same candidates, 59,931 and 60,597 respectively. No important changes have been made in the state constitution since 1875, when the present constitution was drawn up by a convention called for that purpose, and was ratified by the people. (M. S. S.)

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[1] Includes proprietors and firm members, with their salaries.
[2] Decrease.

Missouri River, the main western branch of the Mississippi river, U.S.A. It rises in three streams in the Rocky Mountains of south-western Montana, the Jefferson, Madison, and Gallatin rivers, which unite at the foot of Gallatin Valley; thence the river flows north, out of the mountain region into the plains, which it traverses in a course at first north-east, then east, flowing down the general slope. Entering North Dakota the river turns gradually to the south-east, then south, and again south-east, traversing both North and South Dakota. It forms the eastern boundary of Nebraska and part of Kansas, and crosses Missouri in an easterly course to its junction with the Mississippi a few miles above St Louis. Its entire length is 3475 miles, and it drains an area of 527,155 square miles, or more than one-sixth of the area of the United States, excluding Alaska. As its longest and largest affluent, it is properly the main source of the Mississippi. Of the three sources of the Missouri, the middle stream, Madison river, rises in Yellowstone National Park, and is fed by geysers and hot springs. Yellowstone river, a right-hand tributary, rises just south of Yellowstone National Park, flows through it, and joins the Missouri at the eastern boundary of Montana. On this stream, within the park, are Yellowstone Lake, the Great Falls (300 feet high), and the cañon, features which constitute some of the finest scenery of the United States. In the Dakotas many small but long streams join it, among them the Little Missouri from the Bad Lands, and the Cheyenne from the Black Hills. In Nebraska come the muddy waters of the Platte, which rises in two large branches in Colorado. At Kansas City the Missouri is joined by Kansas river, a stream of the plains. On the left the Missouri is fed by Sun, Marias, and Milk rivers, which rise in Mission Range in western Montana, and farther down by the James, the Big Sioux, and many smaller streams. Owing to the vast amount of detritus which its waters collect in its long course over the plains, the Missouri is at all times thick with mud, and well deserves its familiar cognomen of "Big Muddy." The Missouri is navigable at high water to the Great Falls, near the city of that name in Montana; and even now, in spite of the competition of the railways, carries a large amount of freight. Upon it are situated many cities, the principal of which are Kansas City, Mo., St Joseph, Mo., and Omaha, Neb. (H. G*.)

Mistral, Frédéric (1830–——), Provençal poet, was born at Maillane (Bouches-du-Rhône) on 8th September 1830. In the autobiographical sketch prefixed to the *Isclo d'Or* (1876) he tells us, with great simplicity and charm, all that is worth knowing of his early life. His father was a prosperous farmer, and his mother a simple and religious woman of the people, who first taught him to love all the songs and legends of the country. In these early days on the farm he received those first impressions which were destined to constitute one of the chief beauties of *Mirèio*. "Mon enfance première se passa donc à la ferme, en compagnie des laboureurs, des faucheurs et des pâtres. Je me souviens toujours de cette époque avec délices. . . ." In his ninth year Mistral was sent to a small school at Avignon, where he was very wretched at first, regretting the free outdoor life of the country. Gradually, however, his studies attracted him, above all the poetry of Homer and Virgil; and he translated the latter's first eclogue, showing his efforts to a young schoolfellow, A. Mathieu, who was destined to play a part in the foundation of the Félibrige. When Roumanille (see PROVENÇAL LITERATURE, MODERN) became an usher at Mistral's school, the two, fired by the same love of poetry and of their native Provence, soon became close friends. "Voilà l'aube que mon âme attendait pour s'éveiller à la lumière," he exclaimed, on reading Roumanille's first dialect poems; and he goes on to say: "Embrasés tous les deux du désir de relever le parler de nos mères, nous étudiâmes ensemble les vieux livres Provençaux, et nous nous proposâmes de restaurer la langue selon ses traditions et caractères nationaux." On leaving school (1847) he returned to Maillane, where he sketched a pastoral poem in four cantos (*Li Meissoun*). With all his love for the country, he soon realized that life on a farm did not satisfy his ambition. So he went to study law at Aix, where he contributed his first published poems to Roumanille's *Li Prouvençalo* (1852). He had become *licencié en droit* the year before, but now decided on a literary career. The Félibrige was founded in 1854, and five years later appeared *Mirèio*, the masterpiece not only of Mistral, but so far of the entire school. It was everywhere hailed with enthusiasm: Lamartine wrote a panegyric on it, Gounod set its theme to music, and several translations appeared. The tale itself was nothing—the old story of a rich girl and her poor lover, kept apart by the girl's parents. Mireille, in despair, wanders along a wide tract of country to the church of the Trois-Maries, in the hope that these may aid her. But the effort was too great: she sinks exhausted, and dies in the presence of her stricken parents and her frenzied lover. Into this simple web Mistral has woven descriptions of Provençal life, scenery, character, customs, and legends that raise the poem to the dignity of a rustic epic, unique in literature. Nothing is forced: every detail is filled into the framework of the whole with a cunning which the poet was never again to attain. In the first lines he invokes Homer; and the Greek nature of his epic has been dwelt on by all its critics, from Lamartine to Gaston Paris. It is indeed Greek in its truth to nature, in the simplicity of its presentment, and in the perfection of its manner. There is no deep psychology in the characters, but then the people depicted are simple rustic folk, who wear their hearts on their sleeve, and whose inner lives and motives do not require, nay, would not bear, the dissecting-knife of a Bourget. *Calendau* (1867), the story of a princess held in bondage by a ruthless brigand, and eventually rescued by a youthful hero, is a comparative failure. There are many purple patches, but an epic must be judged as a whole, not piecemeal. The description of scenery is again masterly; but the old lore, which had charmed all readers in *Mirèio*, here becomes wearisome, its introduction being forced, not inevitable. The characters are mere symbols—indeed, the whole poem is obviously an allegory, the princess standing for Provence, the brigand for France, and the young lover for the Félibrige. Mistral lavished enormous labour on this work, which probably accounts for its lack of spontaneity, as also for the love he bears it ("Malgré la bienveillance de tous les journaux, le public en général se montra moins empressé pour *Calendal* que pour *Mireille;* non pas que le premier contienne moins de poésie, mais parce que dans *Mireille* la nature prédomine, et dans l'autre, à mon sens, c'est l'imagination. J'ai croyance pourtant que, si un jour ce pays n'est plus émasculé par une éducation fausse, beaucoup prendront plaisir à lire *Calendal*"). In 1876 (the same year in which he married Mlle Marie Rivière, of Dijon) was published the volume *Lis Isclo d'Or*—a collection of the shorter poems Mistral had composed from the year 1848 onwards. Here he is again at his very best. Old legends, *sirventes* (mostly, as in mediæval times, poems with a tendency), and lyrics—all are admirable. Even the *pièces d'occasion* may be reckoned with the best of their kind. Two pieces, the *Coupe* and the *Princesse,* aroused violent controversy on their first appearance. They reproduce, in effect, the theme of *Calendau,* and Mistral was accused of trying to sow discord between the north and south of France. Needless to say, he was altogether innocent of such a design. His earnest desire to awaken in the Provençals a sense of their past achievement was not only compatible with a love of the whole of France, but inseparable from it. *Nerto* (1884) is a charming tale of Avignon in the olden days, in which a girl's purity triumphs over her lover's base designs and leads him to nobler thoughts. There is little individuality in the characters, which should rather be regarded as types; and we feel no terror or pity at the tragic close. But we are carried along by Mistral's art and by the brilliancy of his episodes; and though comparisons with Ariosto, that have so often been instituted, are altogether beside the mark, our poet has here achieved the object he had in view: he has told a pretty tale—it is almost a fairy tale—and he has imbued it with the proper touch of local colour and with the true spirit of romance. The play *La Rèino Jano* (1890) is a complete failure, if judged from the dramatic standpoint: it is rather a brilliant panorama, a series of stage pictures, and the characters neither live nor arouse our sympathy. In the great epic on the Rhone (*Lou Pouèmo dóu Rouse,* 1897), the poet depicts the former barge-life of that river, and intertwines his narrative with the legends clustering round its banks, and with a graceful love episode. For the first time he employs blank verse, and uses it with great mastery; the lines roll on with a fine volume of sound. But his chief failing reappears in an accentuated form: the ancient lore is overdone, and produces a sense of weariness. A splendid piece of work is *Lou Tresor dóu Félibrige* (1886), which is fit to rank with Littré's great French dictionary. In these two volumes Mistral has deposited with loving care every word and phrase, every proverb, every scrap of legend that he had gathered during his many years' journeyings in the south of France.

An excellent literary appreciation of the poet is that by Gaston Paris, *Frédéric Mistral* (originally in the *Revue de Paris,* October and November 1894; then in *Penseurs et Poètes,* Paris, 1896). More elaborate accounts are Welter, *Frédéric Mistral,* Marburg (1899); and Downer, *Frédéric Mistral,* New York, 1901 (with a full bibliography).

Mitcham (the Michelham, "great village," of Domesday Book), a suburb of London, in the Wimbledon parliamentary division of Surrey, 10 miles south of London Bridge by rail. Mitcham Common covers an area of 480 acres, and affords one of the best golf-courses near London. The neighbourhood abounds in market gardens and plantations of aromatic herbs for the manufacture of scents and essences. Population (1901), 14,904.

Mitchell, Donald Grant (1822–——), American author, was born in Norwich, Connecticut, on the 12th of April, 1822. He graduated at Yale College in 1841; studied law, but soon took up literature as his profession. Throughout his life he showed a particular interest in agricultural and horticultural pursuits, which he followed at first in pursuit of health. He has produced books of travel; volumes of essays on rural themes, of which *My Farm of Edgewood* (1863) is the best; sketchy studies of English monarchs and of English and American literature; and a character-novel entitled *Doctor Johns* (1866), &c.; but is best known as the author, under the pseudonym of "Ik Marvel," of the gently sentimental essays contained in the volumes *Reveries of a Bachelor, or a Book of the Heart* (1850), and *Dream Life, a Fable of the Seasons* (1851), long popular in the United States, especially during the latter years of the first literary period in that country, in which reminiscential egotism of the school of Irving had affected many writers and readers.

Mitchell, Silas Weir (1829–——), American physician and author, was born in Philadelphia on the 15th of February 1829. He studied at the University of Pennsylvania in that city, and received the degree of M.D. at Jefferson Medical College in 1850. During the Civil War he had charge of the governmental wards for nervous injuries and maladies at Turner's Lane Hospital, Philadelphia, and at the close of the war became a specialist in nervous diseases, contributing numerous articles to medical and other scientific journals, and attaining a high place in his profession and in various academies and societies. While working in his chosen field as a physician, in 1863, he wrote a clever short story, combining physiological and psychological problems, entitled *The Case of George Dedlow,* which appeared in the *Atlantic Monthly.* Thenceforward Dr Mitchell, as a writer, divided his attention between professional and literary pursuits. In the former field he produced monographs on rattlesnake poison, on intellectual hygiene, on injuries to the nerves, on neurasthenia, on nervous diseases of women, on the effects of gunshot wounds upon the nervous system, and on the relations between nurse, physician, and patient; while on the latter he wrote juvenile stories, several volumes of respectable verse, and prose fiction of varying merit, which, however, gave him a leading place among the American authors of the close of the 19th century. His short stories, with the exception of the strong tale already named, are sketches rather than finished results; but his historical novels *Hugh Wynne, Free Quaker* (1897) and *The Adventures of François* (1898) take high rank amongst the best efforts in this branch of fiction.

Mitford, William (1744–1827), English historian, was the elder of the two sons of John Mitford, a barrister, who lived near Beaulieu, at the edge of the New Forest. Here, at Exbury House, his father's property, Mitford was born on the 10th of February 1744. He was educated at Cheam School, under the picturesque writer William Gilpin, but at the age of fifteen a severe illness led to his being removed, and after two years of idleness Mitford was sent, in July 1761, as a gentleman commoner to Queen's College, Oxford. In this year his father died, and left him the Exbury property and a considerable fortune. Mitford, therefore, being "very much his own master, was easily led to prefer amusement to study." He left Oxford (where the only sign of assiduity he had shown was to attend the lectures of Blackstone) without a degree, in 1763, and proceeded to the Middle Temple. But gradually he began to feel a curiosity "to become acquainted with the celebrated writings of the Greeks in their own language," and when he married Miss Fanny Molloy in 1766, and retired to Exbury for the rest of his life, he made the study of the Greek language and literature "without the assistance of any instructor" his constant hobby and occupation. After ten years passed in this way, his wife died, and in October 1776 Mitford went abroad. He was encouraged by French scholars whom he met in Paris, Avignon, and Nice to give himself systematically to the study of Greek history. But it was Gibbon, with whom he was closely associated when they both were officers in the South Hampshire Militia, who definitely suggested to Mitford the form which his work should take. In 1784 the first of the volumes of his *History of Greece* appeared, and the fifth and last of these quartos was published in 1810, after which the state of Mitford's eyesight and other physical infirmities, including a loss of memory, forbade his continuation of the enterprise, although he painfully revised successive new editions. While his great book was slowly progressing, Mitford was engaged in a certain amount of public activity. He was a member of the House of Commons, with intervals, from 1785 to 1818, and he was for many years verderer of the New Forest and a county magistrate. It does not appear that at any time in his life William Mitford visited Greece. After a long and enfeebling illness he died at Exbury on his eighty-third birthday, 10th February 1827. In addition to his famous *History of Greece*, he published a few smaller works, most of them of a subsidiary character. Of these the most important was an *Essay on the Harmony of Language*, 1774. The style of Mitford is natural and lucid, but without any of the rich colour of Gibbon. He affected some oddities both of language and of orthography, for which he was censured and which he endeavoured to revise. But his political opinions, applied to the constitutions of the Greek republics, were still more severely treated, since Mitford was an impassioned anti-Jacobin, and thought that a king could do no wrong. His partiality for a monarchical form of government led him to be unjust to the Athenians. Hence his *History of Greece*, after having had no peer in European literature for half a century, faded in interest on the appearance of the more democratic work of Grote. Clinton, too, in his *Fasti Hellenici*, charged Mitford with "a general negligence of dates," though admitting that in his philosophical range "he is far superior to any former writer" on Greek history. Byron, who dilated on Mitford's shortcomings, nevertheless declared that he was "perhaps the best of all modern historians altogether." This Mitford certainly is not, but his pre-eminence in the little school of English historians who succeeded Hume and Gibbon it would be easier to maintain. (E. G.)

Mithras.—The cult of Mithras is one of the most important Eastern cults which were introduced at Rome. The god was worshipped before the separation of the Iranian from the Indian Aryans. Among the early Persians he held a foremost place with Ahura-Mazda and Anahita. In the Avesta he has become less potent, and is one of the gods who serve Ahura-Mazda in his struggle against evil. He is the embodiment of created light, and is the god of truth. From Iran his worship spread to Babylonia, where it absorbed Chaldean elements. Old Persian gods became identified with the stars adored by the Babylonians, and were connected with the theory that the soul after death wanders through the region of the stars. From Babylon Mithras travelled to Pontus and Cappadocia, and while little known to the Greeks, was brought to Rome by soldiers and slaves. He is first mentioned by Statius in the *Thebais*, A.D. 90. The oldest known Roman Mithras inscriptions date from Trajan and Hadrian. First favoured by the lower classes, the cult spread upwards. Sculptures represent Mithras as (1) a boy with Phrygian cap, emerging from a rock and holding a torch, probably signifying Mithras as god of light, gilding the mountains; (2) shooting a rock whence comes a stream from which a man takes water: here he is the mythical bowman who causes rain to come upon the earth; (3) stabbing a bull: a serpent and a dog lick the blood, a scorpion grips the bull, a raven stands by, and boys hold torches: here the bull is the first creature made by Ahura-Mazda, the death of which is necessary for the creation of plants and animals; the scorpion is the animal of Añgra-Manyu (Ahriman), who tries to hinder the work of Ahura-Mazda; the serpent is the symbol of the earth enriched by the bull's blood; the dog catches the soul of the bull for new uses; the raven is probably an emblem of the sun-god, signifying that the sacrifice is performed at his command.

The devotees of Mithras formed a community which consisted of seven divisions, *Coraces*, *Gryphi*, *Milites*, *Leones*, *Persæ*, *Heliodromi*, *Patres*. At the head of the *Patres* was the *Pater Patrum*. The *Patres* do not seem to have been necessarily *sacerdotes*, a class which offered the sacrifices and was presided over by a *summus pontifex*. Worship was not conducted in temples. Each Mithraeum was a grotto, real or artificial. Existing examples are at Rome under the church of S. Clemente, and under the Capitol, and at Spoleto. That at Spoleto had three niches at the end for statues of Mithras and the two torch-bearers. Before them was a small altar inscribed "Soli invicto Mitrae Sacrum." Near it stood two large stones, one triangular and the other conical and perforated. The latter may have been an emblem of the rock from which Mithras was born. Some caves have two altars and a hole for the blood of the bull sacrificed. The Christians regarded Mithraism as a dangerous rival of Christianity. Its belief in a mediator, in the resurrection, the lustrations and the common meal of bread and water were points of contact. Apparently the Mithraists made the most of these resemblances, as is done in parts of India by Hindus who exalt Krishna against Christ. Investigation of early Christian worship has proved that it owes nothing to Mithraism. The only point still dubious is the origin of observing 25th December as Christmas. But the heathen Roman observance of 25th December seems to date from the Syrian sun worship introduced by Aurelian A.D. 270, while belief that Christ was born on 25th December can be traced back at Rome to Hippolytus *c.* 220. It is possible that 25th December was attained as the result of the strong belief that Christ died on 25th March. It was thought that He spent an exact number of years on earth, and thus 25th March was chosen for the Annunciation and 25th December reckoned from it.

For bibliography see article "Mithras" in W. H. Roscher's *Lexicon der Griechischen und Römischen Mythologie* (B. G. Teubner, Leipzig, 1894–97). (L. P.)

Mitrovicza, a town of Hungary, in the county of Szerém, in the province of Croatia-Slavonia, on the Save, with 19,795 inhabitants in 1891, and 11,518 in 1901. It has an under *realschule*, many administrative and other offices, and a thriving trade. On its site once stood the Roman city of Syrmium, the capital of Pannonia, and later of Illyricum, where was born and buried the Emperor Probus, and where dwelt other Roman emperors. Its ancient buildings were destroyed by the Turks in 1396 and 1521.

Mittweida, a town of Germany, on the Zschopau, 12 miles by rail north of Chemnitz, in the circle of Leipzig, kingdom of Saxony. There are an engineering and electrotechnical institute, cotton and spinning mills, machinery, dye, earthenware, and furniture works. Population (1890), 11,298; (1900), 16,117.

Mivart, St George (1827–1900), English biologist, was born in London on 30th November 1827, and educated at Clapham Grammar School, Harrow and King's College, London, and afterwards at St Mary's, Oscott, since his conversion to Catholicism prevented him from going to Oxford. In 1851 he was called to the bar, but his interests were chiefly scientific, and he devoted himself to medical and biological studies. In 1862 he was appointed lecturer at St Mary's Hospital medical school, in 1869 he became a fellow of the Zoological Society, and in 1874 he was appointed professor of biology at University College, London. In 1873 he had published *Lessons in Elementary Anatomy*, and a separate essay on *Man and Apes.* His monograph on Apes written for the *Encyclopædia Britannica* was incorporated in the *Study of Mammals* by Flower and Lydekker, for which he also wrote *Skeleton* and *Reptiles.* In 1881 appeared *The Cat, an Introduction to the Study of Back-boned Animals,* in which the detailed study of one particular animal is made the starting-point of a general survey of its kindred. The careful and detailed work he bestowed on Insectivora and Carnivora has largely increased our knowledge of the anatomy of these groups. In 1871 his *Genesis of Species* had brought him into the controversy then raging round the question of evolution. While fully asserting evolution generally, Mivart denied its applicability to the human intellect. He represented the formation of new species as mainly due to one mode of action of that plastic innate power manifest on all hands in nature, as evidenced by many instances quoted by him. His views as to the relationship existing between human nature and intellect and animal nature in general were given in *Nature and Thought* (1882); and in the *Origin of Human Reason* (1899) he stated what he considered the fundamental difference between men and animals, pointing out where the human intellect differed from the highest psychical actions of brutes. In 1884, at the invitation of the Belgian episcopate, he became professor of the philosophy of natural history at Louvain. This university also conferred on him the degree of M.D. Some articles in the *Nineteenth Century,* in which Mivart advocated the claims of science even where they seemed to conflict with religion, were placed on the *Index Expurgatorius,* and a curious correspondence ensued between him and Cardinal Vaughan, in which Mivart vindicated his claim to hold liberal opinions while remaining in the Catholic Church; but the result was that, as he refused to recant, he was excommunicated. The episode was interesting as throwing light on the state of Roman Catholic sentiment in England; but Mivart died almost immediately afterwards (on 1st April 1900), and the discussion dropped. (A. Z.)

Mława, a district town of Russian Poland, government of Płock, 7 miles from the Prussian frontier, and 78 miles by rail north-west of Warsaw, near the Prussian frontier. It has a *realschule,* agricultural machinery works, steam flour-mill, tanneries, and soap-works. It is an important railway junction, and has considerable trade in grain. Population (1897), 13,449.

Moberly, a city of Randolph county, Missouri, U.S.A., on the Missouri, Kansas and Texas and the Wabash railways, north of the centre of the state, at an altitude of 858 feet. It has a level prairie site and a regular plan, divided into four wards. It contains the machine shops of the Wabash railroad, in addition to varied manufactures. Population (1880), 6070; (1890), 8215; (1900), 8012, of whom 450 were foreign-born and 923 were negroes.

Mobile, a city and seaport of Alabama, U.S.A., capital of Mobile county, on the west side of the Mobile river near its mouth. Its site is level and its plan fairly regular; it has a good water-supply, and its business streets are paved with brick and wood. Four railways centre in the city, the Louisville and Nashville, the Mobile and Ohio, the Mobile, Jacksonville and Kansas City, and the Southern. Mobile is the only seaport of the state, and it has considerable export trade, consisting almost entirely of cotton. Its importance in this regard has, however, diminished greatly. In 1900 its manufacturing establishments had a total capital of $3,294,238, and employed an average number of 2827 wage-earners. The total products were valued at $4,451,062, of which the most important were lumber and timber products ($566,800) and flouring and grist-mill products ($454,134). The city was rechartered in 1887, the state assuming most of the debt which had made it bankrupt. The assessed valuation of real and personal property in 1900, on a basis of about one-half of the full value, was $15,986,201, the net debt was $822,000, and the rate of taxation was $26·50 per $1000. Population (1890), 31,076; (1900), 38,469, of whom 2111 were foreign-born and 17,045 were negroes. The death-rate in 1900 was 25·9; the death-rate of the coloured population was about one-half greater than that of the white.

Models.—The term model denotes a tangible representation, whether the size be equal, or greater, or smaller, of an object which is either in actual existence, or has to be constructed in fact or in thought. More generally it denotes a thing, whether actually existing or only mentally conceived of, whose properties are to be copied. In foundries, the object of which a cast is to be taken, whether it be for engineering or artistic purposes, is usually first formed of some easily workable material, generally wood. The form of this model is then reproduced in clay or plaster, and into the mould thus obtained the molten metal is poured. The animate figures which serve the painter as types are described as models. The sculptor first makes a model of the object he wishes to chisel in some plastic material such as wax, ingenious and complicated contrivances being employed to transfer this wax model, true to nature, to the stone in which the final work is to be executed. In anatomy and physiology, models are specially employed as aids in teaching and study, and the method of *moulage* or chromoplastic yields excellent impressions of living organisms, and enables anatomical and medical preparations to be copied both in form and colour. A special method is also in use for making plastic models of microscopic and minute microscopic objects. That their internal nature and structure may be more readily studied, these are divided by numerous parallel transverse cuts, by means of a microtome, into exceedingly thin sections (see Microtomy). Each of these shavings is then modelled on an enlarged scale in wax or pulp plates, which are fixed together to form a reproduction of the object.

Representation in thought.

Models in the mathematical, physical, and mechanical sciences are of the greatest importance. Long ago philosophy perceived the essence of our process of thought to lie in the fact that we attach to the various real objects around us particular physical attributes—our concepts—and by means of these try to represent the objects to our minds. Such views were formerly regarded by mathematicians and physicists as nothing more than unfertile speculations, but in more recent times they have been brought by Maxwell, Helmholtz, Mach, Hertz, and many others into intimate relation with the whole body of mathematical and physical theory. On this view our thoughts stand to things in the same relation as models to the objects they represent. The essence of the process is the attachment of one concept having a definite content to each thing, but without implying complete similarity between thing and thought; for naturally we can know but little of the resemblance of our thoughts to the things to which we attach them. What resemblance there is lies principally in the nature of the connexion, the correlation being analogous to that which obtains between thought and language, language and writing, the notes on the stave and musical sounds, &c. Here, of course, the symbolization of the thing is the important point, though, where feasible, the utmost possible correspondence is sought between the two—the musical scale, for example, being imitated by placing the notes higher or lower. When, therefore, we endeavour to assist our conceptions of space by figures, by the methods of descriptive geometry, and by various thread and object models; our topography by plans, charts, and globes; and our mechanical and physical ideas by kinematic models—we are simply extending and continuing the principle by means of which we comprehend objects in thought and represent them in language or writing. In precisely the same way the microscope or telescope forms a continuation and multiplication of the lenses of the eye; and the notebook represents an external expansion of the same process which the memory brings about by purely internal means. There is also an obvious parallelism with representation by means of models when we express longitude, mileage, temperature, &c., by numbers, which should be looked upon as arithmetical analogies. Of a kindred character is the representation of distances by straight lines, of the course of events in time by curves, &c. Still, neither in this case nor in that of maps, charts, musical notes, figures, &c., can we legitimately speak of models, for these always involve a concrete spatial analogy in three dimensions.

So long as the volume of matter to be dealt with in science was insignificant, the need for the employment of models was naturally less imperative; indeed, there are self-evident advantages in comprehending things without resort to complicated models, which are difficult to make, and cannot be altered and adapted to extremely varied conditions so readily as can the easily adjusted symbols of thought, conception, and calculation. Yet, as the facts of science increased in number, the greatest economy of effort had to be observed in comprehending them and in conveying them to others; and the firm establishment of ocular demonstration was inevitable in view of its enormous superiority over purely abstract symbolism for the rapid and complete exhibition of complicated relations. At the present time it is desirable, on the one hand, that the power of deducing results from purely abstract premisses, without recourse to the aid of tangible models, should be more and more perfected, and on the other that purely abstract conceptions should be helped by objective and comprehensive models in cases where the mass of matter cannot be adequately dealt with directly.

Models in mathematics and physics.

As regards their use, models may be divided into those which only subserve educational purposes and those which assist scientific investigation. In pure mathematics, especially geometry, models constructed of *papier-mâché* and plaster are chiefly employed to present to the senses the precise form of geometrical figures, surfaces, and curves. Surfaces of the second order, represented by equations of the second degree between the rectangular co-ordinates of a point, are very simple to classify, and accordingly all their possible forms can easily be shown by a few models, which, however, become somewhat more intricate when lines of curvature, loxodromics, and geodesic lines have to appear on their surfaces. On the other hand, the multiplicity of surfaces of the third order is enormous, and to convey their fundamental types it is necessary to employ numerous models of complicated, not to say hazardous, construction. In the case of more intricate surfaces it is sufficient to present those singularities which exhibit variation from the usual type of surface with synclastic or anticlastic curvatures, such as, for example, a sharp edge or point, or an intersection of the surface with itself; the elucidation of such singularities is of fundamental importance in modern mathematics.

In physical science, again, models that are of unchangeable form are largely employed. For example, the operation of the refraction of light in crystals can be pictured if we imagine a point in the centre of the crystal whence light is dispersed in all directions. The aggregate of the places at which the light arrives at any instant after it has started is called the wave-front. This surface consists of two cups or sheets fitting closely and exactly one inside the other. The two rays into which a single ray is broken are always determined by the points of contact of certain tangent planes drawn to those sheets. With crystals possessing two axes these wave-surfaces display peculiar singularities in the above sense of the term, in that the inner sheet has four protuberances, while the outer has four funnel-like depressions, the lowest point of each depression meeting the highest point of each protuberance. At each of these funnels there is a tangent-plane that touches, not in a single point, but in a circle bounding the depression, so that the corresponding ray of light is refracted, not into two rays, but into a whole cone of light—the so-called conical refraction theoretically predicted by Hamilton and experimentally detected by Lloyd. These conditions, which it is difficult adequately to express in language, are self-evident so soon as the wave-surface formed in plaster lies before our eyes. In thermodynamics, again, similar models serve, among other purposes, for the representation of the surfaces which exhibits the relation between the three thermodynamic variables of a body, *e.g.*, between its temperature, pressure, and volume. A glance at the model of such a thermodynamic surface enables the behaviour of a particular substance under the most varied conditions to be immediately realized. When the ordinate intersects the surface but once a single phase only of the body is conceivable, but where there is a multiple intersection various phases are possible, which may be liquid or gaseous. On the boundaries between these regions lie the critical phases, where transition occurs from one type of phase into the other. If for one of the elements a quantity which occurs in calorimetry be chosen—for example, entropy—information is also gained about the behaviour of the body when heat is taken in or abstracted.

After the stationary models hitherto considered come the manifold forms of moving models, such as are used in geometry, to show the origin of geometrical figures from the motion of others; *e.g.*, the origin of surfaces from the motion of lines. These include the thread models, in which threads are drawn tightly between movable bars, cords, wheels, rollers, &c. In mechanics and engineering an endless variety of working models are employed to convey to the eye the working either of machines as a whole, or of their component and subordinate parts. In theoretical mechanics models are often used to exhibit the physical laws of motion in interesting or special cases; *e.g.*, the motion of a falling body or of a spinning-top, the movement of a pendulum on the rotating earth, the vortical motions of fluids, &c. Akin to these are the models which execute more or less exactly the hypothetical motions by which it is sought to explain various physical phenomena, as for instance the complicated wave-machines which present the motion of the particles in waves of sound (now ascertained with fair accuracy), or the more hypothetical motion of the atoms of the ether in waves of light.

Theories of Nature.

The varying importance which in recent times has been attached to models of this kind is intimately connected with the changes which have taken place in our conceptions of Nature. The first method by which an attempt was made to solve the problem of the universe was entirely under the influence of Newton's laws. In analogy to his laws of celestial gravitation, all bodies were conceived of as consisting of points of matter—atoms or molecules—to which was attributed a direct action at a distance. The circumstances of this action at a distance, however, were conceived as differing from those of the Newtonian law of attraction, in that they could explain the properties not only of solid elastic bodies, but also those of fluids, both liquids and gases. The phenomena of heat were explained by the motion of minute particles absolutely invisible to the eye, while to explain those of light it was assumed that an impalpable medium, called luminiferous ether, permeated the whole universe; to this were attributed the same properties as were possessed by solid bodies, and it was also supposed to consist of atoms, although of a much finer composition. To explain electric and magnetic phenomena the assumption was made of a third species of matter—electric fluids which were conceived of as being more of the nature of fluids, but still consisting of infinitesimal particles, also acting directly upon one another at a distance. This first phase of theoretical physics may be called the direct one, in that it took as its principal object the investigation of the internal structure of matter as it actually exists. It is also known as the mechanical theory of nature, in that it seeks to trace back all natural phenomena to motions of infinitesimal particles, *i.e.*, to purely mechanical phenomena. In explaining magnetic and electrical phenomena it inevitably fell into somewhat artificial and improbable hypotheses, and this induced Maxwell, adopting the ideas of Faraday, to propound a theory of electric and magnetic phenomena which was not only new in substance, but also essentially different in form. If the molecules and atoms of the old theory were not to be conceived of as exact mathematical points in the abstract sense, then their true nature and form must be regarded as absolutely unknown, and their groupings and motions, required by theory, looked upon as simply a process having more or less resemblance to the workings of Nature, and representing more or less exactly certain aspects incidental to them. With this in mind, Maxwell propounded certain physical theories which were purely mechanical so far as they proceeded from a conception of purely mechanical processes. But he explicitly stated that he did not believe in the existence in Nature of mechanical agents so constituted, and that he regarded them merely as means by which phenomena could be reproduced, bearing a certain similarity to those actually existing, and which also served to include larger groups of phenomena in a uniform manner and to determine the relations that held in their case. The question no longer being one of ascertaining the actual internal structure of matter, many mechanical analogies or dynamical illustrations became available, possessing different advantages; and as a matter of fact Maxwell at first employed special and intricate mechanical arrangements, though later these became more general and indefinite. This theory, which is called that of mechanical analogies, leads to the construction of numerous mechanical models. Maxwell himself and his followers devised many kinematic models, designed to afford a representation of the mechanical construction of the ether as a whole as well as of the separate mechanisms at work in it: these resemble the old wave-machines, so far as they represent the movements of a purely hypothetical mechanism. But while it was formerly believed that it was allowable to assume with a great show of probability the actual existence of such mechanisms in Nature, yet nowadays philosophers postulate no more than a partial resemblance between the phenomena visible in such mechanisms and those which appear in Nature. Here again it is perfectly clear that these models of wood, metal, and cardboard are really a continuation and integration of our process of thought; for, according to the view in question, physical theory is merely a mental construction of mechanical models, the working of which we make plain to ourselves by the analogy of mechanisms we hold in our hands, and which have so much in common with natural phenomena as to help our comprehension of the latter.

Although Maxwell gave up the idea of making a precise investigation into the final structure of matter as it actually is, yet in Germany his work, under Kirchhoff's lead, was carried still farther. Kirchhoff defined his own aim as being to describe, not to explain, the world of phenomena; but as he leaves the means of description open his theory differs little from Maxwell's, so soon as recourse is had to description by means of mechanical models and analogies. Now the resources of pure mathematics being particularly suited for the exact description of relations of quantity, Kirchhoff's school laid great stress on description by mathematical expressions and formulæ, and the aim of physical theory came to be regarded as mainly the construction of formulæ by which phenomena in the various branches of physics should be determined with the greatest approximation to the reality. This view of the nature of physical theory is known as mathematical phenomenology; it is a presentation of phenomena by analogies, though only by such as may be called mathematical.

Another phenomenology in the widest sense of the term, maintained especially by Mach, gives less prominence to mathematics, but considers the view that the phenomena of motion are essentially more fundamental than all the others to have been too hastily taken. It rather emphasizes the prime importance of description in the most general terms of the various spheres of phenomena, and holds that in each sphere its own fundamental law and the notions derived from this must be employed. Analogies and elucidations of one sphere by another, *e.g.*, heat, electricity, &c., by mechanical conceptions, this theory regards as mere ephemeral aids to perception, which are necessitated by historical development, but which in course of time either give place to others or entirely vanish from the domain of science.

All these theories are opposed by one, called in Germany Energetics (in the narrower sense), which looks upon the conception of energy, not that of matter, as the fundamental notion of all scientific investigation. It is in the main based on the similarities energy displays in its various spheres of action, but at the same time it takes its stand upon an interpretation or explanation of natural phenomena by analogies which, however, are not mechanical, but deal with the behaviour of energy in its various modes of manifestation.

Experimental models.

A distinction must be observed between the models which have been described and those experimental models which present on a small scale a machine that is subsequently to be completed on a larger, so as to afford a trial of its capabilities. Here it must be noted that a mere alteration in dimensions is often sufficient to cause a material alteration in the action, since the various capabilities depend in various ways on the linear dimensions. Thus the weight varies as the cube of the linear dimensions, the surface of any single part and the phenomena that depend on such surfaces are proportionate to the square, while other effects, such as friction, expansion, and conduction of heat, &c., vary according to other laws. Hence a flying machine, which when made on a small scale is able to support its own weight, loses its power when its dimensions are increased. The theory, initiated by Newton, of the dependence of various effects on the linear dimensions, is treated at length in the text-books of mechanics. Under simple conditions it may often be affirmed that in comparison with a large machine a small one has the same capacity, with reference to a standard of time which must be diminished in a certain ratio.

Of course experimental models are not only those in which purely mechanical forces are employed, but also include models of thermal, electro-magnetic, and other engines; *e.g.*, dynamos and telegraphic machines. The largest collection of such models is to be found in the museum of the New York Patent Office, in which a model of every patented invention must be deposited. Sometimes, again, other than purely mechanical forces are at work in models for purposes of investigation and instruction. It often happens that a series of natural processes, such as motion in liquids, internal friction of gases, and the conduction of heat and electricity in metals, may be expressed by the same differential equations; and it is frequently possible to follow by means of measurements one of the processes in question —*e.g.*, the conduction of electricity just mentioned. If then there be shown in a model a particular case of electrical conduction in which the same conditions at the boundary hold as in a problem of the internal friction of gases, we are able by measuring the electrical conduction in the model to determine at once the numerical data which obtain for the analogous case of internal friction, and which could only be ascertained otherwise by intricate calculations. Intricate calculations, moreover, can very often be dispensed with by the aid of mechanical devices, such as the ingenious calculating machines which perform additions and subtractions and very elaborate multiplications and divisions with surprising speed and accuracy, or apparatus for solving the higher equations, for determining the volume or area of geometrical figures, for carrying out integrations, and for developing a function in a Fourier's series by mechanical means. (L. BO.)

Modena, a town, archiepiscopal see, and capital of the province of Modena, Emilia, Italy, 23 miles north-west of Bologna by rail. The ducal palace now shelters the military school and the astronomical observatory, while the art galleries and the libraries are housed in the Albergo Arti, built by Duke Francesco III. in 1764. In 1898 the university was attended by 435 students, with 45 professors. Amongst the public statues is a particularly fine one of Victor Emmanuel (1890), by Gibellini; others are of the poet Tassoni (1860), Menotti (1879), and Muratori (1853). There is a noteworthy town hall, with arcades, dating from 1194, but in part rebuilt in 1826. Population (1881), 31,053; of commune (1901), 64,941.

Modica, a town of the province of Syracuse, Sicily, Italy, 63 miles south-west of Syracuse by rail. It has a technical school and an industrial institute; also factories for macaroni, sweetmeats made from oranges, lemons, &c., olive oil presses, limestone quarries, and cheese factories. Population (1881), 38,390; (1899), about 42,000.

Modjeska, Helena (1844-——), Polish actress, was born at Cracow, 12th October 1844. Her father, Michael Opido, was something of a musician, and her tastes soon declared themselves strongly in favour of a dramatic career; but it was not until after her marriage in 1861 that she first attempted to act, and then it was with a company of strolling players. Her husband (whose name, Modrzejewski, she afterwards adopted in a simplified form for stage purposes) died in 1865. Three years later she married Count Bozenta Chlapowski, a Polish politician and critic, and almost immediately after that event received an invitation to act at Warsaw. There she remained for seven or eight years, and won a high position in her art. In 1876 she went with her husband to California, where they settled on a ranch. This new career, however, proved a failure, and Madame Modjeska returned to the stage. She appeared in San Francisco in 1877, in an English version of *Adrienne Lecouvreur*, and, in spite of her imperfect command of the language, achieved a remarkable success. She continued to act principally in America, but was also seen from time to time in London and other towns in the United Kingdom, her repertory including several Shakespearian *rôles* and a variety of emotional parts in modern drama.

Mödling, an old town in the government district of the same name in Lower Austria, about 10 miles south of Vienna, at the entrance of the Brühl valley. It has iron and sulphur baths, and is a popular local summer resort, being connected with Vienna by rail and tramway. There is a park, a "cur-salon," and an open-air theatre; and it possesses a Gothic church, with a crypt dating from the 15th century, and a still older Romanesque burial chapel. It has a considerable iron and metal industry, including railway material, and manufactures shoes, varnish, &c. Population (1890), 11,120; (1900), 15,304, mostly German and Catholic.

Moe, Jörgen Engebretsen. See ASBJÖRNSEN.

Moffat, a burgh of barony, police burgh, and health resort of Upper Annandale, Dumfriesshire, Scotland, 52 miles south-south-west of Edinburgh by road. Its spa was purchased by the Burgh Commissioners from a company in 1898. There are a hydropathic establishment and an endowed workmen's institute, containing a library and baths. Episcopal, Established, and United Free churches have been erected. The academy is a secondary school, and the town contains several well-known private boarding schools. Population (1891), 2291; (1901), 2153.

Mogador (*Es-Sûeïra*), seaport on the west coast of Morocco, Africa, 128 miles west by south of Morocco. It is the best-built port of the sultanate, and second in point of trade. Although formerly much more important, it still includes the largest variety of exports. The climate, although damp, is healthy, and is strongly recommended for chest complaints. The rainfall varies between 13 and 20 inches annually. Exports: 1896, £225,963; 1900, £407,592, the principal items being almonds (51 per cent.), goat-skins, olive oil, beeswax, gums, and eggs. Imports: 1896, £225,430; 1900, £246,231. In the same year the port was entered and cleared by 143 vessels of 132,326 tons, an increase of 6538 tons since 1896. Population, about 20,000.

Moghilev, a government of western Russia, having Minsk on the W., Smolensk on the N.E., and Chernigov on the E. and S. Its area occupies 18,551 square miles. It is built up of Devonian deposits in the north, of Cretaceous in the east, and of Tertiary elsewhere, but generally is covered with a thick layer of Glacial and later alluvial deposits. Interesting finds from the Stone Age, as well as remains of the mammoth, have been made. The population in 1898 was 1,717,291, of whom 861,533 were women, and 146,752 lived in towns (census of 1897). Both birth-rate (77,790 in 1897) and death-rate (47,158) are high. The population is mostly White Russian, and was distributed as follows according to religion: Greek Orthodox, 1,426,347; Raskolniks, 26,286; Roman Catholics, 50,344; Protestants, 5651; Jews, 208,560; Mussulmans, 103.

In 1899, out of a total of 11,309,200 acres, 4,622,000 acres were held in communal ownership by the peasants, 5,776,300 acres were owned by landlords owning more than 270 acres each, and 399,000 acres by small owners. Most of the private owners belong to the nobility. At the same time 3,185,600 acres were under crops, and the produce of the crops in 1899 was: wheat, 219,000 cwt.; rye, 5,353,700; oats, 2,893,600; of all cereals, 10,200,000 cwt. Flax, hemp, and tobacco are also grown. In 1897 there were 401,960 horses, 470,770 horned cattle, 427,000 sheep, and 439,150 swine. In the same year 820 factories employed 6835 hands, but showed an aggregate return of only £528,400. Paper, spirits, wire and nails, leather, and tiles were the chief products. Nearly 60,000 children were in receipt of education. The province is divided into 11 districts, of which the chief towns, with their population in 1897, were: Moghilev-on-Dnieper, or Moghilev Gubernskiy (43,106 in 1897), Chausy (5550), Cherikoff (5250), Gomel (35,846), Gorki (6730), Klimovichi (4706), Mstislavl (8467), Orsha (13,161), Rogacheff (9103), Staryi Bykhov (6354), and Syenno (4061). Shklov, another town, has 10,630 inhabitants. (P. A. K.)

Moguer, a town of Spain, in the province of Huelva, on the Rio Tinto, not far from the sea. The population, 8750 in 1887, was only 7689 in 1897. The streets are regular, and contain many modern houses. There are distilleries and flour mills, and vessels of light draught can come up to the town. There is an active export of wine and oil.

Mohl, Hugo von (1805–1872), German botanist, was born at Stuttgart on 8th April 1805. He came of a family connected on both sides with the higher class of state officials of Würtemberg, and he and his three brothers justified by their distinguished careers their excellent early education at home. While a pupil at the gymnasium he pursued botany and mineralogy in his leisure time, till in 1823 he entered the University of Tübingen. After graduating with distinction in medicine he went to Munich, where he met a distinguished circle of botanists, and found ample material for research. This seems to have determined his career as a botanist, and he started in 1828 those anatomical investigations which he continued till his death. In 1832 he was appointed professor of botany in Tübingen, a post which he never left. Unmarried, his pleasures were in his laboratory and library, and in perfecting optical apparatus and microscopic preparations, for which he showed extraordinary manual skill. He was largely a self-taught botanist from boyhood, and, little influenced in his opinions even by his teachers, preserved always his independence of view on scientific questions. He received many honours during his lifetime, and was elected Foreign Fellow of the Royal Society in 1868. Von Mohl's writings cover a period of forty-four years; the most notable of them were republished in 1845 in a volume entitled *Vermischte Schriften*. (For lists of his works see *Botanische Zeitung*, 1872, p. 576, and *Royal Soc. Catalogue*, 1870, vol. iv.) They dealt with a variety of subjects, but chiefly with the structure of the higher forms, including both rough anatomy and minute histology. The word "protoplasm" was his suggestion; the nucleus had already been recognized by Brown and others, but von Mohl showed in 1844 that the protoplasm is the source of those movements which at that time excited so much attention. He recognized under the name of "primordial utricle" the protoplasmic lining of the vacuolated cell, and first described the behaviour of the protoplasm in cell-division. These and other observations led to the overthrow of Schleiden's theory of origin of cells by free-cell-formation. His contributions to knowledge of the cell-wall were no less remarkable; he held the view now generally adopted of growth of cell-wall by apposition. He first explained the true nature of pits, and showed the cellular origin of vessels and of fibrous cells; he was, in fact, the true founder of the cell theory. Clearly the author of such researches was the man to collect into one volume the theory of cell-formation—this he did in his treatise *Die Vegetabilische Zelle* (1851), a short work translated into English (Ray Society, 1852). Von Mohl's early investigations on the structure of palms, of cycads, and of tree-ferns permanently laid the foundation of all later knowledge of this subject: so also his work on *Isoetes* (1840). His later anatomical work was chiefly on the stems of dicotyledons and gymnosperms; in his observations on cork and bark he first explained the formation, and the origin of different types of bark, and corrected errors relating to lenticels. Following on his early demonstration of the origin of stomata (1838), he wrote a classical paper on their opening and closing (1850). In 1843 he started in conjunction with Schlechtendal the weekly *Botanische Zeitung*, which he jointly edited till his death. He was never a great writer of comprehensive works; no text-book exists in his name, and it would indeed appear from his withdrawal from co-operation in Hofmeister's *Handbuch* that he had a distaste for such efforts. In his latter years his productive activity fell off, doubtless through failing health, and he died suddenly at Tübingen on 1st April 1872.

See Sachs, *History of Botany*, p. 292, &c.—De Bary, *Botanische Zeitung*, 1872, p. 561.—*Roy. Soc. Proc.* vol. xxiii. p. 1.—*Allgemeine Deutsche Biographie*, vol. xxii. p. 55. (F. O. B.)

Mohmand Campaign, The.—The year 1897 witnessed an almost general outbreak among the tribes on the north-west frontier of India. The tribes involved were practically independent, but the new frontier arranged with the Amir of Afghanistan, and demarcated by Sir Mortimer Durand's commission of 1893–94, brought them within the British sphere of influence. The great dread of these high-spirited mountaineers was annexation, and the hostility shown during the demarcation led to the Waziri expedition of 1894. Other causes, however, contributed to bring about the outbreak of 1897. The easy victory of the Turks over the Greeks gave rise to excitement throughout the Mahommedan world, and the publication by the Amir of Afghanistan, in his assumed capacity of king of Islam, of a religious work, in portions of which fanatical antipathy to Christians was thinly veiled, aroused a warlike spirit among the border Mahommedans. The growing unrest was not recognized, and all appeared quiet, when, on 10th June 1897, a detachment of Indian troops escorting a British frontier officer was suddenly attacked during the mid-day halt in the Tochi valley, where, since the Waziri expedition of 1894–95, certain armed posts had been retained by the Government of India. On the 29th July, with equal suddenness, the fortified posts at Chakdara and Malakand, in the Swat valley, which had been held since the Chitral expedition of 1895, were for several days fiercely assailed by the usually peaceful Swatis under the leadership of the Mad Mullah. On 8th August the village of Shankaghar, within a few miles of Peshawur, and in British territory, was raided by the Mohmands, while the Afridis besieged the fortified posts on the Samana ridge, which had been maintained since the expeditions of 1888 and 1891. Finally, the Afridis, within a few days, captured all the British posts in the Khyber Pass. A division commanded by Major-General Sir Bindon Blood was assembled at Nowshera. The post at Malakand was reached on 1st August, and on the following day Chakdara was relieved. The punishment of the Afridis was deferred till the preparations for the Tirah campaign (see Tirah) could be completed. The Mohmands, however, could be immediately dealt with, and against them the two brigades of Sir Bindon Blood's division advanced from Malakand simultaneously with the movement of another division under Major-General (afterwards Sir Edmund) R. Elles from Peshawur; it was intended that the two columns should effect a junction in Bajaor. About the 6th September the two forces advanced, and Major-General Blood reached Nawagai on 14th September, having detached a brigade to cross the Rambat Pass. This brigade being sharply attacked in camp at Markhanai at the foot of the pass on the night of the 14th, was ordered to turn northwards and punish the tribesmen of the Mamund valley. On the 15th Brigadier- (afterwards Major-) General Jeffreys camped at Inayat Killa, and on the following day he moved up the Mamund valley in three columns, which met with strong resistance. A retirement was ordered, the tribesmen following, and when darkness fell the general, with a battery and a small escort, was cut off, and with difficulty defended some buildings until relieved. The casualties in this action numbered 149. This partial reverse placed Major-General Blood in a position of some difficulty. He determined, however, to remain at Nawagai, awaiting the arrival of Major-General Elles, and sent orders to Brigadier-General Jeffreys to prosecute the operations in the Mamund valley. From the 18th to the 23rd these operations were carried on successfully, several villages being burned, and the Mamunds were disheartened. Meanwhile, the camp at Nawagai was heavily attacked on the night of the 20th by about 4000 men belonging to the Hadda Mullah's following. The attack was repulsed with loss, and on the 21st Generals Blood and Elles met at Lakarai. The junction having been effected, the latter, in accordance with the scheme, advanced to deal with the Upper Mohmands in the Jarobi and Koda Khel valleys, and they were soon brought to reason by his successful and well-conducted operations. The work of the Peshawur division was now accomplished, and it returned to take part in the Tirah campaign. Its total casualties were about 30 killed and wounded. On the 22nd Major-General Blood joined Brigadier-General Jeffreys, and on the 24th he started with his staff for Panjkora. On the 27th Brigadier-General Jeffreys resumed punitive operations in the Mohmand valley, destroying numerous villages. On the 30th he encountered strong opposition at Agrah, and had 61 casualties. On 2nd October Sir Bindon Blood arrived at Inayat Killa with reinforcements, and on the 11th the Mohmands tendered their submission. The total British loss in the Mohmand valley was 282 out of a force which never exceeded 1200 men. After marching into Bunar, and revisiting the scenes of the Ambeyla expedition of 1863, the Malakand field-force was broken up on 21st January. The objects of the Mohmand expedition were completely attained, in spite of the great natural difficulties of the country. The employment of imperial service troops with the Peshawur column marked a new departure in frontier campaigns. (C. J. B.)

Moji, a Japanese town on the Kiushiu side of the Shimonoseki strait. The strait being only one mile in width, Moji and Shimonoseki would be practically the same port did not the swiftness of the current along the latter shore make it convenient for vessels to anchor on the Moji side. Moji is one of the places voluntarily opened by the Japanese for purposes of direct export. It is the starting point of the Kiushiu railway, and as there is abundance of coal in its neighbourhood, it promises to become a town of great importance. In 1890 it was little more than a hamlet, but it had in 1901 a population of 25,274, and its foreign trade aggregates nearly £700,000.

Mokha. See ARABIA.

Mola di Bari, a seaport town of the province of Bari, Apulia, Italy, on the Adriatic coast, 12 miles east-south-east of Bari by the railway to Brindisi. Population (1881), 12,070; (1899), 13,000.

Mold, contributory parliamentary borough, market town, and railway station of Flintshire, Wales, 11 miles west by south of Chester. There are extensive collieries, potteries, limestone quarries, and lead mines in the neighbourhood. Population (1891), 4457; (1901), 4263.

Molenbeek-Saint-Jean, a town of Belgium, in the province of Brabant, north-west of Brussels, one of the eight communes constituting the capital, with a station on the suburban railway running round the city. It has been called the Manchester of Belgium, on account of its great manufacturing establishments. The population (communal) (1880), 41,737; (1900), 58,445.

Molesworth, Mary Louisa (1839——), Scottish writer, daughter of Major-General Stewart, of Strath, N.B., was born in Rotterdam, 29th May 1839, and was educated partly in Great Britain and partly abroad. In 1861 Miss Stewart married Major R. Molesworth. She began writing stories while quite young, and her first novels (*Lover and Husband*, 1869, to *Cicely*, 1874) appeared under the pseudonym of "Ennis Graham." Mrs Molesworth is best known, however, as a writer of books for the young. Her *Tell Me a Story* (1875), *Carrots* (1876), and *The Cuckoo Clock* (1877) at once established her reputation in that line, and were succeeded by many others.

Molfetta, a seaport town and episcopal see of the province of Bari, Apulia, Italy, on the Adriatic coast, 16 miles north-west of Bari by rail. It has manufactures of macaroni and olive oil, shipbuilding, brickworks, fishing, and an active coasting trade, the port being cleared by approximately 250,000 tons annually. Population (1881), 29,697; (1899), about 30,000.

Moline, a city of Rock Island county, Illinois, U.S.A., on the east bank of the Mississippi river, adjoining Rock Island, and opposite the upper end of the island, in the north-western part of the state, at an altitude of 574 feet. It has four railways, the Chicago, Burlington and Quincy, the Chicago, Milwaukee and St Paul, the Chicago, Rock Island and Pacific, and the Davenport, Rock Island and North-western. In 1900 the city contained 157 manufacturing establishments, with a total capital of $11,165,701, an average number of 4438 wage-earners, and products valued at $10,000,282. Moline is noted for its manufacture of agricultural implements, and especially for its farm waggons. Population (1890), 12,000; (1900), 17,248, of whom 5699 were foreign-born and 268 were negroes.

Molique, Wilhelm Bernhardt (1802–1869), German violinist and composer, was born at Nuremberg, 7th October 1802, and learnt the violin at Munich under Pietro Rovelli. In 1826 he became music-director at Stuttgart. As a composer for the violin Molique was commonly compared with Spohr. Some of his songs, too, were charming, and have survived. He died at Cannstadt in 1869.

Mollusca.—Until comparatively recently, the number of types of Mollusca which had been studied from the morphological standpoint was relatively inconsiderable. The different subdivisions of the group thus seemed quite distinct and easily characterized; and the really intimate relations between them were not apparent. The first, but fruitless, attempt at a phylogeny of Mollusca was made by von Jhering (1) in 1877—that is to say, at a time when our knowledge of the organization and development of these organisms was still inadequate. But, a decade later, numerous studies were begun with the aim of investigating the more primitive forms in each group, and thus of throwing light on morphology by means of phylogeny. The article by Ray Lankester in an earlier volume of this work (ninth ed., vol. xvi.) contributed not a little to the genesis of this movement; hence the fact that since its publication our knowledge of Molluscs has made such great strides, the cause being, not so much the large number of memoirs as the phylogenetic tendency of many of them. (See list at the end of this article.)

Classification.—It has not been necessary to alter the boundaries of the group, but the genus Rhodope has been definitely removed as a Platyhelminth (Böhmig, 14). The affinity of the Aplacophora and Chitonidæ to one another has been completely confirmed, and the molluscan nature of these two subdivisions is now hardly questioned. The only three modifications in the general classification which have been introduced since the ninth edition of this Encyclopædia are as follows :—(*a*) the class Cephalopoda contains only the Siphonopoda of Lankester, the Pteropoda being excluded ; (*b*) the class Gastropoda comprises only the Anisopleura of Lankester *plus* the Pteropoda (Boas, 4, and Pelseneer, 5), a more complete knowledge of the Aplacophora and Polyplacophora having shown that the Isopleura of Lankester form a distinct class = the Amphineura of von Jhering ; (*c*) on the other hand the class Lamellibranchia no longer constitutes a distinct "branch," in contrast to the remaining Mollusca ; as a result of the work of Pelseneer (6), it is recognized as having great special affinity to the Gastropoda and Scaphopoda, these three groups being capable of union into one branch, the Prorhipidoglossomorpha (Grobben) ; the name being taken from their common ancestor Prorhipidoglossum (Pelseneer). The following table summarizes the division into classes which is generally adopted at the present day :—

PHYLUM MOLLUSCA.

Class I. **Amphineura**
,, II. **Gastropoda** }
,, III. **Scaphopoda** } Branch **Prorhipidoglossomorpha**
,, IV. **Lamellibranchia** }
,, V. **Cephalopoda**

Morphology.—The general morphological characters are obviously those of the more primitive forms of the different classes, for in each class the same specializations may be observed—the loss of shell, foot, ctenidia, and radula. This is the case not only in Lamellibranchia, but also in numerous Gastropoda (Eulimidæ, Pyramidellidæ, Coralliophilidæ, Phyllidiidæ, Thetyidæ, &c.), in several Aplacophora, and even in Cephalopoda (Cirroteuthidæ). The nervous system consists of two pedal cords and two pallial cords, united by a supra-œsophageal (cerebral) commissure which innervates the principal sense-organs, and also by an infraœsophageal (labial) commissure, from which arise the stomato-gastric nerves. The alimentary canal exhibits a radula-sac on its anterior portion. The circulatory system is closed, allowing no water to enter the blood ; respiration is effected by a pair of ctenidia. The cœlom is represented only by the gonad and the pericardium ; and is not an enterocœl, for its wall is derived from endodermal elements in the neighbourhood of the blastopore ; these sink down between the adjacent cells, or divide, giving rise to other elements which interpose themselves between ectoderm and endoderm. The dorsal invagination for the shell-gland, often present as early as a gastrula-stage, is notable as forming the mantle and secreting the embryonic shell. The *Schematic Mollusc* (the *Archimollusc* of Lankester) is a generalized hypothetical type which summarizes the principal features which we believe to have been possessed by those ancestral organisms from which have descended all the classes of Molluscs existing at the present day. In addition to many of the general morphological characters just enumerated, it may be conceived to have possessed a symmetrical organization, with the anal orifice at the posterior extremity, and on the dorsal surface a shell which was not covered by mantle-folds. The two portions of the primitive cœlom were continuous, namely, the anterior or gonadial and the posterior or pericardial ; each of these possessed its pair of nephridia (retained in some Cephalopoda and Polyplacophora), an anterior or genital pair, a posterior or renal pair.

Class I. **Amphineura** (=**Isopleura**).—Without torsion, possessing an elongate body, a heart, posterior anal and renal openings, and spicules in the integument ; no visceral commissure.

Subclass A. POLYPLACOPHORA. —Mantle with a shell of eight articulated valves ; foot for crawling ; ctenidia metamerically segmented ; one pair of genital nephridia. Families : Lepidopleuridæ, Ischnochitonidæ, Acanthochitonidæ, Cryptoplacidæ, Chitonidæ.

Subclass B. APLACOPHORA.—Foot vestigial ; mantle occupying the whole surface of the body, and devoid of shell ; gonads opening into the pericardium.

Order 1. *Neomenioidea.*—A longitudinal ventral groove ; the foot represented by a ciliated ridge ; gonads paired, hermaphrodite. About forty species, distributed not only in the northern hemisphere, but also in the Malayan, Australian, and Antarctic regions. Principal genera : Neomenia, Tullberg ; Paramenia, Pruv. ; Proneomenia, Hubr. ; Ismenia, Pruv. ; Lepidomenia, Kowal. Mar. ; Dondersia, Hubr.

Order 2. *Chætodermoidea.*—No pedal ridge ; two ctenidia, posterior, symmetrical, and bipectinate ; sexes separate. Genus : Chætoderma, Loven.

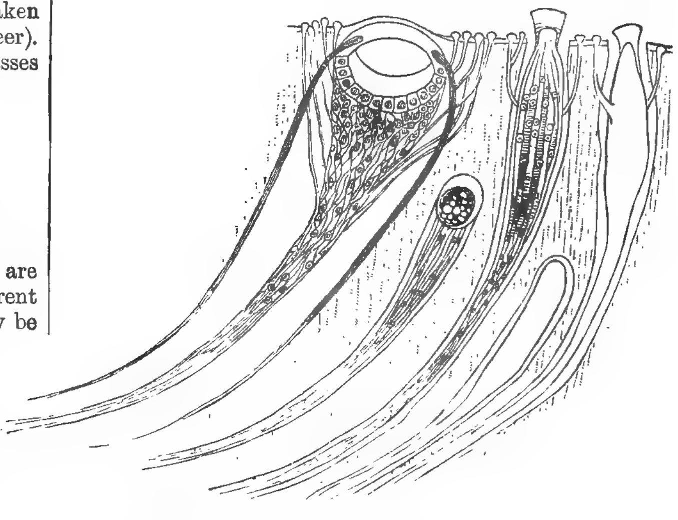


FIG. 1.—Pallial Eye and Æsthetes of *Acanthopleura spiniger* (Moseley).

The shell of the Polyplacophora is formed of two layers—the one deep and compact (articulamentum) ; the other (tegmentum) is alone to be seen externally, and is pierced by numerous vertical canals through which pass sense-organs. The tegmentum is a secondary structure, derived from the edges of the mantle which overlap the border of the articulamentum. The pallial sense-organs which perforate the tegmentum are epithelial papillæ, innervated by the pallial cords, containing nerve-end bulbs, and covered by a dome of cuticle ; they are termed, according to size, micræsthetes and megalæsthetes. In some cases (Tonicia, Chætopleura) megalæsthetes are modified into eyes, formed by a deep retina, a lens, a calcareous cornea, and an envelope of pigment (15). The ctenidia of the Polyplacophora are metamerically segmented, and form from four to eighty pairs. They are arranged on both sides of the body in rows between mantle and foot, as holobranchs or merobranchs. The largest pair of branchiæ is placed immediately behind the renal openings, and corresponds to the two ctenidia of other Molluscs, the original ctenidia being repeated anteriorly and posteriorly in the Mesomacrobranchs, anteriorly only in the Metamacrobranchs. In adults of various species, the number of branchiæ is greater than in young specimens ; and there is often a numerical asymmetry on the two sides.

In all Amphineura (including Neomeniidæ) there is a true heart with a contractile ventricle formed of the hinder part of the dorsal vessel. The ventricle in Polyplacophora has two lateral auricles, continuous posteriorly, with which it communicates by one or more openings, which occasionally are asymmetrical. The extension anteriorly of the nephridia is generally proportionate to that of the rows of branchiæ. The external opening is placed immediately in front of the largest branchia. The gonad is paired in Nuttalochiton and the Neomeniidæ ; in other cases it is single.

It always occupies the whole dorsal and anterior region of the body in front of the pericardium. The genital ducts of the Polyplacophora have the same arrangement as the renal nephridia, bent slightly forward. They are not directly continuous with the wall of the gonadial cavity, which they place in communication with the exterior; but each commences by a large ciliated funnel; they are, in fact, an anterior pair of nephridia, like the genital ducts of the Cephalopoda. The Chitons are therefore no less primitive in this respect than Molluscs the gonads of which open to the interior of the renal nephridia; on the contrary they are more primitive than most Mollusca, as having retained two pairs of nephridia, the anterior serving as gonaducts. The genital opening is slightly in front of the renal; between the two are one or more pairs of branchiæ (at most, nine, in Cryptoplax larvæformis). In the Aplacophora the generative organs open into the pericardium; the nephridia thus serve as genital ducts, and exhibit accessory glands in their course; they often unite into a single median aperture in the cloacæ (Neomeniidæ). With regard to the nervous system, in addition to anastomoses between the pedal cords, there are in the majority of species pallio-pedal anastomoses between the pedal and pallial cords of the same side. Further, in certain Aplacophora (Chætoderma and Paramenia) the pallial and pedal cords of the same side unite posteriorly into a single cord. The two lateral cords always unite posteriorly above the rectum, often producing a ganglionic swelling. There is no visceral commissure; the generative and renal glands and heart are innervated from the pallial cords. The labial or infra-œsophageal commissure of Polyplacophora gives rise to a stomato-gastric commissure, the two branches of which unite above and below the alimentary canal; and also to a second infra-œsophageal or subradular commissure with ganglia and sense-organs, which lies in front of the radula. This labial commissure, with subradular commissure and organs, corresponds to the parts of the same name in Scaphopoda and Cephalopoda. In addition to the subradular organ, adult Chitonids sometimes have pallial eyes (see above), and generally an osphradium on each side, not one at the base of each ctenidium. This organ is a sensitive spot on the inner face of the mantle outside the branchial region, near the largest branchia, and innervated from the pallial cord.

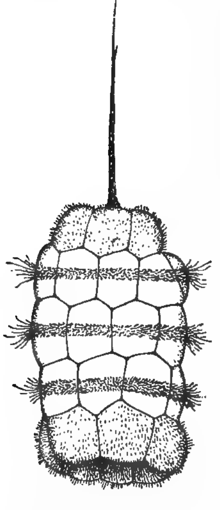


Fig. 2.—Embryo of *Yoldia limatula*, about 70 hours old (Drew).

In the Polyplacophora (16, 17) the embryo becomes a trochophore with apical ciliary tuft in the centre of the velar ring; its large and long foot-gland [byssus-gland] atrophies in the adult. The dorsal cuticle calcifies to form the shell-plates, of which often only the anterior seven are found at first. In each lateral groove, immediately behind the velum, is a larval eye corresponding to the cephalic eye of Lamellibranchia (18). In the Neomenioidea (19) the ova develop into an invaginate gastrula which becomes a trochophore with posterior blastopore, anterior ciliated ring on the velum, and central apical flagellum. The external surface of the trochophore is formed of ciliated "test cells," which ultimately disappear, as in Yoldia (Fig. 2); beneath them is formed the future mantle. On the trochophore becoming a larva, spicules appear under the mantle, and the dorsal face is covered by seven imbricated calcareous plates, formed by apposed flattened spicules (Fig. 3, C).

The Polyplacophora present the most archaic characters among the Amphineura; the Aplacophora, on the contrary, are the more specialized in the following points—(1) the reduction of the foot; (2) the disappearance of the shell (one of the Polyplacophora shows how these two reductions result simultaneously); (3) the loss of the anterior nephridia; (4) the absence of the radula in several forms.

Branch **Prorhipidoglossomorpha**.—These organisms are characterized by the presence of a visceral commissure in the nervous system, and by the absence of genital nephridio-ducts; the gonads open either into the kidneys, or more or less close to their external apertures, by means of ducts formed at the expense of part of the renal nephridia.

Class II. **Gastropoda**.—Their essential character is a loss of symmetry, produced by torsion of the visceral sac. This torsion may be resolved into two successive movements—the first is a ventral flexure in the antero-posterior or sagittal plane; the result of this is to approximate the two ends of the alimentary canal. In development, the openings of the mantle-cavity and the anus are always originally posterior; later they are brought forward ventrally. During this first movement flexure is also produced by the coiling of the visceral sac and shell; primitively the latter was bowl-shaped; but the ventral flexure, which brings together the two extremities of the digestive tube, gives the visceral sac the outline of a more or less acute cone. The shell necessarily takes this form also; and then becomes coiled in a dorsal or anterior plane—that is to say, it becomes exogastric. This condition may be seen in embryonic Patellidæ, Fissurellidæ, and Trochidæ, and agrees with the method of coiling of a Mollusc without lateral torsion, such as Nautilus. But ultimately the coil becomes ventral or endogastric, in consequence of the second torsion movement then apparent, the first being inadequate to approximate the two extremities of the digestive tract. The elongation for crawling of the ventral surface, which primitively was very short, not only prevents the approximation of these two extremities, but actually tends to separate them. The second movement is therefore a lateral torsion of the visceral mass, which forcibly effects this approximation; the foot remaining a fixed point, this torsion occurs in a plane approximately at right angles to that of the first movement, and carries the pallial aperture and the anus from behind forwards. If, at this moment, the animal were placed with mouth and ventral surface turned towards the observer, this torsion carries the circumanal complex in a clockwise direction (along the right side in dextral forms) through 180° as compared with its primitive condition. The (primitively) right-hand organs of the complex thus become left-hand, and *vice versâ*. The visceral commissure, while still surrounding the digestive tract, becomes looped; its right half, with its proper ganglion, passes to the left side over the dorsal face of the alimentary canal (whence the name supra-intestinal), while the left half passes below towards the right side, thus originating the name infra-intestinal given to this half and to its ganglion. Next, the shell, the coil of which was at first exogastric, being also entangled in this rotation through 180°, exhibits an endogastric coiling. This, however, is not generally retained in one plane, and the spire projects, little by little, on the side which was originally left but finally becomes right (in dextral forms, with a clockwise direction, if viewed from the side of the spire; but counter-clockwise in sinistral forms). The direction of involution of the shell thus corresponds to that of the lateral torsion. Finally, the original symmetry of the circumanal complex vanishes; the anus leaves the centre of the pallial cavity and passes towards the right side (left side in sinistral forms); the organs of this side become atrophied and disappear. The essential feature of the asymmetry of Gastropoda is the atrophy or disappearance of the primitively left half of the circumanal complex (the right half in sinistral forms), because the direction of coiling is in relation both to that of the asymmetry and to that of the torsion; the sinistral involution corresponds exactly to a *situs inversus viscerum* of a Gastropod with dextral coil (Physa, Clausilia, Triforis, &c.) But there are forms in which the involution is "hyperstrophic," that is to say, the turns of the spire projecting but slightly, the spire, after flattening out gradually, finally becomes re-entrant and transformed into a false umbilicus; at the same time that part which corresponds to the umbilicus of forms with a normal coil, projects and constitutes a false spire; the coil thus appears to be sinistral, although the asymmetry remains dextral, and the coil of the operculum (always the opposite to that of the shell) sinistral (Lanistes among Streptoneura, Limacinidæ among Opisthobranchia). The same, *mutatis mutandis*, may occur in sinistral shells.

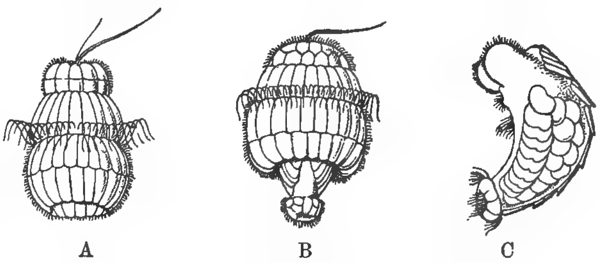


Fig. 3.—*Dondersia banyulensis* (Pruvot). A, larva of 36 hours; B, larva of 100 hours; C, young animal of 7 days.

The characteristic torsion attains its maximum effect among the majority of Streptoneura. It is followed in some specialized "Heteropoda" and in the Euthyneura by a torsion in the opposite direction or detorsion, which brings the anus farther back, and untwists the visceral commissure (see Euthyneura, below). This conclusion has shown that the Euthyneura do not represent an archaic form of Gastropoda, but are themselves derived from streptoneurous forms. The difference between the two subclasses has been shown to be slight; certain of the more archaic Tectibranchia (Actæon) and Pulmonata (Chilina) still have the visceral commissure long and not untwisted. The fact that all the Euthyneura are hermaphrodite is not a fundamental difference;

several Streptoneura are so likewise (Valvata, Onchidiopsis, Marsenina, Odostomia, Bathysciadium, Entoconcha).

Subclass A. STREPTONEURA.—The old division into Zygobranchia and Azygobranchia must be abandoned, for the Azygobranchiate Rhipidoglossa have much greater affinity to the Zygobranchiate Haliotidæ and Fissurellidæ than to the Azygobranchia in general, properly so called. This is shown by the labial commissure and pedal cords of the nervous system, by the opening of the gonad into the right kidney, and by other points. Further, the Pleurotomariidæ have been discovered to possess two branchiæ.

Order I. *Scutibranchia.*—A general symmetry of the nephridia and auricles; pedal cords with multiple anastomoses; bipectinate ctenidia; the genital products escape to the exterior by the right nephridium (except Helicinidæ). Suborder A. *Docoglossa.* Radula with the lateral teeth few in number, generally beam-shaped; the heart is not traversed by the rectum, and has but one auricle. Families: Acmæidæ, Patellidæ, Lepetidæ, Bathysciadiidæ. Suborder B. *Rhipidoglossa.* Radula with numerous lateral teeth, disposed in a fan; heart traversed by the rectum, and provided with two auricles. Families: Pleurotomariidæ, Fissurellidæ, Haliotidæ, Trochidæ, Stomatellidæ, Delphinulidæ, Turbinidæ, Neritidæ, Titiscaniidæ, Helicinidæ.

The bipectinate branchiæ are only paired in Pleurotomaria, Fissurellidæ, and Haliotidæ. In Scissurella the right branchia is only monopectinate; in other cases it is absent (Acmæa, Trochus, Nerita, &c.); but the left is always bipectinate in them. In the Helicinidæ, which are terrestrial and physiologically Pneumochlamydate although morphologically Rhipidoglossate, there is neither branchia nor osphradium, but the pallial chamber with a large opening serves as a lung. The shell which at times is largely overspread by the mantle in certain Fissurellidæ, is entirely internal in Pupilia, and absent from Titiscaniidæ. Each pleural ganglion anastomoses with the opposite half of the visceral commissure by its pallial nerve (dialyneury) in the Rhipidoglossa, but not in the Docoglossa. The gonad opens into the right kidney, connexion being made through a permanent opening or a papilla, at any rate in various Rhipidoglossa; but the Neritidæ have lost the right kidney, and consequently have an external generative opening. The trochosphere has a shell which is at first exogastrically coiled, and has a posterior pallial chamber; torsion commences late.

Order II. *Pectinibranchia.*—One branchia only present; monopectinate (except in Valvata); gonad opening to the exterior by its own duct. The former classification into Holochlamyda, Pneumochlamyda, and Siphonochlamyda must be abandoned, as the Pneumochlamyda and Siphonochlamyda are polyphyletic; the Helicinidæ in particular can no longer be retained in the former, as being Scutibranchia Rhipidoglossa, with close affinity to the Neritidæ. Suborder A. *Tænioglossa.* Radula with three rows of teeth on each side of the median. This suborder includes two groups:—1. Platypoda (Reptantia), comprising the great majority of the families of Streptoneura; 2. Heteropoda (Natantia), containing the families Atlantidæ, Carinariidæ, Pterotracheidæ. Suborder B. *Stenoglossa.* The radula narrow, with only one lateral tooth on each side, in each transverse row; all are siphonate. Group 1. *Rhachiglossa.* With a median tooth. Families: Fasciolariidæ, Turbinellidæ, Mitridæ, Buccinidæ, Haliidæ, Muricidæ, Coralliophilidæ, Cancellariidæ, Volutidæ, Olividæ, Harpidæ, Marginellidæ. Group 2. *Toxiglossa.* No median tooth. Families: Conidæ, Terebridæ, Pleurotomatidæ.

Throughout, the pleural ganglia anastomose with the opposite half of the visceral commissure, or even with the corresponding ganglion, by a longer or shorter connective. In the more primitive Tænioglossa the osphradium is only a filiform prominence of epithelium (Littorina, Fig. 4); by further specialization it may develop pectinations on both sides, which may even be arborescent (Pteroceras, Cypræa). It is absent from the Pulmonate forms; in one of these (Cerithidea) it is replaced by a pallial eye, of structure analogous to those of Onchidium and the Pectinidæ. There are two larval nephridia—closed sacs in marine Pectinibranchia, tubes with an external opening in Paludina and Bithynia. The adult kidney develops at the expense of the cœlomic (pericardial) epithelium. In Paludina traces of the left kidney are recognizable, but atrophy, the ducts becoming the genital duct. The genital gland is formed in mesoderm as a cœlomic region separate from the pericardium (Paludina). The branchia is formed by folds on the internal surface of the mantle. In pelagic Streptoneura (Heteropoda) we may observe a detorsion and return to an external symmetry concurrently with a retrogressive evolution of the shell, which is paralleled by Opisthobranchia: the Atlantidæ have a coiled and well-developed shell, an operculum, and prosobranchialism; the Carinariidæ, an uncoiled and diminished shell, and no operculum; the Pterotracheidæ, no shell and opisthobranchialism, or even abranchialism in Firoloida. The foot is laterally compressed, and carries a sucker in the middle line (in the male only, among Pterotracheidæ). In the nervous system the pleural ganglia are coupled to the cerebral and not to the pedal centres; there is no dialyneury, but viscero-pedal anastomoses connect the right pedal ganglion with the infra-intestinal, and the left with the supra-intestinal. In Carinariidæ and Pterotracheidæ the eyes are very voluminous, the retina of small extent, with rods arranged in grooves perpendicular to the optic axis.

Subclass B. EUTHYNEURA.—Among the essential characters which discriminate these from the Streptoneura, is notable not an absence of torsion, but an actual detorsion of the visceral commissure. In several of the more primitive forms (Actæonidæ and Limacinidæ among Opisthobranchia, Chilinidæ among Pulmonata) the same torsion occurs as in Streptoneura: prosobranchialism (Actæon), a looped visceral commissure (Actæon = Tornatella, Chilina, and even slightly still in Bulla and Scaphander), the osphradium to the left, innervated from the supra-intestinal ganglion (Actæon, Limacina). This untwisting of the visceral commissure is the result of a general untwisting which gradually restores the anus and circumanal complex from the anterior region to the right side (Bulla, Aplysia), or even to a posterior position (Onchidium, Philine, straight Pteropoda, Thecosomata, Cavolinia, Clio, &c.).

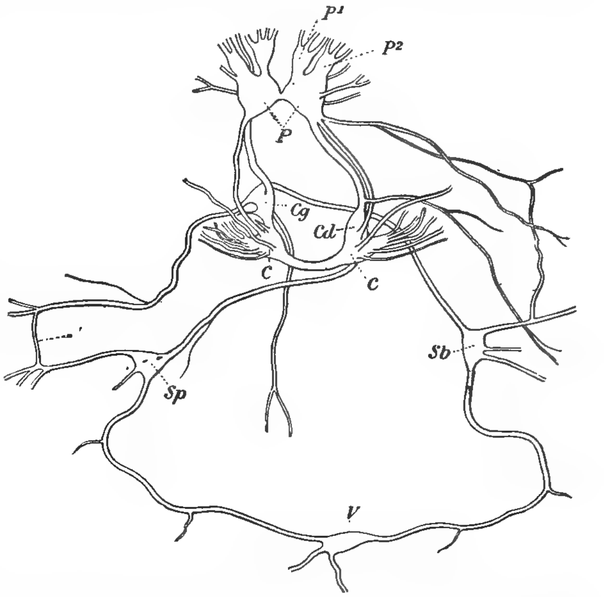


FIG. 4.—Littorina, dorsal view of nervous system (Bouvier): p^1, p^2, accessory pedal ganglia; *P*, pedal ganglia; *Cq*, left pleural ganglion; *Cd*, right pleural ganglion; *c*, cerebral ganglia; *Sp*, supra-intestinal ganglion; *Sb*, sub-intestinal ganglion; *V*, abdominal ganglion; *Z*, dialyneuric anatomosis.

In the latter the detorsion is complete, and consists in a rotation of 180° in a direction counter to the original Gastropod torsion; it carries the pallial cavity on to the ventral surface by way of the right-hand side, and from this results in "straight Pteropods" the loop of the genital duct round the alimentary tract. An operculum is retained by the adult not only of Actæon, but also in Limacinidæ, Ringiculidæ, and Amphibolidæ (Pulmonata). The subclass contains two orders.

Order I. *Opisthobranchia.*—The order contains two sections only, Tectibranchia and Nudibranchia; the old Phyllidiobranchia being united with the latter; indeed, the Phyllidia are Dorids, and the Pleurophyllidia are Eolids.

Section 1. *Tectibranchia.*—Characterized by the presence of a ctenidium and the asymmetry of their external form. Suborder A. *Bulloida* (including Pteropoda Thecosomata). Pallial cavity well developed. Families: Actæonidæ, Ringiculidæ, Tornatinidæ, Scaphandridæ, Philinidæ, Peltidæ, Lophocercidæ, Limacinidæ, Cymbuliidæ, Cavoliniidæ (the three last forming the old Pteropoda Thecosomata). Suborder B. *Aplysioida.* Pallial cavity greatly reduced or absent; parapodia not continuous with the sole of the foot. Families: Aplysiidæ, and the four families of Pteropoda Gymnosomata—Pneumonodermatidæ, Notobranchæidæ, Clionidæ, Halopsychidæ. Suborder C. *Pleurobranchoida.* Pallial cavity absent; no parapodia. Families: Umbrellidæ, Pleurobranchidæ.

Section 2. *Nudibranchia.*—Characterized by the absence of ctenidia, and their external symmetry. Suborder A. *Tritonioida.* Holohepatic, with anus on the right side. Families: Tritoniidæ, Scyllæidæ, Phyllirhoidæ, Thetyidæ. Suborder B. *Doridoida.* Holohepatic, with anus, median, and posterior. Families: Polyceratidæ, Dorididæ, Doridopsidæ, Corambidæ, Phyllidiidæ. Suborder C. *Eolidoida.* Cladohepatic, with simple oviduct. Families: Eolididæ, Glaucidæ, Pleurophyllidiidæ, Dotonidæ, Proctonotidæ, Fionidæ. Suborder D. *Elysioida.* Cladohepatic, with bifurcated oviduct. Families: Hermæidæ, Elysiidæ, Limapontiidæ (Fig. 5).

The borders of the solar face of the foot are often produced into fins or "parapodia," to be distinguished from the epipodia of the Aspidobranchia which are outgrowths of the sides of the foot and not of its ventral surface. These parapodia, which are greatly developed in Acera and Gastropteron among Bulloida, may even form a contractile sac right round the body (Notarchus) and constitute the fins of many Pteropods. The ctenidium is generally a lamina plicated in two directions alternately, and not a bipectinate appendage as in Streptoneura Aspidobranchia. It is absent from Nudibranchs, even from Dorids, the peri-anal leaf-like gills of which are homodynamous with the dorsal appendages of Tritonioida. Prosobranchialism occurs in Actæon, Limacina, &c., as in the Streptoneura. The hepatic cæca in the dorsal papillæ of Eolidoida actually communicate with the cnidogenous sacs at their extremity; cnidocysts are absent from Eolis glaucoides. The nervous system is concentrated dorsally in Pleurobranchoida and Nudibranchia, but ventrally in Pteropoda Thecosomata. The osphradium is absent from Nudibranchia, in which there is an increase of the tentacular olfactory organ (rhinophore); it is, however, retained by all Pteropoda Gymnosomata, although they generally lack a ctenidium.

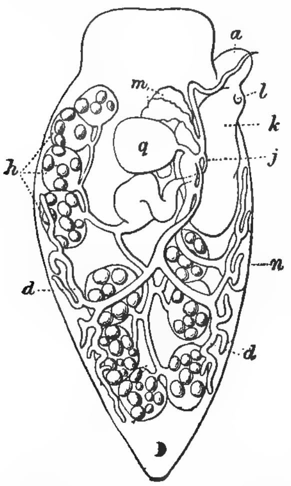


FIG. 5.—*Limapontia nigra*, generative organs (Hancock): *a*, penis; *d*, albuminiparous gland; *h*, hermaphrodite follicles; *j*, oviduct; *k*, mucous oviducal gland; *l*, oviducal opening; *m*, prostate; *n*, vaginal opening; *q*, receptaculum seminis.

The free veliger of Nudibranchs is followed by a creeping planariform stage which shortly loses its shell, and ultimately acquires dorsal papillæ, beginning with the anterior. In Cenia (Elysioida) the young leave the egg in the adult shape; there exists in this case, as in Pelta = Runcina among Tectibranchs, neither free veliger nor embryonic shell, these being the sole examples known among Opisthobranchia; all the others have a larval shell, even the Pteropoda Gymnosomata, with the possible exception of Theceurybia = Halopsyche.

The phylogenetic relations between Nudibranchia and Tectibranchia become clear through the organization of the Pleurobranchioida; in these there is neither pallial chamber nor osphradium, and respiration is largely pallial; the shell may be entirely absent (Pleurobranchia); the nervous system is concentrated dorsally; spicules and cnidocysts exist in the dorsal integuments. The mantle of Doridoida is quite homologous with that of Pleurobranchoida, and in no case with an epipodium reflected dorsally over the surface of the body.

Order II. *Pulmonata.*—(For the definition the article in vol. xvi. of this work should be consulted.) Suborder I. *Basommatophora.* Families: Auriculidæ, Amphibolidæ, Siphonariadæ, Chilinidæ, Limnæidæ, Planorbidæ, Physidæ. Suborder II. *Stylommatophora.* The various slugs do not form a homogeneous group, but are polyphyletic. Families: Succineidæ, Athoracophoridæ, Pupidæ, Helicidæ, Philomycidæ, Arionidæ, Limacidæ, Testacellidæ, Vaginulidæ, Onchidiidæ.

The Pulmonate ventricle is generally at the back of the heart; this is explicable by the descent of Pulmonata from very primitive Tectibranchia, highly twisted forms alone carrying the ventricle behind (Testacella, Onchidium). The lung, which in the majority of cases is vascular, is tracheal in the Athoracophoridæ. Among Stylommatophora, this organ is reduced in Onchidiidæ (the marine forms of which acquire branchial mantle-tufts dorsally) and absent in Vaginulidæ. Among Basommatophora, in addition to Limnæa of deep lakes the following admit water to the lung:—of marine forms, Amphibola, Gadinia, Siphonaria (this acquires a new pallial intrapulmonary gill); and of fresh-water forms, Chilina and Planorbis nautileus. Other fresh-water Basommatophora develop a pallial extrapulmonary gill (Planorbis corneus, Pulmobranchia (Fig. 6), Ancylus, the latter having lost all trace of a lung-cavity). The kidney almost invariably, notably among Stylommatophora, has a distinct ureter, opening more or less closely to the lung-aperture, sometimes at the extremity of the rectum. In Pythia of the Auriculidæ, the sperm-duct is an open furrow from the hermaphrodite opening to the penis; in other members of the same family it is tubular, and the bifurcation of the hermaphrodite duct occurs at some distance from the female opening, representing the primitive hermaphrodite opening. The penis is apparently innervated from the cerebral centre, but in fact from the pedal ganglion. In some less specialized Basommatophora the nervous system still exhibits a long commissure; it is even slightly looped in Chilina. An osphradium occurs in development, even among Stylommatophora (Helix, Limax); among these, however, it is always on the right in dextral species, as is the vestigial osphradial ganglion of Auricula. The velum is vestigial, except in Auriculidæ, Siphonariidæ, Amphibolidæ, and Onchidiidæ, where it is well developed. These families possess a larval operculum, retained till the adult stage by Amphibola. The eyes and part of the cerebral centres develop as ectodermal invaginations; these cerebral cavities are preserved in adult Limnæa and Planorbis. In Clausilia and Succinea the shell arises in a sac which at first is entirely closed. The embryonic nephridia are bent tubes, which open to the exterior and terminate internally by a funnel with flame-cell. In the Basommatophora three perforated cells constitute the canal, a fourth forms the funnel.

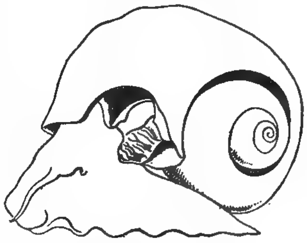
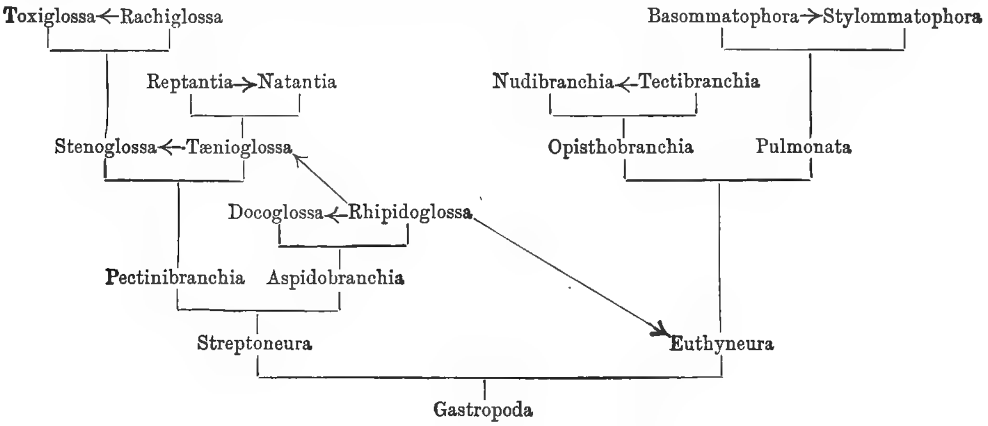


FIG. 6.—*Pulmobranchia lamellata*, with mantle partially cut out above the pulmonary opening and the gill.

Tabular View of the Phylogenetic Classification of the Class Gastropoda.



Class III. **Scaphopoda.**—The Scaphopoda have no ctenidia. The cephalic filaments or captacula are outgrowths of the paired dorsal cephalic lobes. The circulatory system has neither vessels nor well-developed muscular walls to the ventricle. The kidneys have no pericardial orifices; the genital gland opens into the right kidney. The nervous system exhibits two pleural ganglia, each with cerebro-pleural and pleuro-pedal connectives, the latter fusing immediately with the cerebro-pedal, as in Nucula. An infraœsophageal labial commissure gives origin to a stomatogastric commissure (as in Aspidobranchia and Polyplacophora), and innervates a sensory subradial organ. The ova are laid singly, and segmentation is irregular; invagination produces a gastrula with large blastopore originally at the posterior end of the embryo. The latter elongates, and acquires anteriorly a tuft of cilia, surrounded by four circles of cilia, to form the velum. The blastopore remains open, and draws gradually towards the anterior end along the ventral surface. On the dorsal aspect spring two lateral pallial ridges, parallel and symmetrical; these stretch towards the ventral surface, where they finally fuse to form a tubular mantle round the body. The shell which this mantle secretes, at first cup-shaped, little by little assumes the form of a tube, like the mantle, by union of its margins. On the ventral surface the foot appears as a prominence; this becomes elongated anteriorly, and by its aid the animal can crawl after the disappearance of the velum. The cerebral ganglia arise as two ectodermal invaginations in the velar area; the otocysts by invagination at the surface of the foot; and the pedal ganglia, after the otocysts, by ectodermal thickenings. The anus is perforated very late. After five or six days the velum atrophies, and the embryo begins to crawl. Families: Dentaliidæ, Siphonodentaliidæ.

Class IV. **Lamellibranchia.**—The old classification, founded on the number of adductor muscles, can no longer be retained, the "Monomya" being polyphyletic. The degree of specialization attained by different forms is well shown by the structure of the branchiæ (ctenidia); using these, five orders may be distinguished.

Order 1. *Protobranchia.*—Branchial filaments short, not flexed, not united by junctions, arranged in two series in opposite directions. Families: Nuculidæ, Solenomyidæ.

Order 2. *Filibranchia.*—Branchial filaments elongated, parallel, flexed, and united together by ciliary junctions. Families: Anomiidæ, Arcidæ, Trigoniidæ, Mytilidæ.

Order 3. *Pseudolamellibranchia.*—Branchial filaments with interfoliate junctions (vascular or connective); branchiæ plicated; posterior adductor muscle reduced or wanting; foot slightly developed. Families: Aviculidæ, Ostræidæ, Pectinidæ, Dimyidæ.

Order 4. *Eulamellibranchia.*—Branchiæ with interfilamentar and interfoliar unions, all of which are vascular; mantle lobes united posteriorly at one or two points. This order includes the great majority of families, which are distributed among seven sub-orders: Submytilacea, Tellinacea, Veneracea Cardiacea, Myacea, Pholadacea, and Anatinacea.

Order 5. *Septibranchia.*—Branchiæ transformed into a muscular septum, which stretches from the anterior adductor to the separation of the two siphons, and surrounds the foot. Families: Poromyidæ, Cuspidariidæ.

As in other Mollusca, the edges of the mantle can be reflected over (Galeomma, Entovalva), or can even entirely conceal the shell, which is absolutely internal in three genera, Chlamydoconcha, Ephippodonta, and Scioberetia. In the last the adductor muscles are absent, as in Aspergillum. Both adductors are embryonically developed in all Lamellibranchs, the anterior appearing always first, even in cases where it ultimately disappears. The retractor muscles of the foot correspond to the columellar muscle of Gastropoda. The foot has a ventral disc only in Protobranchia and Pectunculus; in other forms it exhibits very generally a cavity, the cells of which secrete a byssus for fixation of the animal. The liver occasionally presents an asymmetry, the left lobe being in such cases the larger (Nuculidæ). The epithelial covering of the auricles often constitutes pericardial glands; other portions of the wall of the pericardium may penetrate into the mantle. In the Septibranchia, by abnormal development of their muscular elements, the branchiæ form a muscular septum with symmetrical orifices; respiration is effected by the internal surface of the mantle, over which the contractions of the septum force a powerful current of water. The two nephridia communicate with one another; they extend sometimes into the mantle. The genital glands also communicate with one another in many forms; and in some cases open into the kidneys. Many species are hermaphrodite, but while in some (*e.g.*, Ostræa, Cardium) ova and spermatozoa arise side by side throughout the extent of the gland, in others (*e.g.*, Pecten) male and female portions are distinct; and in Poromya and Anatinacea there exist a pair of ovaries and a pair of testes entirely distinct, each with its proper orifice.

In the more archaic forms (Protobranchia) the pleural ganglia are distinct, as in Gastropoda and Scaphopoda; they are coupled to the cerebral, each giving rise to a pallial nerve, and a pleuro-pedal connective more or less promptly united to a cerebro-pedal connective. The existence of the pleural ganglia shows that no other visceral centre is fused with the cerebral, and that these are the posterior centres which correspond to the visceral ganglia of other Mollusca. The otocysts remain open to the exterior in some adult Nuculidæ. The cephalic eyes observable in various larvæ are retained in some adults on the anterior region of the branchial axis (Mytilus, Avicula, Fig. 7). A unique structure characterizes the pallial eyes of Pectinidæ and of some species of Cardium.

The ova are laid separately (except in Nucula delphinodonta). A large number of Lamellibranchia retain the developing eggs in the branchial lamellæ (Submytilacea, and fresh-water forms, except Dreissensi). Larval nephridia have been detected in several sub-groups, consisting of a deep canalicular portion, and a superficial portion which opens to the exterior postero-ventrally of the head; the lumen is intracellular, with a flame cell.

In the Unionidæ the larva (Glochidium) is temporarily parasitic, and encysts in the skin of a fish, deriving sustenance by means of the ectodermal cells of the mantle from the epidermis of the host. Parasitic life lasts from two to five weeks.

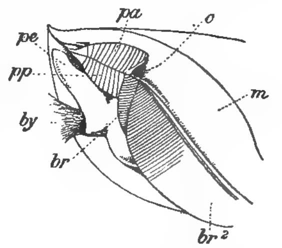


FIG. 7.—Avicula, left view of anterior part of the body: *pa*, anterior palp; *pe*, foot; *pp*, posterior palp; *by*, byssus; *br*, internal gill-plate; *br*^{2}, external gill-plate; *m*, reflected left mantle lobe; *o*, eye (on the first internal gill filament).

Class V. **Cephalopoda.**—For definitions of the divisions, the article in vol. xvi. of this work should be consulted.

Subclass A. TETRABRANCHIA.—This contains a single living genus, Nautilus, and numerous fossil genera (see article CEPHALOPODA).

Subclass B. DIBRANCHIA.

Order 1. *Decapoda.*—Suborder (*a*) Œgopsida, with seven living families: Spirulidæ, Ommatostrephidæ, Physanoteuthidæ, Onychoteuthidæ, Gonatidæ, Chiroteuthidæ, Cranchiidæ. Suborder (*b*) Myopsida. Families: Sepiolidæ, Idiosepiidæ, Sepiidariidæ, Loliginidæ, Sepiidæ

Order 2. *Octopoda.*—Families: Cirrhoteuthidæ, Octopodidæ, Argonautidæ, Philonexidæ. The internal shell is greatly reduced; it is purely chitinous in all Octopoda, forming an unpaired piece in Cirrhoteuthis, a pair of stylets in Octopus. In Argonauta alone the shell gland shallows out, without closing. In the Decapoda some allies of Sepiola are also shell-less. The tentacular arms atrophy in various Œgopsida. The hectocotylized arm belongs generally to the fourth pair in Decapoda, that of the left side only (Ommatostrephidæ, Onychoteuthidæ, and most Myopsida), or on both sides (Idiosepius, Spirula, Fig. 8). In Nautilus the spadix may be right or left. Some deep-water Œgopsida possess luminous organs. The radula is absent from Cirrhoteuthis; the ink-sac is also wanting in this genus and in some species of Octopus. In Octopoda the pericardial part of the cœlom is wanting. The cœlom includes only the genital capsule, which communicates with the capsules of the branchial hearts by long canals (absent in two families). The appendices of the branchial hearts are the morphological equivalent of the "pericardial glands" of other Mollusca; their glandular wall is excretory. The nervous system presents the same labial commissure as do Amphineura and Prorhipidoglossomorpha. The osphradium of Nautilus is placed against and protected by the interbranchial papilla. Certain pigmented organs of Cirrhoteuthis are supposed to be thermoscopic. In those Octopoda in which the hectocotylus is not autotomous, it is intruded into the pallial cavity of the female so as to introduce spermatophores into the distal portion of the oviduct (Octopus); both arms of the dorsal pair in Sepiolidæ place the spermatophores in the neighbourhood of the female opening.

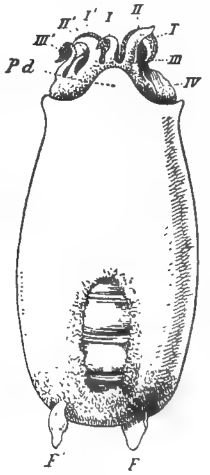


FIG. 8.—*Spirula peronii* (Huxley and Pelseneer): *F*, *F*^{1}, fins; *Pd*, dorsal anterior mantle-lobe; *T*, right tentacular arm; *I'*, *II'*, *III'*, left arms; *I*, *II*, *III*, *IV*, right arms.

In Nautilus the ova, which are four or five millimetres long, are laid separately in two shells, the outer of which is partially opened. In the Dibranchia, the nerve-centres arise from ectodermal thickenings; the brachial ganglia are formed by subdivision of the primitive pedal ganglia, thus showing the pedal origin of the arms. The external portion of the crystalline lens has a separate origin from the internal portion. The blastoderm of the egg forms the ectoderm; the primitive endoderm takes origin at the periphery of the ectoderm, spreading under and away from it, enclosing the yolk with a layer of large nuclei at its surface to form the perivitelline membrane. The remainder of the endoderm is in great measure transformed into the mesoderm. The primitive endoderm being unable to surround itself with ectoderm to form a gastrula, the definitive endoderm appears rather late in development; a furrow of cells below the hinder part of the mantle in the middle line, derived, like the perivitelline membrane, from the primitive endoderm, gives rise to stomach, liver, and intestine.

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(P. P.)

Molsheim, an ancient town of Germany, in the province of Alsace-Lorraine, known in the 9th century as Molleshem, and formerly the seat of a famous Jesuit college, which in 1701 was removed to and united with the University of Strassburg. It has now manufactures of bayonets, swords, and hardware. Population, 4000.

Moltke, Helmuth Carl Bernhard, Count von (1800–1891), Prussian field-marshal, for thirty years chief of the staff of the Prussian army, the greatest strategist of the latter half of the 19th century, and the creator of the modern method of directing armies in the field, was born 26th October 1800, at Parchim in Mecklenburg, of a German family of ancient nobility. His father in 1805 settled in Holstein and became a Danish subject, but about the same time was impoverished by the burning of his country house and the plunder by the French of his town house in Lübeck, where his wife and children were. Young Moltke therefore grew up in straitened circumstances. At the age of nine he was sent as a boarder to Hohenfelde in Holstein, and at the age of eleven to the cadet school at Copenhagen, being destined for the Danish army and court. In 1818 he became a page to the king of Denmark and second lieutenant in a Danish infantry regiment. But at twenty-one he resolved to enter the Prussian service, in spite of the loss of seniority. He passed the necessary examination with credit, and became second lieutenant in the 8th Infantry Regiment stationed at Frankfort-on-the-Oder. At twenty-three, after much less than the regulation term of service, he was allowed to enter the general war school, now the war academy, where he studied the full three years and passed in 1826 a brilliant final examination. He then for a year had charge of a cadet school at Frankfort-on-the-Oder, after which he was for three years employed on the military survey in Silesia and Posen. In 1832 he was seconded for service on the general staff at Berlin, to which in 1833 on promotion to first lieutenant he was transferred. He was at this time regarded as a brilliant officer by his superiors, and among them by Prince William, then a lieutenant-general, afterwards king and emperor. He was well received at court, and in the best society of Berlin. His tastes inclined him to literature, to historical study and to travel. In 1827 he had published a short romance, *The Two Friends.* In 1831 it was followed by an essay entitled *Holland and Belgium in their Mutual Relations, from their Separation under Philip II. to their Reunion under William I.*, in which were displayed the author's interest in the political issues of the day, and his extensive historical reading. In 1832 appeared *An Account of the Internal Circumstances and Social Conditions of Poland*, a second study of a burning question based both on reading and on personal observation of Polish life and character. In 1832 he contracted to translate Gibbon's *Decline and Fall* into German, for which he was to receive £75, his object being to earn the money to buy a horse. In eighteen months he had finished nine volumes out of twelve, but the publisher failed to produce the book and Moltke never received more than £25, so that the chief reward of his labour was the historical knowledge which he acquired. He had already found opportunities to travel in South Germany and Northern Italy, and in 1835 on his promotion as captain he obtained six months' leave to travel in South-Eastern Europe. After a short stay in Constantinople he was requested by the Sultan to enter the Turkish service, and being duly authorized from Berlin he accepted the offer. He remained two years at Constantinople, learned Turkish and surveyed for the Sultan the city of Constantinople, the Bosphorus, and the Dardanelles. He travelled in the Sultan's retinue through Bulgaria and Rumelia, and made many other journeys on both sides of the Strait. In 1838 he was sent as adviser to the Turkish general commanding the troops in Armenia, who was to carry on a campaign against Mehemet Ali of Egypt. During the summer he made extensive reconnaissances and surveys, riding several thousand miles in the course of his journeys, navigating the dangerous rapids of the Euphrates, and visiting and mapping many districts where no European traveller had preceded him since Xenophon. In 1839 the army moved south to meet the Egyptians, but upon the approach of the enemy the general became more attentive to the prophecies of the mollahs than to the advice of the Prussian captain. Moltke resigned his post of staff officer and took charge of the artillery, which therefore, in the ensuing battle of Nisib, was the last portion of the Turkish army to run away. The Turks were well beaten and their army dispersed to the four winds. Moltke with infinite hardship made his way back to the Black Sea, and thence to Constantinople. His patron Sultan Mahmoud was dead, so he returned to Berlin, where he arrived, broken in health, in December 1839. When he left Berlin in 1834 he had already "the courtier's, soldier's, scholar's eye, tongue, sword." When he returned it was with a mind expanded by a rare experience, and with a character doubly tempered and annealed. While away, he had been a constant letter-writer to his mother and sisters, and he now revised and published his letters as *Letters on Conditions and Events in Turkey in the Years 1835 to 1839.* No other book gives so deep an insight into the character of the Turkish Empire, and no other book of travels better deserves to be regarded as a German classic. One of his sisters had married an English widower named Burt, who had settled in Holstein. Her step-daughter, Mary Burt, had read the traveller's letters, and when he came home as a wooer was quickly won. The marriage took place in 1841, when Mary was just turned sixteen. It was a very happy union, though there were no children, and Moltke's love-letters and letters to his wife are among the most valuable materials for his biography. On his return in 1840 Moltke had been appointed to the staff of the 4th army corps, stationed at Berlin; he was promoted major on his wedding day. The fruits of his Eastern travels were by no means exhausted. He published his maps of Constantinople, of the Bosphorus, and of the Dardanelles, and, jointly with other German travellers, a new map of Asia Minor and a memoir on the geography of that country, as well as a number of periodical essays on various factors in the Eastern Question. In 1845 appeared *The Russo-Turkish Campaign in Europe, 1828–29, described in 1845 by Baron von Moltke, Major in the Prussian Staff*, a volume which was recognized by competent judges as a masterpiece of military history and criticism. Moltke at this period was much occupied with the development of railways. He was one of the first directors of the Hamburg–Berlin railway, and in 1843 published a review article entitled *What Considerations should determine the Choice of the Course of Railways?* which reveals a mastery of the technical questions involved in the construction and working of railway lines.

Field-Marshal von Moltke.
(From a photograph by Loescher and Petsch, Berlin.)

In 1845 Moltke was appointed personal adjutant to Prince Henry of Prussia, a Roman Catholic who lived at Rome. He thus had the opportunity of a long stay in the Eternal City, with no more than nominal duties to perform. It was a life which he and his wife much enjoyed, and he spent much of his leisure in a survey, of which the result was a splendid map of Rome, published at Berlin in 1852. In 1846 Prince Henry died, and Moltke was then appointed to the staff of the 8th army corps at Coblenz. In 1848, after a brief return to the great general staff at Berlin, he became chief of the staff of the 4th army corps, of which the headquarters were then at Magdeburg, where he remained seven years, during which he rose to lieutenant-colonel (1850), and colonel (1851). In 1855 he was appointed first adjutant to Prince Frederick William (afterwards crown prince and emperor), whom he accompanied to England on his betrothal and marriage, as well as to Paris and to St Petersburg to the coronation of Alexander II. of Russia. Prince Frederick William was in command of a regiment stationed at Breslau, and there as his adjutant Moltke remained for a year, becoming major-general in 1856. On the 23rd of October 1857, owing to the serious illness of King Frederick William IV., Prince William became prince regent. Six days later the regent selected Moltke for the then vacant post of chief of the general staff of the army. The appointment was made definitive in January 1858. Moltke's posthumously published military works disclose a remarkable activity, beginning in 1857, devoted to the adaptation of strategical and tactical methods to changes in armament and in means of communication, to the training of staff officers in accordance with the methods thus worked out, to the perfection of the arrangements for the mobilization of the army, and to the study of European politics in connexion with the plans for campaigns which might become necessary. In 1859 came the war in Italy, which occasioned the mobilization of the Prussian army, and as a consequence the reorganization of that army, by which its numerical strength was nearly doubled. The reorganization was the work not of Moltke but of the king, and of Roon, minister of war; but Moltke watched the Italian campaign closely, and wrote a history of it, published in 1862, and attributed on the title-page to the historical division of the Prussian staff, which is the clearest account of the campaign and contains the best criticism upon it. In December 1862 Moltke was asked for an opinion upon the military aspect of the quarrel with Denmark then becoming acute. He thought the difficulty would be to bring the war to an end, as the Danish army would if possible retire to the islands, where, as the Danes had the command of the sea, it could not be attacked. He sketched a plan for turning the flank of the Danish army before the attack upon its position in front of Schleswig, and hoped that by this means its retreat might be intercepted. When the war began in February 1864, Moltke was not sent with the Prussian forces, but kept at Berlin. The plan was mismanaged in the execution, and the Danish army escaped to the fortresses of Düppel and Fredericia, each of which commanded a retreat across a strait on to an island. The allies were now checked; Düppel and Fredericia were besieged by them, Düppel taken by storm, and Fredericia abandoned by the Danes without assault; but the war showed no signs of ending, as the Danish army was safe in the islands of Alsen and Fünen. On the 30th of April Moltke was sent to be chief of the staff to the commander-in-chief of the allied forces, and, so soon as the armistice of May and June was over, persuaded Prince Frederick Charles to attempt to force the passage of the Sundewitt and attack the Danes in the island of Alsen. The landing was effected on the 29th of June, and the Danes then evacuated Alsen. Moltke next proposed a landing in Fünen, but it was unnecessary. The Danes no longer felt safe in their islands, and agreed to the German terms. Moltke's appearance on the scene had quickly transformed the aspect of the war, and his influence with the king had thus acquired a firm basis. Accordingly, when in 1866 the quarrel with Austria came to a head, Moltke's plans were adopted and he was almost invariably supported in their execution. A disciple rather of Clausewitz, whose theory of war was an effort to grasp its conditions, than of Jomini, who expounded a system of rules, Moltke regarded strategy as a practical art of adapting means to ends, and had developed the methods of Napoleon in accordance with the altered conditions. He had been the first to realize the great defensive power of modern firearms, and had inferred from it that an enveloping attack had become more formidable than the attempt to pierce an enemy's front. He had pondered the tactics of Napoleon at Bautzen, when the emperor preferred to bring up Ney's corps, coming from a distance, against the flank of the allies, rather than to unite it with his own force before the battle; he had also drawn a moral from the combined action of the allies at Waterloo. At the same time he had worked out the conditions of the march and supply of an army. Only one army corps could be moved along one road in the same day; to put two or three corps on the same road meant that the rear corps could not be made use of in a battle at the front. Several corps stationed close together in a small area could not be fed for more than a day or two. Accordingly he inferred that the essence of strategy lay in arrangements for the separation of the corps for marching and their concentration in time for battle. In order to make a large army manageable, it must be broken up into separate armies or groups of corps, each group under a commander authorized to regulate its movements and action subject to the instructions of the commander-in-chief as regards the direction and purpose of its operations. In the strategy of 1866 the conspicuous points are: (1) The concentration of effort. There were two groups of enemies, the Austro-Saxon armies, 270,000; and the North and South German armies, 120,000. The Prussian forces were 64,000 short of the adverse total, but Moltke determined to be superior at the decisive point against the Austro-Saxons; he therefore told off 278,000 men for that portion of the struggle, and employed only 48,000 men in Germany proper. His brilliant direction enabled the 48,000 to capture the Hanoverian army in less than a fortnight, and then to attack and drive asunder the South German forces. (2) In dealing with Austro-Saxony the difficulty was to have the Prussian army first ready—no easy matter, as the king would not mobilize until after the Austrians. Moltke's railway knowledge helped him to save time. Five lines of railway led from the various Prussian provinces to a series of points on the southern frontier on the curved line Zeitz–Halle–Görlitz–Schweidnitz. By employing all these railways at once, Moltke had the several army corps moved simultaneously from their peace quarters to points on this curved line. When this first move was finished the corps then marched along the curve to collect into three groups, one near Torgau (Elbe army), another at the west end of Silesia (first army, Prince Frederick Charles), the third between Landshut and Waldenburg (second army, Crown Prince). The first army when formed marched eastwards towards Görlitz. The small Saxon army at Dresden now had the Elbe army in its front and the first army on its right flank, and as it was outnumbered by either of them, its position was untenable, and so soon as hostilities began fell back into Bohemia, where it was joined by an Austrian corps, with which it formed an advance guard far in front of the Austrian main army concentrated near Olmütz. The Elbe army advanced to Dresden, left a garrison there, and moved to the right of Prince Frederick Charles, under whose command it now came. (3) Moltke now had two armies about 100 miles apart. The problem was how to bring them together so as to catch the Austrian army between them like the French at Waterloo between Wellington and Blücher. If, as was thought likely, the Austrians moved upon Breslau, the first and Elbe armies could continue their eastward march to co-operate with the second. But on 15th June Moltke learned that on the 11th of June the Austrian army had been spread out over the country between Wildenschwerdt, Olmütz, and Brünn. He inferred that it could not be concentrated at Josefstadt in less than thirteen days. Accordingly he determined to bring his own two armies together by directing each of them to advance towards Gitschin. He foresaw that the march of the Crown Prince would probably bring him into collision with a portion of the Austrian army; but the Crown Prince had 100,000 men, and it was not likely that the Austrians could have a stronger force than that within reach of him. The order to advance upon Gitschin was issued on the 22nd of June, and led to one of the greatest victories on record. The Austrians marched faster than Moltke expected, and might have opposed the Crown Prince with four or five corps; but Benedek's attention was centred on Prince Frederick Charles, and he interposed against the Crown Prince's advance four corps not under a common command, so that they were beaten in detail, as were also the Saxons and the Austrian corps with them, by Prince Frederick Charles. On the 1st of July Benedek collected his already shaken forces in a defensive position in front of Königgrätz. Moltke's two armies were now within a march of one another and of the enemy. On the 3rd of July they were brought into action, the first against the Austrian front and the second against the Austrian right flank. The Austrian army was completely defeated and the campaign decided, though an advance towards Vienna was needed to bring about the peace upon Prussia's terms. Moltke was not quite satisfied with the battle of Königgrätz. He had tried to have the Elbe army brought up to the Elbe above Königgrätz so as to prevent the Austrian retreat, but its general failed to accomplish this. He also tried to prevent the first army from pushing its attack, hoping in that way to keep the Austrians in their position until retreat should be cut off by the Crown Prince, but he could not restrain the impetuosity of Prince Frederick Charles and of the king. During the negotiations Bismarck, who dared not risk the active intervention of France, opposed the king's wish to annex Saxony and perhaps other territory beyond what was actually taken. Moltke would not have hesitated; he was confident of beating both French and Austrians if the French should intervene, and he submitted to Bismarck his plans in case of need for the opening moves against both French and Austrians.

After the peace, the Prussian Diet voted Moltke the sum of £30,000, with which he bought the estate of Creisau, near Schweidnitz, in Silesia. In 1867 was published *The Campaign of 1866 in Germany*, a history produced under Moltke's personal supervision, and remarkable for its combination of accuracy with reticence. On the 24th of December 1868 Moltke's wife died at Berlin. Her remains were buried in a small chapel erected by Moltke as a mausoleum in the park at Creisau.

In 1870 suddenly came the war with France. The probability of such a war had occupied Moltke's attention almost continuously since 1857, and a series of memoirs is preserved in which from time to time he worked out and recorded his ideas as to the best arrangement of the Prussian or German forces for the opening of the campaign. The arrangements for the transport of the army by railway were annually revised in order to suit the changes in his plans brought about by political conditions and by the growth of the army, as well as by the improvement of the Prussian system of railways. The great successes of 1866 had strengthened Moltke's position, so that when on the 15th of July 1870 the order for the mobilization of the Prussian and South German forces was issued, his plans were adopted without dispute, and five days later he was appointed "Chief of the general staff of the army at the headquarters of his Majesty the King" for the duration of the war. This gave Moltke the right to issue in the king's name, though of course not without his approval, orders which were equivalent to royal commands. Moltke's plan was to assemble the whole army to the south of Mainz, this being the one district in which an army could best secure the defence of the whole frontier. If the French should disregard the neutrality of Belgium and Luxemburg, and advance on the line from Paris to Cologne or any other point on the Lower Rhine, the German army would be able to strike at their flank, while the Rhine itself, with the fortresses of Coblenz, Cologne, and Wesel, would be a serious obstacle in their front. If the French should attempt to invade South Germany, an advance of the Germans up either bank of the Rhine would threaten their communications. Moltke expected that the French would be compelled by the direction of their railways to collect the greater part of their army near Metz, and a smaller portion near Strasburg. The German forces were grouped into three armies: the first of 60,000 men, under Steinmetz, on the Moselle below Treves; the second of 131,000 men, under Prince Frederick Charles, round Homburg, with a reserve of 60,000 men behind it; the third under the Crown Prince, of 130,000 men, at Landau. Three army corps amounting to 100,000 men were not reckoned upon in the first instance, as it was desirable to keep a considerable force in north-eastern Germany, in case Austria should make common cause with France. If, as seemed probable, the French should take the initiative before the German armies were ready, and for that purpose should advance from Metz in the direction of Mainz, Moltke would merely put back a few miles nearer to Mainz the points of debarcation from the railway of the troops of the second army. This measure was actually adopted, though the anticipated French invasion did not take place. Moltke's plan of operations was that the three armies while advancing should make a right wheel, so that the first army on the right would reach the bank of the Moselle opposite Metz, while the second and third armies should push forward, the third army to defeat the French force near Strasburg, and the second to strike the Moselle near Pont-à-Mousson. If the French army should be found during this advance in front of the second army, it would be attacked in front by the second army and in flank by the first or the third or both. If it should be found on or north of the line from Saarburg to Lunéville, it could still be attacked from two sides by the second and third armies in co-operation. The intention of the great right wheel was to attack the principal French army in such a direction as to drive it north and cut its communications with Paris. The fortress of Metz was to be observed, and the main German forces, after defeating the chief French army, to march upon Paris. This plan was carried out in its broad outlines. The battle of Wörth was brought on prematurely, and therefore led, not to the capture of MacMahon's army, which was intended, but only to its total defeat and hasty retreat as far as Châlons. The battle of Spicheren was not intended by Moltke, who wished to keep Bazaine's army on the Saar till he could attack it with the second army in front and the first army on its left flank, while the third army was closing towards its rear. But these unintended or unexpected victories did not disconcert Moltke, who carried out his intended advance to Pont-à-Mousson, there crossed the Moselle with the first and second armies, then faced north and wheeled round, so that the effect of the battle of Gravelotte was to drive Bazaine into the fortress of Metz and cut him off from Paris. Nothing shows Moltke's insight and strength of purpose in a clearer light than his determination to attack on the 18th of August, when many strategists would have thought that, the strategical victory having been gained, a tactical victory was unnecessary. He has been blamed for the last local attack at Gravelotte, in which there was a fruitless heavy loss; but it is now known that this attack was ordered by the king, and Moltke blamed himself for not having used his influence to prevent it. During the night following the battle Moltke made his next decision. He left one army to invest Bazaine and Metz, and set out with the two others to march towards Paris, the more southerly one leading, so that when MacMahon's army should be found the main blow might be delivered from the south and MacMahon driven to the north. On the 25th of August it was found that MacMahon was moving north-east for the relief of Bazaine. The moment Moltke was satisfied of the accuracy of his information, he ordered the German columns to turn their faces north instead of west. MacMahon's right wing was attacked at Beaumont while attempting to cross the Meuse, his advance necessarily abandoned, and his army with difficulty collected at Sedan. Here the two German armies were so brought up as completely to surround the French army, which on the 1st of September was attacked and compelled to raise the white flag. After the capitulation of Sedan, Moltke resumed the advance on Paris, which was surrounded and invested. From this time his strategy is remarkable for its judicious economy of force, for he was wise enough never to attempt more than was practicable with the means at his disposal. The surrender of Metz and of Paris was a question of time, and the problem was, while maintaining the investment, to be able to ward off the attacks of the new French armies levied for the purpose of raising the siege of Paris. Metz surrendered on the 27th of October, and on the 28th of January 1871 an armistice was concluded at Paris by which the garrison became virtually prisoners and the war was ended.

On the 29th of October 1870 Moltke was created Graf (count or earl), and on the 16th of June 1871, field-marshal. After the war he superintended the preparation of its history, which was published between 1874 and 1881 by the great general staff. In 1888 he resigned his post as chief of the staff. In 1867 Moltke was elected to the North German Diet, and in 1871 to the Reichstag. His speeches, dealing mostly with military questions, were regarded as models of conciseness and relevancy. He died suddenly on the 24th of April 1891, and after a magnificent funeral ceremony at Berlin his remains were laid beside those of his wife in the chapel which he had erected as her tomb at Creisau.

As a strategist Moltke cannot be estimated by comparison with Frederick or Napoleon, because he had not the authority either of a king or of a commander-in-chief. While it is doubtful whether he can be convicted of any strategical errors, it seems beyond doubt that he never had to face a situation which placed any strain on his powers, for in the campaigns of 1866 and 1870 his decisions seemed to be made without the slightest effort, and he was never at a loss.

He had a tall spare figure, and in his latter years his tanned features had received a set expression which was at once hard and grand. He was habitually taciturn and reserved, though a most accomplished linguist, so that it was said of him that he was "silent in seven languages." The stern school of his early life had given him a rare self-control, so that no indiscreet or unkind expression is known to have ever fallen from him. Long before his name was on the lips of the public he was known in the army and in the staff as the "man of gold," the ideal character whom every one admired and who had no enemies.

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(H. S. W.)

Molton, South, municipal borough, and ancient market-town in the South Molton parliamentary division of Devonshire, England, 12 miles east-south-east of Barnstaple by rail, on the river Mole. There are a shirt and collar factory, and numerous corn mills, all worked by the river. The gasworks belong to the corporation. Population (1881), 3340; (1901), 2848, the area having been altered between 1891 and 1901.

Moluccas, groups of islands lying between Celebes on the west and New Guinea on the east, in the Malay Archipelago (*q.v.*), between 2° 43′ N. and 8° 23′ S. and 124° 22′ and 135° E., with an area, inclusive of Dutch or Western New Guinea, of about 160,000 square miles. Since 1867, when the political unity, under a governor, was dissolved, the Moluccas are often named by the Dutch the "Great East" (*Groote Oost*). Politically they now belong to the residencies of Amboyna and Ternate. Most of the islands are mountainous, with still active volcanoes. As they lie near or under the equator, the monsoons blowing over them are less regular, and the rainfall, of large volume throughout the year, is dependent on the height and direction of the chains. The vegetation of the small and narrow islands, all encompassed by the sea, is very luxuriant, and the products, principally nutmegs, mace, and other spices, include also rice and sago. The original inhabitants, Alfuros, have become mixed with the traders and colonists of later times—the Makassars, Buginese, Javanese, and Europeans. See CELEBES, SERANG, TERNATE, TIDOR, TIMOR, NEW GUINEA (DUTCH).

Mombasa, a seaport town and the administrative capital of British East Africa (East African Protectorate), on the east side of a small island of the same name, close to the coast, in 4° S. It has two good harbours; one, Kilindini, is a naval depôt. Its total trade in 1901 amounted to £423,000, of which £348,600 were imports and £74,400 exports. These last consist principally of ivory, copra, hides, and rubber. Population, about 27,000. See EAST AFRICA, BRITISH.

Momein, the Burmese name of the Chinese city Teng Yueh-chow, a town in the south-west of the province of Yunnan, China. It was opened to foreign trade by the Burmese convention of 1897, but so far no advantage has been taken of the permission. It lies close to the Burmese frontier, and on the old trade route from Bhamo to Yunnan, but its importance as an outpost of the British empire is political rather than commercial. Near Momein and within its jurisdiction is the frontier town of Manwyne, where Mr A. R. Margary, a member of H.B.M. consular service, was assassinated in January 1875 (*vide* CHINA).

Mommsen, Theodor (1817-——), German historian, was born on 30th November 1817, at Garding, in Schleswig, where his father was the pastor; he was the eldest of three brothers (the others being August and Tycho), who earned distinction in scholarship. After being educated in the gymnasium at Altona and the University of Kiel, he devoted himself to the study of Roman law and antiquities. In 1839 he published, with his brother Tycho and another friend, a short collection of poems of no great merit. In 1843 a grant from the Danish Government enabled him to undertake a journey to Italy, which was to be as decisive for his future career as was the Italian journey of Goethe or of Ranke. There he began the study of Roman inscriptions, in association with other Italian and German scholars, especially Borghesi, de Rossi, and Henzen. His first work was directed to the restoration of the old Italian dialects. It was a time when the necessity for compiling a complete collection of all extant Roman inscriptions was becoming pressing. Mommsen's work attracted attention, and the French Government, which at one time proposed to undertake the task, asked for his co-operation. When they gave up the project it was taken up by the Berlin Academy, which had recently completed the collection of Greek inscriptions edited by Boeckh. They had already made a grant to Mommsen, and in 1844 Savigny proposed that he should be appointed to carry out the great work. The Academy, however, feared the expense, and there were rival claimants, especially Zumpt; many years accordingly passed before the plan was finally approved. Meanwhile Mommsen continued his work in Italy: he drew up a full memorandum explaining the principles on which a *Corpus Inscriptionum* should be compiled, and on which alone he could undertake the editorship; he insisted that it should be based on a fresh examination of every stone, and not a mere compilation from existing collections. As a specimen he collected the inscriptions of Samnium, and in 1852 published the inscriptions of the kingdom of Naples. These works caused him to be recognized as the first authority in this field of learning. In 1847, however, he was obliged to return to Germany: he first went to Schleswig, where during the Revolution he edited a paper in which he supported the claims of the Elbe Duchies; at the end of 1848 he was appointed professor of civil law at Leipzig. His work there was interrupted by his political opinions. During 1848, when the extreme party was in the ascendant, Mommsen supported the monarchy against the Republicans. With characteristic courage and independence, next year, when the Revolution had spent its force and Beust executed his *coup d'état*, he protested, with many of his colleagues, against this act, but was summoned before a disciplinary court, and, together with Haupt and Jahn, two of the other most distinguished scholars of that generation, to whom his *Roman History* was afterwards dedicated, he was dismissed from his professorship.

Like many other Germans, Mommsen found an asylum in Switzerland, and became professor at Zürich: he repaid the hospitality of the Republic by writing exhaustive monographs on Roman Switzerland. His spare time was occupied with the *Roman History*, undertaken at the suggestion of a publisher, whose daughter he married. The three volumes appeared between 1854 and 1856. His name at once became known throughout Europe. It was a new thing in Germany for a great scholar to write a book which men who were not scholars would read. The fruits of profoundest learning were given without display of erudition. With a true insight into the relative importance of things, he passed over with a few strong broad touches the antiquarian discussions on the origins of the city, on which previous historians had laboured so long; but in place of this he painted with astonishing vigour the great political struggle that accompanied the fall of the Republic. It was, above all, his new reading of old characters which demanded attention, if not always approval: Cicero, the favourite of men of letters, was for him "a journalist in the worst sense of the word"; Pompey, the hero of Plutarch and the Moralists, was brushed aside as a mere drill-sergeant; and the book culminated in the picture of Cæsar, who established absolute rule in the name of democracy, "the complete and perfect man." The work had more than a mere literary interest; it was one of the numerous influences which awoke in the rising generation the feeling that what Germany wanted was not theories and principles of government, but power and efficiency. But he always disclaimed the belief that in his panegyric of Cæsar he was thinking of and recommending the new Cæsarism of Napoleon III.

The three volumes ended with the dictatorship of Cæsar. The book has never been continued, for the volume on the *Roman Provinces under the Empire*, which appeared in 1884, though nominally the fourth volume of the history, is in reality a separate work. Mommsen was henceforward fully occupied with work of a more technical nature. In 1854 the definite offer was made to him by the Academy that he should be chief editor of a *Corpus Inscriptionum*, with full control. In order that he might carry on the work, he was appointed to a professorship at Berlin (for two years he had already been at Breslau), and for over forty years he was occupied in producing this great work. The first volume appeared in 1861, followed by sixteen others; and Mommsen lived to see his task completed so far as work of this kind ever can be complete. Five of the volumes he edited himself, and the whole was executed according to his instructions, under his immediate supervision and co-operation to a great extent, by scholars whom he had himself trained. It is the finest example of that association in learning which he made the text of one of his addresses to the Academy.

Enormous as was the labour, this task occupied only a small part of his extraordinary intellectual energy. During these forty years he found time to write two larger works, the *History of the Roman Coinage* and the *Römisches Staatsrecht*, a profound analysis of Roman constitutional law. His *Roman Provinces* already mentioned gives a singularly interesting picture of certain aspects of social life under the Empire. His smaller papers amount to many hundreds in number, and there is no department of Roman life and learning, from the earliest records of the Roman law to the time of Jornandes, which he has not illuminated. Nor did this exhaust his activity. He has himself realized the ideal of a scholar which was in his mind when he said, "Each one must specialize in one branch of learning, but not shut himself up in it. How miserable and small is the world in the eyes of the man who sees in it only Greek and Latin authors or mathematical problems!" As secretary to the Berlin Academy for over twenty years he took a leading part in their deliberations, and was their spokesman on great occasions. His interest in political problems of the present was as keen as in those of the past. He was one of the founders of the *Preussische Jahrbücher*, the most influential of German political periodicals. For many years he was a member of the Prussian Parliament. His political opinions were strong but ill-regulated. Intensely nationalist, he acquiesced in the annexation of his native land to Prussia, and in a public letter to the Italian nation in 1870 defended the German cause before the nation which had become to him a second fatherland; but he was of too independent a character ever to be quite at ease under Prussian government. Loving liberty, he hated its consequences; a democrat, he had and always expressed a profound contempt for the mob. Like many idealists, he was a severe critic of the faults of his own and other countries, and he added something to the increasing Chauvinism in Germany. He was one of the few men in high position who always refused to bow the knee to Bismarck. A member of the Freisinnige party, he was even brought to trial in 1880 because in an election address he had used the expression "Politik von Schwindel" of the Government. He defended himself, and was acquitted.

It was, however, above all, German scholarship which remained his first interest. There is probably no other instance in the history of scholarship in which one man has established so complete an ascendancy in a great department of learning. Equally great as antiquary, jurist, political and social historian, he lived to see the time when among students of Roman history he had pupils, followers, critics, but no rivals. He combined the power of patient and minute investigation with a singular faculty for bold generalization and the capacity for tracing out the effects of thoughts and ideas on political and social life. Partly, perhaps, owing to a philosophical and legal training, he had not the gift of clear and simple narrative, and he is more successful in discussing the connexion between events than in describing the events themselves. Though his *History* ends with the fall of the Republic, his most enduring work has been that on the Empire; and if he has not written the history of the Empire, he has made it possible for others to do so.

The *History of Rome* (including the volumes on the Provinces) has been translated into English; there is a French edition of his work on *Roman Coinage*. Many of his pamphlets and articles have been collected under the title *Römische Forschungen*. Of his other works, the more important are the *Roman Chronology to the Time of Cæsar* (1858), a work written in conjunction with his brother August; his editions of the *Monumentum Ancyranum* and of the *Digest* in the *Corpus Juris Civilis*. A great part of his work is to be found in the German learned publications such as *Hermes*, *Rheinisches Museum*, &c. A full list of his works is given by Zangemeister, *Mommsen als Schriftsteller* (1887).

Monaco, the smallest sovereign principality of Europe, on the Mediterranean, 9 miles east of Nice, and surrounded by the French Alpes Maritimes, with an area of about 3 square miles and a population of (1890) 13,304. It includes the towns of Monaco (3292), Condamine (6218), and Monte Carlo (3794). The principality at one time included Mentone and Roccabruna, now known as Roquebrune, which towns, however, were ceded to France in 1861 for a sum of four million francs. The ruler of the principality, Prince Albert, born 1848, succeeded his father, Prince Charles III., in 1889. He married in 1869 Lady Mary Douglas Hamilton, by whom in 1870 he had a son, Prince Louis: that marriage was, however, annulled in 1880, and subsequently Prince Albert married Alice, dowager-duchess of Richelieu.

Monte Carlo.

The interest of the principality centres in the Casino of Monte Carlo, which is visited by thousands of people from every part of the world; but the natural attractions of the place are sufficiently great, apart from its connexion with gambling. It is a common experience for travellers to Monte Carlo to leave England shrouded in snow, and in well under twenty-four hours to find themselves beneath a cloudless blue sky, in a climate which makes the shade welcome, surrounded by summer foliage and flowers. The journey, or at least the latter part of it, has also charms of its own. It is customary to leave Paris in the evening, the trains being provided with *wagon-lits* and *lit-salons*, which afford as comfortable sleeping accommodation as can be procured on the ill-laid Paris, Lyons and Mediterranean line. Marseilles is reached in the morning, and the first glimpse of the Mediterranean obtained, thence nearly to St Raphaël the line is mostly inland, but afterwards it runs by the sea, past singularly beautiful coast scenery. Numberless tiny bays indent the shore; into them the blue waters of the tideless sea ripple gently, or if there be any wind the waves break in snowy showers against the jagged rocks. From the left-hand window of the carriage endless acres of olive-trees covering the valleys at the foot of the hills are to be seen; the yellow flower of the mimosa brightens the picture, as do the orange-trees, the rich fruit of which peeps through the dark green leaves; palms, aloes, cacti, and other tropical plants are frequent. On some of the hill-tops are forts which suggest watchfulness and vigour in restraint. Cannes and Antibes are passed, Nice at length is reached, and passing through a number of tunnels, which make the glimpses of the shore all the brighter, the train runs through Monaco to Monte Carlo.

Gambling concession.

There appear to have been some gambling-tables here in the year 1856, but it was in 1861 that M. Blanc, seeing his tenancy at Homburg coming to an end with no hope of renewal, obtained a concession for fifty years from Charles III. This concession passed into the hands of a joint-stock company, which in 1898 obtained an extension to 1947, in return for a payment to the prince of £400,000 in 1899 and of £600,000 in 1913, together with an increase of the annual tribute of £50,000 to £70,000 in 1907, £80,000 in 1917, £90,000 in 1927, and £100,000 in 1937.

The Casino.

M. Blanc was a man who did nothing by halves. He set to work to build the Salons des Jeux, the famous—or infamous—Casino, and began to devise means to attract wealthy pleasure-seekers from all countries to the little principality. He erected the Hôtel de Paris, a notably fine structure in comparison with the hotels of the period; the best available chefs were employed, a dinner at least equal to that obtainable at the leading Paris restaurants was here to be had for a tenth of the amount it would there have cost; wines of the best vintages were to be procured at cost price or under; beautiful gardens were laid out and assiduously tended; attached to the Casino was a concert-room, where an admirable orchestra of carefully-selected musicians could be heard without payment by those who cared to stroll in and take a seat. The comfort and convenience of visitors were considered in every possible way, the shrewd administrator knowing that his outlay would come back to him with interest from the tables. Other hotels rapidly sprang up, handsomely served and appointed; sumptuous villas were built; in the Salons des Jeux tables were added, and now the twelve devoted to roulette and the four to trente-et-quarante are found insufficient, for at the busiest hours of the afternoon—play begins at mid-day, and continues till eleven o'clock in the evening—a crowd four or five deep prevents many who are anxious to tempt fortune from approaching near enough to stake. The pressure has been somewhat relieved latterly by the establishment upstairs of a *cercle privée*, where the games are continued till long past midnight under the same conditions as downstairs, except that visitors are here allowed to smoke, tobacco and the wearing of hats being interdicted in the lower room.

Admission to the salon is obtained by ticket. Turning to the left on entering the Casino, the would-be player finds a number of clerks seated in a small room. He presents his visiting card, and is furnished with a *carte d'admission*, making him free of the Cercle des Etrangers de Monaco for one day; but if he desires an extension it is afterwards readily obtainable. On the back of the carte it is stated that "Une tenue de ville convenable est indispensable pour obtenir l'entrée dans les salons," and the applicant is warned that "Cette carte ne peut être délivrée que sur la production de pièces d'identité sérieuses," as also that "Cette carte doit être présentée pour l'entrée dans les salons et peut être retirée." The holder's signature and that of *le commissaire spéciale* complete the business. Entering the rooms at any hour, play is sure to be found in progress. Early in the day not all the tables are occupied, though on the other hand many persons who have been keen to begin have waited in the capacious atrium for the opening of the doors, in order that they might rush to secure their favourite places. Liveried attendants stand about, furnished with ruled cards, on which some players like to keep records of the numbers which have turned up; and these servants will also supply large pins, for at trente-et-quarante it is a favourite custom to score by means of pricks. At the newspaper kiosks in the gardens round the Casino, and at shops in the town, all sorts of brochures giving details of various systems of play can be procured, together with diagrams of the tables and all sorts of information about the methods in vogue.

Methods of play.

Under the heads of ROULETTE and TRENTE-ET-QUARANTE these games are elsewhere described; it will suffice here to remark that by no system can success by any possibility be assured, for the simple reason that at both games, but much more especially at roulette, there is a steady percentage in favour of the bank which must inevitably tell in its favour in the long run. There are thirty-seven numbers on the roulette board, including zero; the table pays only thirty-five times the player's stake on the winning number, so that practically from every coin won something is deducted. As a rule, however, players are not satisfied with one stake. The ways in which the *mise* can be placed are almost innumerable, and if players stake on different numbers and combinations, so much more does the bank secure. There are various systems which frequently bring profit for a time, though on the other hand they may be defeated at the first attempt, and subsequently day after day; but if the player were to stake blindfold he would have just as good a chance of winning as he can have by any method of calculation. Sometimes when *rouge, pair*, or *manque* has turned up several times players will stake on them again because of the "run"; sometimes, on the contrary, they will stake on the opposites, *noir, impair*, and *passe*, because it seems the turn of those to come up. In truth there are no turns, and one way is just as sensible or as foolish as the other. In these days of multi-millionaires it might seem to the uninitiated that force of money, if some system of gradual increase were adopted, would in time defeat the bank; but here the bank protects itself by limiting the stakes to various maximums, beyond which it is not permissible to wager. On this subject an instructive little anecdote may perhaps be related. One morning on the terrace by the Casino overlooking the sea a visitor was in conversation with an old croupier, and made mention of a system that had been recommended. The old man shook his head. "There are more than 150 of us croupiers employed in that building, sir," he said; "we sit there and watch the game hour after hour, week after week, year after year. Some of us are not fools. Do you not think that if any successful system existed, one of us would have found it out before now?" At trente-et-quarante many players are accustomed to follow "the run of the table," as it is termed—that is to say, to wager on the colour which last won; but there is of course no foundation for the idea that runs of colour are more likely to happen than intermittences. Very often nearly all the coins and banknotes will be on one side, either on red or black, and very often therefore the bank makes a rich haul with little or nothing to pay. The morality of gambling is not here in question; the folly of it is surely evident. The only point is whether the gambler derives from playing what he considers sufficient amusement to recompense him for the money he loses.

The natural beauties of Monte Carlo, and the warm climate so comparatively near to places where more rigorous temperatures are the rule, might well tempt visitors to the principality. A very special temptation, however, is the luxury which prevails, apart from those beauties which nature has provided. The whole district for miles round has benefited by the influx of wealth, and travellers on the roads beyond Bordighera cannot fail to be struck by the comparative squalor of the surroundings in contrast

Environs of Monte Carlo.

with the charming villas, superb gardens, well-provided shops, and perfect roads which distinguish Monte Carlo and the neighbourhood. Concerts are no longer free in the Casino. The room has been turned into a theatre, where operatic performances, supported by the best singers, are given during the season. A Salon des Beaux Arts has been built, and pictures of more or less merit are always on exhibition. Here, too, theatrical representations sometimes take place in the afternoons. Indoor entertainments are not likely to receive much patronage when the days are fine; but those who have visited Monte Carlo on only a few occasions, and have been fortunate in their weather, would be surprised to find how bleak and wet the sunny south can sometimes be. Deep snow on the racecourse at Nice once actually led to the abandonment of the steeplechases that annually take place there and are a feature of the season, and more than once they have been interfered with by frost; though whenever this happens the residents, jealous for the reputation of their town, will declare that such a thing was never known before in the memory of the oldest inhabitant. Rainy weather causes grave dismay at Monte Carlo, and with regard to climate it may be noted that genial as is the sun during the day, the evenings are often treacherous and chilly. A favourite pastime is a drive to Nice, which enables one to enjoy the beautiful coast scenery in more leisurely fashion than when viewing it during the more rapid railway journey. Off Beaulieu, and in the picturesque harbour of Villefranche, yachts are often anchored, and in the latter not seldom French men-of-war. Long since the district appealed to Lord Salisbury, whose villa on the hillside above Beaulieu became one of the landmarks of the district. On the east of Monte Carlo lies Mentone, some five miles away along a road which winds round the bays, and within a long drive farther on, past Ventimiglia and Bordighera, are the frontiers of Italy, with the picturesque old town of San Remo accessible for well-horsed carriages or motors. Travellers who propose to make the journey thitherwards by rail from Monte Carlo will do well to remember the great difference between French and Italian time, for French time is adopted in the principality, though in some respects the prince maintains the integrity of his own little land. Thus Monte Carlo issues its own postage stamps; and one coin, a handsome five-louis gold piece, bears the prince's effigy, and may perhaps be described as only current in his abbreviated dominion, for even at Nice not a few of the shopkeepers look at it with curiosity and doubt.

A particularly agreeable walk from Monte Carlo is down the hill by the Condamine, and round the rock of Monaco, upon which the prince's palace, part of which dates from 1572, and the administrative buildings, are erected. The rock was fortified by Louis XIV., and some quaint old cannon, with piles of round iron cannon-balls, are supposed to guard the fortress. A portion of the wealth which flows into the little country has been devoted to the building of a beautiful church here. The path winds down, high up above the Mediterranean, through well-kept gardens, until turning the corner Monte Carlo is seen across the bay, with the Casino prominent, and near to it the little semicircular patch of green upon which pigeon-shooting is practised during several weeks of the season. Looking to the right Corsica may usually be discerned. The bay has been described as a favourite anchorage for English and other yachts, but this statement must be accepted with reservations, as when certain winds prevail an ugly sea is frequently raised, rendering the harbour dangerous. Plans for the construction of a breakwater have been mooted. Beyond and behind Monte Carlo rises the mountain, with its olive-clad slopes and carefully cultivated terraces, at the top of which, on the old Cornice road, is situated the village of La Turbie, and this may now be reached by a cog-wheeled mountain railway. Trains run at frequent intervals during the day. (A. E. T. W.)

Monaghan, an inland county of Ireland, province of Ulster. The area of the administrative county in 1900 was 318,806 acres, of which 113,311 were tillage, 169,112 pasture, 450 fallow, 4291 plantation, 5646 turf bog, 1184 marsh, 1514 barren mountain, and 23,298 water, roads, fences, &c. The new administrative county under the Local Government (Ireland) Act, 1898, is identical with the old judicial county.

The population in 1881 was 102,748; in 1891, 86,206; and in 1901, 74,505, of whom 37,034 were males and 37,471 females, divided as follows among the different religions: Roman Catholics, 54,708; Protestant Episcopalians 9532; Presbyterians, 9515; Methodists, 407; and other denominations, 343. The decrease of population between 1881 and 1891 was 16·1 per cent., and between 1891 and 1901, 13·6, the largest decrease in both decades of any county in Ireland. The average number of persons to an acre in 1891 was ·27, and of the total population, 81,236 persons inhabited the rural districts, being an average of 183 persons to each square mile under crops and pasture.

The following table gives the degree of education in 1891:—

	Males.	Females.	Total.	Percentage.			
				R. C.	Pr.Ep.	Presb.	Meth.
Read and write	27,011	25,586	52,597	60·9	79·4	86·4	91·7
Read only	4,955	7,107	12,062	17·2	12·1	8·7	4·6
Illiterate .	6,927	7,092	14,019	21·9	8·5	4·9	3·7

The percentage of illiterates among Roman Catholics in 1881 was 28·1. In 1891 there were 7 superior schools with 178 pupils (Roman Catholics, 111, and Protestants, 67), and 188 primary schools with 12,236 pupils (Roman Catholics, 8633, and Protestants, 3603). The number of pupils on the rolls of the national schools on 31st December 1900 was 12,460, of whom 8959 were Roman Catholics and 3501 Protestants. The following table gives the number of births, deaths, and marriages in the years specified:—

Year.	Births.	Deaths.	Marriages.
1881	2379	1779	391
1891	1598	1486	349
1900	1410	1567	334

In 1900 the birth-rate per thousand was 18·9, and the death-rate 21·0; the rate of illegitimacy was 2·5 per cent. of the total births. The total number of emigrants who left the county between 1st May 1851 and 31st December 1900 was 73,825, of whom 38,404 were males and 35,421 females. The chief towns in the county, with their populations in 1901, are: Monaghan, 2938; Clones, 2065; Carrickmacross, 1880.

Administration.—The county is divided into two parliamentary divisions, North and South, the number of registered electors in 1901 being respectively 6863 and 6765. The rateable value in 1900 was £274,904. By the Local Government (Ireland) Act, 1898, the fiscal and administrative duties of the grand jury were transferred to a county council, urban and rural district councils were established, and under that Act the county now comprises 4 urban and 7 rural sanitary districts.

Agriculture.—The following tables show the acreage under

"L'Église de Vétheuil.' By Claude Monet.

(In the Luxembourg Gallery)

crops, including meadow and clover, and the amount of live stock in 1881, 1891, 1895, and 1900 :—

Year.	Wheat.	Oats.	Barley, Rye, Beans, &c.	Potatoes.	Turnips.	Other Green Crops.	Flax.	Meadow and Clover.	Total.
1881	1049	55,964	2298	21,328	7877	1865	15,688	32,154	138,223
1891	935	46,046	1236	21,960	7422	2270	6,913	38,260	125,042
1895	446	45,504	712	21,427	7849	2112	9,214	42,215	129,479
1900	506	42,481	895	19,065	7085	2142	2,085	39,112	118,321

In 1900 the total value of the cereal and other crops was estimated at £632,197. The number of acres under pasture in 1881 was 140,532 ; in 1891, 158,840, and in 1900, 169,112.

Year.	Horses and Mules.	Asses.	Cattle.	Sheep.	Pigs.	Goats.	Poultry.
1881	11,071	3571	70,282	11,313	19,965	12,305	440,803
1891	12,721	4210	86,184	21,378	36,225	14,339	517,518
1895	14,139	4350	85,294	16,220	34,795	13,086	561,411
1900	12,466	4568	90,387	17,758	34,001	13,128	700,152

The number of milch cows in 1891 was 30,940, and in 1900, 31,151. The total value of cattle, sheep, and pigs for 1900 was £1,203,382. In 1900 the number of holdings not exceeding 1 acre was 855 ; between 1 and 5, 1888 ; between 5 and 15, 7366 ; between 15 and 30, 4941 ; between 30 and 50, 1560 ; between 50 and 100, 530 ; between 100 and 200, 114 ; between 200 and 500, 22, and above 500, 4—total, 17,280. The number of loans issued (the number of loans being the same as the number of tenants) under the Land Purchase Acts 1885, 1891, and 1896, up to 31st March 1901, was 2642, amounting to £613,016. The number of loans for agricultural improvements sanctioned under sect. 31 of the Land Act, 1881, between 1882 and 1901 was 113, and the amount issued, £6317. The total amount issued on loan for all classes of works under the Land Improvement Acts, from the commencement of operations in 1847 to 31st March 1901, was £46,750. (W. H. PO.)

Monastir, the second city of Macedonia, and the capital of the vilayet of Monastir in European Turkey, situated in a valley watered by the Kara Su, an affluent of the Vardar, and on the Salonica–Monastir railway, 400 miles west of Constantinople. The chief exports are cereals, flour, hides, woollen stuffs, and bones. The total value of the exports in 1899 was £71,000 and of the imports £299,500. The city is the headquarters of the third army corps, and possesses nine mosques, a military hospital, a school of art and science, &c. Population, 60,000.

Monchique, a town of Portugal, in the district of Faro, 40 miles north-west from Faro, on the Serra de Monchique. Three miles south of the town there are hot sulphur springs, with baths and a sanatorium. Wheat, millet, rye, beans, vegetables, wine, olive oil, and chestnuts are the chief products, and there is a woollen factory. Population, about 7000.

Moncton, a city and port of entry in Westmoreland county, New Brunswick, the centre of the Intercolonial railway. It has a good harbour, good municipal buildings and schools, nine churches, three banks, and two daily newspapers; an iron foundry, cotton, woollen, and flour mills, and other industries. In 1901 the value of the exports was $591,523; imports, $495,688. Population (1891), 8762; (1901), 9026.

Mondovi, a town and episcopal see of the province of Cuneo, Piedmont, Italy, 14 miles by rail east of Cuneo. It has a school of the industrial arts and handicrafts, manufactures majolica and paper, and raises cocoons. Population (1881), 10,302; (1899), 9000. About 2 miles to the east the sanctuary of Vico, a church designed by Ascanio Vittozzi in 1590, and crowned by a famous dome (1730–48), has been declared a national monument. In the square before it is a monument (1891) to Charles Emmanuel I. of Savoy.

Monet, Claude (1840- ——), French painter, was born in Paris 14th November 1840. His youth was passed at Hâvre, where his father had settled in 1845. Until he was fifteen years old he led a somewhat irregular life, learning little at school, and spending all his time in decorating his books with drawings and caricatures which gave him notoriety in Hâvre. At the same time he became acquainted with Boudin, a clever sea-painter, under whose guidance he learned to love and to understand nature. At the age of twenty he became a soldier, and spent two years of his military time with the regiment of the Chasseurs d'Afrique in the desert. Falling ill with fever, he was sent home, and entered the studio of Gleyre. This classical painter tried in vain to keep him to conventional art and away from truth and nature, and Monet left his studio, where he had become acquainted with two other "impressionistic" painters, Sisley and Renoir. At that time he also knew Manet (*q.v.*) and in 1869 he joined the group of Cézanne, Degas, Duranty, Sisley, and became a *plein air* (open-air) painter. During the war of 1870 he withdrew to England, and on his return was introduced by Daubigny to a dealer, M. Durand-Ruel, in whose galleries almost all his works have been exhibited. In 1872 he exhibited views of Argenteuil, near Paris; in 1874 a series entitled "Cathedrals," showing the Cathedral of Rouen under different lights. He afterwards painted views of Vétheuil (1875, see Plate), Pourville and cliffs of Étretat (1881), of Bordighera (1886), of the Creuse (1889), Le Meules (1891), and some further views of cathedrals (1894). In December 1900 he exhibited some pictures called "Le Bassin des Nymphéas," and was engaged at the beginning of 1901 in painting views of London. Several of Monet's paintings, bequeathed by M. Caillebotte, are in the Luxembourg Museum, Paris. (See also IMPRESSIONISM.)

See GUSTAVE GEFFROY. *La Vie Artistique (passim).*—J. VAN DYKE (Ed.). *Modern French Masters.* London, 1896.

Monforte, a township of Spain, in the province of Lugo, on the railway from Palencia to Corunna. The population in 1897 was 12,664. In the old part of the town there are a tower, belonging to the Counts of Leon; a hospital, in an old convent; the church of San Vicente, a handsome Renaissance structure; and a palace of the Counts of Leon. The new part of the town contains a fine Jesuit college. Monforte has several convents and an ancient synagogue. The local industries are the manufactures of linen and soap, saw-milling, and live stock rearing.

Monghyr, a town and district of British India, in the Bhagalpur division of Bengal. The town is on the right bank of the Ganges, and has a railway station, with steam ferry to the railway on the opposite bank of the river. Population (1881), 55,372; (1891), 57,077; (1901), 35,883, a decrease of 37·1 per cent. between 1891 and 1901. Cheap firearms, swords, and other iron articles are still manufactured. The high school had 302 pupils in 1896–97. There are two printing-presses, and Mahommedan, Hindu, and bar associations.

The district of MONGHYR has an area of 3921 square miles; population (1881), 1,969,950; (1891), 2,036,021; (1901), 2,064,077, showing an increase of 3 per cent. between 1881 and 1891, and of 1·4 per cent. between 1891 and 1901; average density, 526 persons per square mile. Classified according to religion, Hindus in 1891 numbered 1,839,159; Mahommedans, 191,770; Christians, 1324, of whom 592 were Europeans; aborigines, 3768. The land revenue and rates in 1897–98 were Rs.10,36,442; number of police, 487; number of boys at school (1896–97), 28,308, being 19 per cent. of the male population of school-going age; registered death-rate (1897), 32·65 per thousand. The principal industry is indigo. There are eleven factories, employing 12,000 persons, with an out-turn of 3000 maunds valued at Rs.3,61,000. The southern portion of the district is well provided with railways. At

Lakhisarai junction the arc and chord lines of the East Indian railway divide, and here also starts the branch to Gaya. At Jamalpur, which is the junction for Monghyr, are the engineering workshops of the company.

Möng Nai (called by the Burmese and on most old maps *Monè*), one of the largest and most important of the states in the eastern subdivision of the southern Shan States of Burma. The state of Kēng Tawng (Burmese Kyaing Taung) is a dependency of Möng Nai. It lies approximately between 20° 10′ and 21° N. and between 97° 30′ and 98° 45′ E., and occupies an area of 2716 square miles. The Salween river bounds it on the east. The main state and the sub-state of Kēng Tawng consist of two plains with a ridge between them. There is much flat paddy bottom, but a considerable portion consists of gently undulating plainland. In 1891 the population was estimated at 18,600 persons, and with Kēng Tawng 21,170; in 1897, 23,673. In the central plain rice is the only crop. Outside this considerable quantities of sugar are produced. Tobacco of a quality highly esteemed by the Shans is grown in the Nawng Wawp circle at an altitude of 3100 feet above sea level; gram, *thanatpet* (a leaf used for cigar wrappers), and garden crops are the chief produce otherwise. In the outlying districts quantities of coarse native paper are manufactured from the bark of a species of mulberry, and much is exported to other parts of the Shan States. This is almost the only thing the state has to export, and the bullock caravans, which are fairly numerous, are chiefly engaged in a carrying trade with the produce of other states, bringing cotton and silk piece goods, salt, kerosene oil, and the like up from Mandalay or Toungoo.

Under King Thibaw the Möng Nai state was reduced to a terrible state of desolation, from which it is only slowly recovering. Möng Nai, the capital, was the seat of the chief Burmese official in the Shan States, and the remains of pagodas and monasteries point to past wealth. There were not fifty houses when the Sawbwa made his submission to the British Government in 1887. The number had grown to 800 in 1898, when a fire destroyed the whole town, but the bamboo and thatch houses were rebuilt within a few months. There is an American Baptist Mission school and dispensary in the town. The political officer in charge of the eastern division now has his headquarters at Bampôn, a village ten miles west of Möng Nai town, with a post of 75 rifles. MÖNG NAI town stands on the western edge of a valley about 12 miles long with an average width of 3 miles, 5 at the town, where there are two lakes. The annual tribute paid by the state is Rs.18,000. The Sawbwa has visited Rangoon, Gaya in India, and Ceylon on pious pilgrimages. (J. G. SC.)

Mongolia, a vast territory belonging to the Chinese Empire, the administrative limits of which cannot be determined with precision. On the north it is bounded by the frontier of Russia, beginning at Mount Kalas or Kanas (49° 5′ N. and 87° 40′ E.) in the Altai, and running to the south-east corner of Transbaikalia in the vicinity of Dalai-nor, thus having on the north the Siberian provinces of Tomsk, Yeniseisk, Irkutsk, and Transbaikalia. In the east the boundary line which separates Mongolia from Manchuria runs past Dalai-nor and Lake Buir, crossing the Great Khingan in 47° 30′ N. towards Tsitsihar in Manchuria; then, crossing the Nonni river, it strikes the Sungari at Khulan-chen, where it turns westwards up this river, reaching the Lao-ho or Shara-muren river in 123° 30′ E. From China proper on the south Mongolia is separated by a line running in a south-westward direction up the Shara-muren and across the Mongolian plateau to the bending of the Hoang-ho or Yellow river in about 40° N. and 110° 30′ E. Thence the boundary describes a sinuous line, following the Great Wall, and thus includes the Ordos (Ho-tao) and Alashañ (Si-tao), and reaches its most southern point in 36° 40′ N. and 104° 20′ E. Thence it turns north-west, following the Great Wall for over 300 miles; it then crosses the plateau so as to separate Mongolia from the Chinese province of Hañ-su-sin-tsian (which includes the Nan-shan highlands and eastern Turkestan) and from Dzungaria, reaching the Chinese or Ektag Altai in 46° 30′ N. and 92° 50′ E. From that point the boundary coincides with the main water-parting of the Altai mountains till it reaches Mount Kalas.

Geographically, Mongolia may thus be said to occupy both terraces of the great plateau of east Asia, which stretches in the south of Siberia, between the Sailughem range of the Great Altai and the Great Khingan—with the exception of the Dzungarian depression. From Manchuria and China it is separated by the border ridge of the plateau—the Great Khingan, while in the south-west it runs up to the foot of the high northern border-ridges of the Tibetan plateau—an artificial frontier separating it from east Turkestan and Dzungaria. Broadly speaking, Mongolia may be divided naturally into three parts: (1) north-western Mongolia, which occupies the high terrace of the plateau; (2) the Gobi, in its wide sense, covering the lower terrace of the plateau, together with a slightly more elevated and better-watered zone along the western slope of the Great Khingan and its south-western continuation; and (3) south-eastern Mongolia, on the eastern slope of the Khingan.

I. North-Western Mongolia.

This was formerly represented as a region intersected by lofty mountain chains. It appears, however, from Russian explorations during the last third of the 19th century that it has all the characteristics of an elevated plateau, of a rhomboid shape (like Bohemia), bounded by four mountain ranges; namely, the Russian Altai on the N.W., the western Sayans on the N.E., the Kentei range on the S.E., and the Ektag Altai on the S.W. The border-ridge character of the west Sayans (Ergik-targak-taiga) is well established, and the same orographic character is confirmed by recent explorers with regard to the Sailughem range of the Altai. The only point still remaining undecided is whether the valleys of the Bom-kemchik (a tributary of the Yenisei) and its left-hand tributaries do not belong geographically to the Altai region. At any rate, throughout the whole of north-west Mongolia, which covers an area of nearly 370,000 square miles, the altitude nowhere falls below 2370 feet (Ubsa-nor); and the area round this lake which has less than 3000 feet of altitude covers only 6600 square miles. The remainder of this extensive territory ranges at altitudes of from 3000 to 4500 feet, even in the bottoms of the river valleys and in the lower plains; while the ridges which constitute the water-partings rise a couple of thousand feet above the general level of the plateau. Along the south-western border of this division of Mongolia a gigantic border-ridge, the Ektag (or Mongolian) Altai, runs in an east-south-eastern direction from the Russian Altai to 99° E. long., and is probably continued even farther by the Artsa-bogdo, the Saikhat, and other ranges as far as the northern loop of the Yellow river. The passes across the Ektag Altai lie at altitudes of 10,000 feet in the north-west and 9250 feet in 93° 20′ E.; farther east they become much lower. But while its southern foot stands in the Dzungarian trench, *i.e.*, at altitudes of 1550 feet only near Lake Ulungur, and at 3000 feet in 94° E., its north-eastern foot rests on the high plateau, *i.e.*, at 4260 feet at Kobdo, 5410 at Oshku, 4070 at Orok-nor on the route from Kiakhtah to Su-chow, and so on. Thus the Ektag Altai is a true border-range—that is, a lofty and steep escarpment facing the Dzungarian depression, with a gentle and relatively short slope towards the plateau.

In the same way the Kentei (or Gentei) mountains, as they are called, to the south of Urga, and the Yablonovoi Khrebet of Transbaikalia, separate the higher terrace of north-west Mongolia (drained by the tributaries of the Selenga) from the lower terrace of the Gobi, which is drained by the upper tributaries of the Onon and the Kerulen, both belonging to the basin of the Amur. It is also very probable that the Tannu-ola mountains to the north-east of Ubsa-nor, and the Khangai mountains between Ulyasutai and the upper Orkhon, both running west-north-west to east-south-east, border another slightly higher terrace of the same great plateau of north-west Mongolia, upon which Lake Kosogol lies, at an altitude of 5320 feet. On this vast upper terrace even the bottoms of the river valleys are at altitudes of 4200 to 5500 feet, with one single exception—the narrow gorge of the Khua (Khi)-khem, or upper Yenisei; while the highest pass across the Tannu-ola mountains is 7090 feet, though the others are much lower. The conception of north-west Mongolia as a region filled with mountain ranges radiating from the Altai must thus be abandoned. It is a massive swelling of the earth's crust, representing the northern counterpart of the plateau of Tibet. This massive swelling is cut into, between the Ektag Altai and the eastern Tian-shan, by the relative depression of Tarbagatai and Dzungaria, 1500 to 3000 feet in altitude; while to the south of the eastern Tian-shan comes the Tarim depression, from 2200 to 3000 feet high, and occupying an area of about 88,000 square miles. Neither of these "depressions," however, penetrates beyond 94° E., and (see Skassi's map) on the route from Kiakhta to Su-chow, in 100° E., there is only one single place (42° N.) in which the altitude drops as low as 3300 feet; everywhere else it varies between 4000 and 5000 feet.

Lakes and Rivers.—North-western Mongolia is well watered, and has in its western part a group of lakes which possess no outlet to the ocean, being in reality the rapidly desiccating remains of what were formerly much larger basins. The chief of them is Ubsanor (2370 feet), which receives the large river Tes. It lies in the middle of a large plain, and has to the west of it a smaller but much higher lake, Urga-nor, besides several smaller ones. Farther south on the same wide plain lie the sister lakes Kirghiz-nor and Airyk-nor, which receive another large river, the Dzap'hyn, and the Kungui. Many small lakes are scattered over the plain to the east of them. A third group of lakes occurs in the neighbourhood of Kobdo. The Kobdo river, which rises in the Dain-gol (7060 feet) in the Ektag Altai, winds in great curves across the plateau, and enters Lake Kara-usu (3840 feet), which also receives the Buyantu, an outflow from Lake Kobdo, and is connected by a small river with another large lake, Durga-nor, situated a score of miles to the east. There are also many smaller lakes fed by the glaciers of the Sailughem (Achit-nor, 4650 feet, and Uryu-nor), and others scattered through the Ektag Altai. The largest lake of this region is, however, Kosogol (Khubsu-gul), which lies at an altitude of 5320 feet, close to the Russian frontier, at the foot of the snowclad Munku-sardyk. Besides the rivers just mentioned, there are others belonging to the basin of the Yenisei (Khua-or Khi-khem, Bei-khem, and Bom-kemchik); while yet others belong to the Selenga, a river formed by the junction of the Eder with the Tel-ghir. The Selenga receives the Tola, at the head of which, the Orkhon, remarkable inscriptions were discovered in the end of the 19th century, and cleverly deciphered by Professor V. Thomsen of Copenhagen.[1] The rivers which flow down the outer slopes of the border-ridges become lost in the Gobi shortly after entering it.

A very large portion of north-west Mongolia constitutes a high plain, 3000 to 4200 feet in altitude, which penetrates from the south-east in a north-western direction between the Ektag Altai and the Khangai mountains. It has a true Mongolian character, *i.e.*, it is covered with gravel, and presents the appearance of a dry prairie devoid of forests. This same character is also exhibited by the bottoms of the broad valleys, while the more elevated and hilly portions of the territory, especially on their northern slopes, are covered with larch, cedar, pine, and deciduous trees belonging to the Siberian flora; where the forests fail they are marshy or assume the character of Alpine meadows—*e.g.*, in the Khangai, the Tannu-ola, and on the slopes of the border-ridges. The whole of this region is covered with excellent pasture. The forests decrease as one travels southwards. For instance, while both slopes of the Sayans are covered with forests, the Tannu-ola and the Khangai mountains have woods on their northern faces only, and the Ektag Altai is quite devoid of woods, even on its northern slope.

Climate.—Owing to its high altitude, north-western Mongolia is very cold, and the severity of the winter is intensified by the prevalence of cold but dry north-western winds. The north-east wind brings more moisture. In summer the warm winds come from the south and south-east, but having first to cross the Gobi, they are dried before they reach north-western Mongolia. The yearly amount of rain at Urga (altitude 4350 feet, at the northern foot of the Kentei mountains is only 9½ inches, and the average temperatures are: year 27° F., January −18°, July 64°; a minimum of −35° F. has been observed. The climate of Ulasutai (5400 feet) may be taken as typical, its average temperatures being: year 31·6°, January −12°, July 66°.

The *geology* is still very imperfectly known. The plateau is built up of granites, gneisses, and crystalline schists of Archæan and probably Primary age. Coal is known to exist to the south-east of Kobdo, in the Tannu-ola, and in the basin of the Yenisei, but its age is unknown (fresh-water Jurassic?). Graphite and some silver ores have also been found.

The *fauna* is a mixture of the Siberian and the Daurian—the latter penetrating up the valleys of the Selenga basin.

The *population* of north-west Mongolia is mixed, and contains, besides Mongols and Kalmuks, also Turkish tribes; namely, Kirghiz, on the slopes of the Ektag Altai; Uryankhs, about Kosogol as well as on the middle course of the Kobdo river (Kokchulutuns); and Kotons, who dwell on the lands of the Durbet (Dorbod) Kalmuks about Ubsa-nor. In the vicinity of this there are also Mussulman immigrants from east Turkestan; and Chinese are found in all the towns. Cattle-breeding is the chief occupation, agriculture being carried on, and then to no great extent, only about Ubsa-nor, occasionally beside the Selenga, and in the southern parts of the Ektag Altai. Hunting is a favourite occupation, and furs (especially of marmots) and stags' horns (*sayans*) are exported in considerable quantities. The transport of goods to and from China is also a large source of income. The chief towns of this division of Mongolia are Urga, Ulasutai, Kobdo, and Ulankom.

II. The Gobi.

Geographically speaking, the Gobi comprises the lower terrace of the great plateau of east Asia, bounded on the N.W. by the slopes of the Kentei mountains, and on the E. and S.E. by the Great Khingan mountains, from which it is, however, separated by a borderland, about 100 miles wide, belonging to the foot-hills of the latter range. Its southern limits cannot yet be definitely determined, as the Gobi cannot very well be separated from Alashañ. In the west, as appears from the journeys of the brothers Grum-Grzimailo, its natural limits are the hilly tracts of the Bei-shan, which occupy the space between the 94th and 100th degrees of longitude (route from Hami or Khami to Su-chow), rising to altitudes of 4000 to 7500 feet. In view of this the Hashuñ Gobi, or Ilhuma, with the Kum-tagh Sands (40° N. and 92° E.), might be advantageously considered as part of the Tarim region. The 95th meridian may be taken as separating the Gobi from Dzungaria. The Mongolian word *Gobi*, as well as the Chinese *Sha-mo*, means a desert, stony or sandy, devoid of water and pasturage; but the resulting current conception of the Gobi as a sand desert is absolutely incorrect. Nowhere does it contain such sand deserts as are found in the Transcaspian territory, but everywhere presents the characteristics of an open, flat, or undulating plain, covered with a hard coating of gravel, from which the wind has swept the lighter and minuter particles of mud or sand, and from beneath which the hills and mountains protrude littered with fragments of rock, much as islands emerge from the sea. As to the name of Han-hai, proposed by Richthofen, it has the disadvantage of presupposing that all the Gobi-like portions of the plateau have been covered by a Central Asian Mediterranean, which is supposed to have levelled the mountains. However, the very origin of the plateau-forms on our globe, as well as the origin of the gravel with which the Gobi is covered, is very far from being known. Everywhere throughout the Gobi a formation of red and brown conglomerates, sandstones, and clays is very common; this most travellers, following Richthofen's hypothesis, have described as deposits of a Tertiary "Han-hai sea." But after traversing some 20,000 miles of the Mongolian plateau, the professional geologists Bogdanovitch and Obrucheff, who have both devoted considerable attention to the red "Gobi or Han-hai deposits," have discovered but one fossil (Obrucheff), namely, the enamel of the teeth of a rhinoceros—a testimony which points to a fresh-water origin of these deposits rather than to a hypothetical Han-hai sea, which consequently remains a mere speculation. On the other hand, Jurassic coal-bearing deposits are known to exist in several places in the Gobi, but all of them, as is proved by their well-explored fossil flora and insects, were deposited in separate fresh-water basins. Since Bogdanovitch has shown that the fossils which Stoliczka picked up in the Sanju Pass at its issue into Kashgaria are Upper Devonian (see KUEN-LUN) and not Triassic, the total absence of marine formations of the Secondary and Tertiary ages on the Mongolian plateau—and during 1885–1900 it was crossed and explored in all directions by a number of scientific explorers—is the more striking from the fact that deposits of these two epochs have been found everywhere on the outer slopes of the plateau—on the Amur, the Sungari, in the Peking plain, and even in the Kalgan gorge, leading down the plateau towards Peking, as well as on the south-eastern slopes of the In-shan border ridge of the plateau.

The Kentei range which limits the Gobi in the north-west, from the Transbaikalian frontier (109° 30′ E.) to the point where it appears to join the Ektag Altai (in about 45° N. and 102° E.), is apparently an escarpment, or border-ridge, of the higher terrace of the plateau occupied by north-west Mongolia, which is fringed (at least to the south-west of Urga) by a second parallel ridge.[1] Farther to the south-west comes the Bei-shan swelling, about 150 miles wide, the border of which runs, broadly speaking, in a north-western direction from the Nan-shan highlands to the extremity of the eastern Tian Shan. It consists of high dry plains, rapidly rising from 2300 feet in the south-east of Hami to 4000 feet in 42° N., and to 5000 and 6000 feet farther south-east, and is intersected by a series of parallel ridges, running west-south-west to east-north-east, and reaching about 1000 feet above the plains (7000 to 7420 feet in the maximum). The Hashuñ Gobi to the west of this swelling is still but little known. This, however, is known, that along its northern border a relatively narrow depression (2000 to 3000 feet) extends west and east at the southern foot of the eastern Tian Shan from Lake Bagrach-kul (42° N. and 87° E.) to 94° 30′ E.; and another similar depression fringes it on the south, along the northern foot of the Altyn-tagh, from Lob-nor (2600 feet) to the small lake of Halachi (3500 feet), situated west-north-west of Su-chow. In the south-west the Gobi may be considered as limited by the Nan-shan highlands (see Kuen-lun)—that is to say, by the Great Wall between Su-chow and Lan-chow on the Yellow river, or rather by the Sin-tang, the Vei-tsi-shang, and the Lu-huang-lin mountains. In reality, however, the Alashañ and the Ordos represent a slightly higher terrace of the Mongolian plateau. In the east the natural limits of the Gobi are the Great Khingan border-ridge, which runs from the Amur at Kumara to Kalgan near Peking, and is further continued by the In-shan mountains and the mountains which are pierced by the Yellow river in the south of Kia (38° 10′ N. and 110° 20′ E.). The Khingan, which is well known from 50° N. to the In-shan mountains, appears throughout this length, not as a single escarpment, but as a series of two or three parallel ridges, thus constituting a zone 80 to 100 miles wide, by which the Mongolian plateau drops south-eastwards to the deeper-lying plains (see Khingan). On the north-western slope of this border-ridge there is a zone, about 100 miles wide, which does not possess the exact characteristic features of the Gobi, but the features of an undulating high tableland, ridged with flat hills and low ranges, well wooded, well watered, and in places marshy. The Gobi proper is thus the deeper part of the trough extending over the lower terrace of the Mongolian plateau for over 1000 miles from south-west to north-east, with a width of from 450 to 550 or 600 miles in its south-western portion. The plateau itself is built up of granites, gneisses, and a variety of crystalline schists and slates, with limestones on its periphery, the youngest of which belong to the Carboniferous formation. Considerable layers of basalt and other volcanic formations occur in the border-ridges. As regards the causes which have produced the abrasion of the surface of the plateau, they are no better known in the case of the Gobi than they are in the case of all other plateaus of the world. Wind and frost are certainly powerful agents in the destruction of denuded rocks, and their force must not be undervalued. Anyway, it is indisputable that the wind has been active in destroying the softer "red Gobi deposits," and in sweeping the finer particles of mud and sand clean off the superficial gravels. Viewed from the Peking lowlands, clouds of dust are seen to envelop the slopes of the Great Khingan, and aërial agencies have unquestionably been at work in the deposition of the thick loess deposits which line the foot of the plateau and fill the valleys of Turkestan. But water must also have played a part in the laying down of these deposits, for usually they contain strata of pebbles in their lower parts. How far an ice-sheet, similar to that of Greenland, which covered the whole of the plateaus of Asia, may have contributed to the levelling of the mountains, is a question for future investigation to decide. The surface of the Gobi lies at altitudes of 2700 to 3000 feet, slightly increasing towards the Khingan mountains. The lowest elevation hitherto determined on this plateau is 2766 feet (907 metres, not 607 metres, as suggested by Obrucheff). But its surface is by no means level: it is diversified by ranges of hills, from 300 to 1000 feet above the general level of the plateau, and occasionally more (Khan-ula, 6400 feet). Perfectly flat plains are of limited extent; as are also sandy plains—the surface being undulating as a rule and intersected by small ravines and protruding rocky areas. Even the western Gobi, especially in its northern parts, as appears from the Kozloff expedition, is covered with numbers of parallel low ranges, which are pretty well watered and have an interesting fauna.

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[1] See V. Thomsen, *Inscriptions de l'Orkhon* (Helsingfors, 1900).

[1] The sources of the Onghin-gol, penetrating into the upper terrace, may mask the connexion. It remains also an open question whether traces of the Kentei escarpment may not be found in a south-west direction as far as 42° N., where they possibly join the Beishan, in which case they would separate the higher plains of Jasaktu-khan (4650 to 5920 feet) from the lower plains (3300 to 4000 feet) to the south-east of it.

Rivers.—In the central parts of the Gobi there are no rivers. They only flow on its outer margin. Such are the Onon, a tributary of the Shilka; the Kerulen, which rises in the Kentei mountains and flows north-east into Dolon-nor or Khulun, from which it only occasionally overflows into the Arguñ; the Khalagol, a tributary of Buir-nor, connected by the Urgon with the former lake, on the north-east frontier of Mongolia; a number of small rivers, which flow from the Khingan mountains but dry up as soon as they reach the Gobi; the Hoang-ho or Yellow river, which describes a great loop round the Ordos; several rivers which flow from the Nan-shan but end in small lakes shortly after they enter the Gobi (*e.g.*, Shao-hai and lakes Sohok and Sobo); and the Onghin-gol, which rises in the Kentei mountains. In the interior of the Gobi, water is only obtainable from wells.

The *climate* of the Gobi is characterized by a great dryness of the air and rapid changes of temperature all the year round and even within twenty-four hours. Dr Woeikoff has ascertained that the Gobi lies within the influence of the south-eastern monsoons. In the winter the prevailing winds blow from the interior of the Asiatic continent towards the ocean, and are very dry, while in summer they blow in the opposite direction, and bring rain. At Si-van-tse the annual rainfall is 18 inches, and the absence of moisture is such that only 1 per cent. of saturation is observed. The cold in winter is truly Siberian—27° Fahr. has been observed in November in South Mongolia, while in the Alashañ the average daily temperature in July is truly Indian, *i.e.*, 99° Fahr., and temperatures of even 150° and 167° Fahr. in the shade have been observed. The average temperature at Si-van-tse is: year, 37°; January, 2°; July, 67°; maximum, 93°; minimum, −53°.

Flora and Fauna.—The vegetation is extremely poor; the *deresu*, the steppe acacia (*Caragana*), and *Festucas* are the commonest plants, together with a number of *Salsolaceæ* (*Nitraria*, *Ephedra*) and poplars along the rivers. It is only upon approaching the slopes of the mountains which encircle the region that other vegetation—*e.g.*, wild peaches, elm-trees, and so on—begins to appear. A little agriculture is carried on in the southern districts of the Gobi. The *fauna* has been well studied by Prjevalsky, and while it is generally similar to that of the Tian-shan region and Siberia, it has its own peculiar forms.

The *Ordos* or *Ho-tao*, in southern Mongolia, forms a sufficiently distinct region to be treated by itself. It is enclosed on the north by the great loop of the Hoang-ho, and in the south it is bounded by the mountains of Lu-huang-lin or the escarpment of the plateau towards the south. The Ordos is a gently sloping tableland, rising from 3300 feet in the north and in the vicinity of the Yellow river to 4400 in the middle, and reaching 5200 feet in the Lu-huang-lin. It is to a great extent covered with sand, especially in the north and west, and with wide depressions (*chaidam* or *tsaidam* in Mongolian), the basins of desiccated lakes; many smaller lakes are scattered over its surface. Minor tributaries of the Hoang-ho drain it in the east. The Arbus or Arbiso mountains, and the Khantagheri, about 3000 feet above the surface of the plateau, appear on the right bank of the Hoang-ho, stretching in a north-north-east direction as a continuation of the Alashañ range. Several caravan routes intersect the Ordos, the principal one being that from Gui-hua-chen or Kuku-khoto, *viâ* Djungar, to Borobolghysun—the chief town of the province. There are also several towns in the eastern part of the province, on or near the Hoang-ho, namely, Fu-gu, Shan-mu, Yui-lin, and Kia, as well as in the south—Huai-shang, Tsin-kiang, Din-kiang, and Lin-chow.

The Alashañ range, to the west of the upper Hoang-ho, separates the Ordos from the Alashañ. It runs south-south-west to north-north-east for about 160 miles, with a width of about 16 miles, and lifts its crest 5000 to 7000 feet above the surrounding plateau (which is itself 3400 to 4800 feet high), and reaches 10,000 and 11,600 feet in the only two passes which cross it. This range does not reach the limit of perpetual snow, but is extremely stony and wild. The *Alashañ* is another vast territory of southern Mongolia; its northern frontier corresponds, broadly speaking, with 42° N., and its southern frontier lies on the Nan-shan highlands, while on the west it has the Bei-shan and on the east the Ordos. It also is a plateau covered by a network of hills, its lowest parts, in the lower valley of the Edzin-gol, being at altitudes of 4000 to 3500 feet (3290 in Sohok-nor), while the remainder of the region has an altitude of 4000 to 5000 feet, with ridges running up to another thousand feet. Its chief river is the Edzin-gol, which flows to the north-west along the foot of the Nan-shan, receiving several tributaries on the way. In 100° E. it turns towards the north, and finally dwindles away in the small lakes Sohok and Sobo. Two other rivers emerge from the Nan-shan, but are lost before they reach the Chukhun-shan hills.

Several towns of some importance, of which Liang-chow, Hang-chow, and Su-chow are the chief, have grown up along the foot of the Nan-shan, amidst a series of well-irrigated and well-cultivated oases, separated from each other by tracts of sand.

III. South-Eastern Mongolia.

This is the part of Mongolia which lies on the eastern slope of the Great Khingan mountains, entering like a wedge between the lower course of the Nonni river and the middle Sungari. Chiefly owing to the dryness of climate, its physical characteristics are similar to those of Mongolia proper, except that the altitude of the plains is much lower. This portion of Mongolia is also much better watered, namely, by the Khatsyr, the Lao-ho, and the Shara-muren, all flowing from the Khingan mountains eastwards, and the last making the frontier between Mongolia and the Chinese province of Chihli.

Population.—The population of the whole of Mongolia is estimated at about 5,000,000. It consists of Mongols—Eastern Mongols and Kalmuks in the west—various Turkish tribes, Chinese, and Tungus. The Mongols proper, with the exception of those who inhabit north-west Mongolia, may be divided into northern and southern (more properly north-western and south-eastern) Mongols. The former, belonging to the Khalkhas, occupy the Gobi and the regions of the Kentei mountains and Khingan mountains, while the second, divided into numerous minor branches, roam over south-eastern and southern Mongolia. The principal occupation of the Mongols is cattle-breeding, and Russian writers estimate that on an average each *yurta*, or family, has about 50 sheep, 25 horses, 15 horned cattle, and 10 camels. The transport of goods is their next most important occupation. It is calculated that 100,000 camels are used for the transport of tea only from Kalgan to Siberia, and that no less than 1,200,000 camels and 300,000 ox-carts are employed in the internal caravan trade. Agriculture is only carried on sporadically, chiefly in the south, where the Mongols have been taught by the Chinese. Various domestic industries are also carried on. The trade is chiefly concentrated at Urga, Ulasutai, and Kobdo, in north-west Mongolia; Kalgan, Kuku-khoto, Kuku-erghi, Dolon-nur, and Biru-khoto, in southern and south-eastern Mongolia; and at Kerulen in the north-east. There is a very considerable trade between Mongolia and China, estimated at £900,000 a year for Urga alone. Some 25,000 horses, 10,000 horned cattle, and 250,000 sheep, as well as 330,000 hides and £30,000 worth of furs, are exported annually from eastern Mongolia; and about 70,000 horses, 30,000 camels, 1,500,000 to 2,000,000 sheep, and £40,000 worth of furs from western Mongolia. Salt, timber, sarsaparilla, stags' horns, rhubarb (drug), mushrooms, &c., must be added; while tea, cottons (Chinese, European, and American), crockery-ware, cutlery, flour, tobacco, paper, &c., are imported from China. The imports from Russia increase every year, but are still a long way behind those from China, hardly reaching £200,000 yearly in value.

Administration.—Before the Manchurian conquest the Mongols were governed by their own feudal princes, who regarded themselves as being descended from seven different ancestors, all, however, of the same kin. Each group of principalities constituted a separate *aimak*, and each principality a separate *hoshun*. Under Manchu rule the *aimaks* became converted into the same number of military corps, each composed of so many *hoshuns* as military units. Each of these again was divided into *sumuns* or squadrons, each containing 150 families. In case a *hoshun* contained more than 6 *sumuns*, every 6 of the latter were organized into a regiment—*tsalan*. Four Manchu *tsian-tsuns*, or governor-generals, acted as chiefs of the troops, and the prince of each *aimak*, nominated from Peking, was considered as the lieutenant or assistant of his respective Manchu chief. The *hoshuns* were subject to their own princes, each of whom had a military adviser, generally a Manchu. Their internal or tribal affairs were in the hands of the princes, those which concerned a whole *aimak* being settled at gatherings of the princes under the eldest of them, named khan. This organization was maintained by the Manchu rulers, the khan being elected from among the princes, and the latter having each an adviser, *tusulakchi*, nominated from Peking.

Mongolia is now divided into 27 *aimaks*, which are bound to furnish 1325 squadrons, of 198,750 armed men, one-third of whom must carry rifles; but as a matter of fact the Mongols are not provided with arms for even one-tenth of that number (Pozdnéeff, in *Russian Encyclopœdical Dictionary*).

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(P. A. K.)

Möng Pai (called *Mobyè* by the Burmese), the most south-westerly of the British Shan States of Burma. It has an approximate area of 1000 square miles. The general character of the country is hilly, rising westwards in a gentle slope from the chief stream, the Nam Pilu or Balu. This is navigable for native boats throughout the year to the point where it sinks underground in Karen-ni. The chief cultivation is rice, with about two acres of dry or hill rice to one of wet bottom. The hill fields are left fallow for ten years after two years' cultivation. Population estimated in 1898 at 16,772, of whom 2520 were Shans, 2048 Taungthus, 617 Taungyos and Inthas (from the Nyaungywe Lake), and the remainder various tribes of Karens, of whom the Padaungs (7792) were the most numerous. The chief, the Sawbwa Hkun Yôn, held charge through the reigns of four Burmese kings, and submitted early in 1887 on the first arrival of British troops. He abdicated in favour of his son in 1890. The state pays Rs.2000 tribute.

Möng Pan (the Burmese *Maingpan*), a state in the eastern division of the Southern Shan States, lying approximately between 19° 45′ and 20° 25′ N. and between 98° and 99° E., with an area of 2299 square miles. The main state lies, except for a few insignificant circles, entirely west of the Salween, but beyond that river are the four sub-feudatory states of Möng Tôn, Möng Hang, Möng Kyawt, and Möng Hta. The only considerable area of flat land is round the capital, which lies in a large and fertile plain, marking roughly the centre of the state. From this plain rise on all sides low hills covered with scrub jungle, sloping up to ranges of about 5000 feet on nearly every side. Rice is the only crop, irrigated where possible; elsewhere dry cultivation prevails. The state has valuable teak forests on both sides of the Salween, which cover a considerable but undetermined area. The general altitude of the valleys is about 2000 feet. The state pays an annual tribute of Rs.2000. The capital is small, and has only about 200 houses. The chief is of Sawbwa rank. Population (1891), 3099; of the trans-Salween sub-states, 4000; (1898), about 9000.

Monier-Williams, Sir Monier (1819–1899), Sanskrit scholar, born at Bombay on 12th November 1819, was a son of Colonel Monier-Williams, surveyor-general, Bombay presidency. He matriculated at Oxford in 1837, but left the University on receiving in 1839 a nomination for the East India Company's civil service, and was completing his course of training at Haileybury when the entreaties of his mother, who had lost a son in India, prevailed upon him to relinquish his nomination and return to Oxford. He there devoted himself to the study of Sanskrit, and gained the Boden scholarship in 1843. After taking his degree he was appointed professor of Sanskrit, Persian, and Hindustani at Haileybury, where he remained until the abolition of the college upon the transfer of the government of India from the Company to the Crown. He taught Oriental languages at Cheltenham for ten years, and in 1860 was elected Boden professor of Sanskrit at Oxford after a severe contest with Professor Max Müller (*q.v.*), which attracted great public interest and severe criticism, the motive of the non-resident voters whose suffrages turned the scale being notoriously not so much to put Monier-Williams in as to keep Max Müller out. Although, however, far inferior to his rival in versatility and literary talent, Monier-Williams was no way inferior in the special field of Sanskrit, and did himself and his professorship much honour by a succession of excellent works, among which may especially be named his Sanskrit-English and English-Sanskrit Dictionaries; his *Indian Wisdom*, an anthology from Sanskrit literature; and his translation of *Sakuntala*. In his later years he was especially attracted by the subject of the native religions of India, and wrote popular works on Brahmanism, Buddhism, and Hinduism. His principal undertaking, however, was the foundation of the Indian Institute at Oxford, which owes its existence entirely to him. He brought the project before the University in May 1875, and in that year and the following, and again in 1883, visited India to solicit the moral and financial support of the native princes and other leading men. Lord Brassey came to his aid with a donation of £9,000, and in November 1880 the Institute was adopted by the University, but the purchase of a site and the erection of a building were left to the professor. Upwards of £30,000 was eventually collected; the Prince of Wales, in memory of his visit to India, laid the foundation stone in May 1883; and the edifice, erected in three instalments, was finally completed in 1896. Ere this, failing health had compelled Monier-Williams to withdraw from the active duties of his professorship, which were discharged by the deputy-professor, Dr Macdonell, who afterwards succeeded him. He continued, nevertheless, to work upon Sanskrit philology until his death at Cannes on 11th April 1899. He had been made K.C.I.E. in 1889, when he adopted his Christian name of Monier as an additional surname. (R. G.)

Monkhouse, William Cosmo (1840–1901), English poet and critic, was born in London on 18th March 1840. His father, Cyril John Monkhouse, was a solicitor; his mother's maiden name was Delafosse. He was educated at St Paul's School, quitting it at seventeen to enter the Board of Trade as a junior supplementary clerk, from which grade he rose eventually to be the assistant-secretary to the finance department of the office. In 1870–71 he visited South America in connexion with the hospital accommodation for seamen at Valparaiso and other ports; and he served on different departmental committees, notably that of 1894–96 on the Mercantile Marine Fund. He was twice married: first to Laura, daughter of James Keymer of Dartford; and secondly, to Lenora Eliza, daughter of Commander Blount, R.N. He died in London, 20th July 1901, and was buried in Finchley Cemetery. Cosmo Monkhouse was one of those who have not only a vocation, but an avocation. His first bias was to poetry, and in 1865 he issued *A Dream of Idleness and other Poems*, a collection strongly coloured by his admiration for Wordsworth and Tennyson. It was marked by exceptional maturity, and scarcely received the recognition it deserved. Owing perhaps to this circumstance, it was not till 1890 that he put forth *Corn and Poppies*, a collection which contains at least one memorable effort in the well-known "Dead March." Five years later appeared a limited edition of the striking ballad of *The Christ upon the Hill*, illustrated with etchings by Mr William Strang. After his death his poetical output was completed by *Pasiteles the Elder and other Poems* (including *The Christ upon the Hill*). In 1868 Monkhouse essayed a novel, *A Question of Honour*. Then, after preluding with a *A Life of Turner* in the "Great Artists Series" (1879), he devoted himself almost exclusively to art criticism. Besides many contributions to the *Academy*, the *Saturday Review*, the *Magazine of Art*, and other periodicals, he published volumes on *The Italian Pre-Raphaelites* (1887), *The Earlier English Water-Colour Painters* (1890 and 1897), *In the National Gallery* (1895), and *British Contemporary Artists* (1899). He also edited the *Life and Works of Joseph Wright* (1885), and his sister-in-law Mrs. Heaton's *Concise History of Painting* (1888). He prefaced many of the publications of the Burlington Fine Arts Club, of which he was a member, and he was a contributor to the *Dictionary of National Biography* from the beginning. Monkhouse also wrote an excellent *Memoir of Leigh Hunt* in the "Great Writers Series" (1887), and for civil service purposes compiled, in 1877, a little manual of *précis* writing. As an art critic Monkhouse's judgments were highly valued; and he had the rare gift of differing without offending, while he invariably secured respect for his honesty and ability. As a poet, his ambition was so wide and his devotion to the art so thorough, that it is difficult not to regret the slender bulk of his legacy to posterity. Some of the best of his pieces are to be found in Mr Miles's *Poets and Poetry of the Century*. (A. D.)

Monkswell, Robert Porrett Collier, 1st Baron, English judge (1817–1886), was born at Plymouth, 21st June 1817, and was the son of a prominent merchant of Quaker extraction. He was educated at Oxford, was called to the bar in 1843, and went the western circuit. He obtained a high reputation by his successful defence of Brazilian pirates in 1845: they were, indeed, convicted at the assizes, but Collier ultimately procured their escape upon a point of law which the judge had refused to reserve. He was elected member of Parliament for Plymouth in the Liberal interest in 1852, and in 1859 was appointed counsel to the Admiralty and judge-advocate to the Fleet. In this capacity he gave in 1862 an opinion in favour of detaining the Confederate rams building in the Mersey, which would have saved his country much money and much credit if it had been acted upon. In 1863 he became Solicitor-General, and in 1868 Attorney-General, and in 1869 successfully passed a Bankruptcy Bill. In 1871 he was appointed by Mr Gladstone one of four new judges upon the judicial committee of Privy Council, although it was expressly provided by the Act creating these offices that none of them should be filled by a law officer of the Crown. This prohibition was evaded by making Collier a judge of Common Pleas, and transferring him after a few days to the Privy Council. It is singular that neither Mr Gladstone, Lord Hatherley, nor Lord Selborne should have seen anything reprehensible in this arrangement, which was unanimously condemned by public opinion, and gave the Gladstone Cabinet a serious blow. Collier's qualifications were undoubted, but that was not the question. He officiated, nevertheless, with distinction until his death on 3rd November 1886, and was raised to the peerage as Baron Monkswell in 1885. He was a man of many accomplishments, and especially distinguished as an amateur painter, frequently exhibiting landscapes at the Royal Academy and elsewhere. In his younger days he had been noted as a clever caricaturist. He was succeeded in the peerage by his eldest son, Robert (b. 1845), who, after taking a first class in law at Cambridge, went to the bar, and became (1871) conveyancing counsel to the Treasury, and (1885–86) an official examiner of the High Court. As a Gladstonian Liberal he unsuccessfully sought a seat in the House of Commons, but for 1892–94 was a lord-in-waiting, and in 1895 Under Secretary of State for War in Lord Rosebery's

Government. Besides serving on parliamentary committees on the sweating system, the London hospitals, and the law of copyhold, he took a leading part in attempting to pass the Bills (1891, 1897) for amending the Copyright Acts. (R. G.)

Monmouth, a maritime county of England, on the Welsh border, bounded on the E. by Gloucester, on the N.E. and N. by Hereford, on the N.W. by Brecknock, on the W. by Glamorgan, and on the S. by the estuary of the Severn.

Area and Population.—The area of the ancient county is 341,688 acres, or 534 square miles, with a population in 1881 of 211,172, in 1891 of 252,416, and in 1901 of 292,327, the number of persons per square mile being 547, and of acres to a person 1·16. The area of the administrative county, as given in the census returns of 1891, was (including the county borough of Newport) 324,701 acres, with a population of 258,054; but since 1891 certain changes have been made in the area, and in 1901 the population was 230,800. In 1894 this county received a small addition from Hereford, and in 1895 the contributory place of Roath in the rural district of Llandaff and Dinas Powis was transferred from Monmouth to the county borough of Cardiff in Glamorganshire, while the area which, prior to the passing of the Local Government Act of 1894, constituted the part of the parish of Rumney in the county borough of Cardiff, was transferred to Monmouth. The area of the registration county is 394,424 acres, with a population in 1891 of 275,242 (of which 206,368 were urban and 68,874 rural), and in 1901 of 316,875. Within the registration area the increase of population between 1881 and 1891 was 7·47 per cent., between 1881 and 1891 the increase was no less than 40,938, and between 1891 and 1901 it was 41,263, or 14·1 per cent. The population in 1901 numbered 316,875. The following table gives the numbers of marriages, births, and deaths, with the number of illegitimate births, for 1880, 1890, and 1898:—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				Males.	Females.
1880	1676	7,900	4520	170	166
1890	2466	9,245	5433	136	163
1898	2085	10,299	4984	181	172

The number of marriages in 1899 was 2504; of births, 9924; and of deaths, 5872.

The following table gives the marriage-, birth-, and death-rates per thousand of the population, with the percentage of illegitimate births, for a series of years:—

	1870–79.	1880.	1880–89.	1890.	1888–97.	1898.
Marriage-rate .	16·5	14·3	15·6	18·1	16·0	13·5
Birth-rate . .	38·1	33·8	34·5	34·0	34·6	33·4
Death-rate . .	22·1	19·3	19·8	20·0	19·0	16·2
Percentage of illegitimacy . .	4·3	4·3	4·1	3·2	3·3	3·4

The birth-rate is above the average, but the percentage of illegitimate births is small. In 1891 there were in the county 944 natives of Scotland, 3807 natives of Ireland, and 1159 foreigners.

Constitution and Government.—The county is divided into three parliamentary divisions, and it also includes the Monmouth district of parliamentary boroughs, consisting of Monmouth, Newport, and Usk. The administrative county contains three municipal boroughs: Abergavenny (7795), Monmouth (5095), and Newport, also a county borough (67,290). The following are urban districts: Abercarn (12,607), Abersychan (17,768), Abertillery (21,955), Bedwellty (9919), Blaenavon (10,869), Caerleon (1367), Chepstow (3067), Ebbw Vale (20,993), Upper Llanfrechfa (2979), Llantarnam (5287), Nantyglo and Blaina (13,491), Panteg (7482), Pontypool (6126), Rhymney (7914), Risca (9661), Tredegar (18,574), and Usk (1476). Monmouthshire is in the Oxford circuit, and assizes are held at Monmouth. The boroughs of Monmouth and Newport have commissions of the peace, but no separate court of quarter sessions. The ancient county—which is partly in the diocese of Llandaff and partly in that of Hereford—contains 120 ecclesiastical parishes and districts, and parts of others.

Education.—There is a board school for the blind at Newport. On 31st August 1899 there were in the county (including Newport) 200 elementary schools, of which 105 were board and 95 voluntary schools, the latter including 74 National Church of England schools, 1 Wesleyan, 13 Roman Catholic, and 7 "British and other." The average attendance at voluntary schools was 12,643, and at board schools 32,104. The total school board receipts for the year ended 29th September 1899 were over £140,127. The income under the Agricultural Rates Act was over £1411.

Agriculture.—Only about two-thirds of the total area of the county is under cultivation, and over three-fourths of this is in permanent pasture. There are also about 35,000 acres in hill pasture, 4000 under orchards, and 32,000 under woods. Wheat and oats are the principal corn crops, and turnips the principal green crop. Since 1880 the acreage under corn crops has diminished by considerably more than a third, and that under wheat by about a half. The following table gives the larger main divisions of the cultivated area at intervals from 1885:—

Year.	Total Area under Cultivation.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1885	243,832	28,721	11,713	19,561	180,438	3348
1890	245,643	26,429	11.264	15,684	189,572	2616
1895	242,942	21,455	9,943	15,215	194,415	1715
1900	242,525	21,373	9,129	14,368	196,545	1008

The following table gives the numbers of the principal live stock during the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or in Calf.	Sheep.	Pigs.
1885	11,881	50,554	18,572	184,955	17,126
1890	11,999	46,893	18,609	200,311	17,590
1895	13,946	45,542	17,763	201,274	18,877
1900	13,209	49,799	18,008	227,142	16,426

Industries and Trade.—According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 16,945, as compared with 16,799 in 1896. Non-textile factories employed 15,200, of whom 8040 were employed in the founding and conversion, extraction and finishing of metals, and 3157 in the manufacture of machines; and there is some manufacture of paper. Of the 1704 employed in workshops, 1114 were employed in clothing industries. The prosperity of the county depends chiefly on its minerals. The total number of persons employed in mines and quarries in 1899 was 33,233. The same year 169,135 tons of clay were raised, much of it valuable fireclay, 79,323 tons of limestone, and 51,036 of sandstone. Some iron is obtained from the coal mines, but coal is by far the more important mineral, and on this account much iron is imported for smelting and other purposes. There are large smelting furnaces at Newport, Cwmbran, Ebbw Vale, Blaina, and Tredegar. The pig iron made in 1885 amounted to 438,092 tons, in 1890 to 399,538 tons, and in 1899 to 350,764 tons. The following table gives the tonnage and value of the principal minerals for 1890 and 1899:—

Year.	Fireclay.		Coal.		Iron Ore.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
1890	97,745	£17,105	1,536,574	£437,070	17,435	£10,026
1899	79,481	19,870	10,103,067	6,061,840	12,794	6,397

AUTHORITIES.—ROGER. *Memoirs of Monmouthshire.* London, 1708.—WILLIAMS. *History of Monmouthshire.* London, 1796.—CONE. *Historical Tour in Monmouthshire.* London, 1801.—ORMEROD. *Strigulensia: Archæological Memoirs relating to the District adjacent to the Confluence of the Severn and the Wye.* London, 1861.—BAGNALL-OAKLEY. *Account of the Rude Monuments in Monmouthshire.* Newport, 1889; and *Proceedings of the Monmouth Antiquarian Association.* (T. F. H.)

Monmouth, a municipal and contributory parliamentary borough (forming, with Newport and Usk, the Monmouth district of boroughs, returning one member) of Monmouthshire, England, 18 miles south of Hereford, at the confluence of the Wye and the Monnow, on the Great Western railway. The Rolls Hall was presented to the town in 1888. Population (1881), 6111; (1891), 5470; (1901), 5095.

Monmouth, a city of Illinois, U.S.A., capital of Warren county, at the intersection of the Chicago, Burlington, and Quincy and the Iowa Central railways, in the western part of the state, at an altitude of 774 feet. It is in a coal region and has some manufactures, largely of agricultural implements. It is the seat of Monmouth College. Population (1890), 5936; (1900), 7460, of whom 594 were foreign-born and 321 were negroes.

Monmouth, a village in Monmouth county, New Jersey, U.S.A., about 28 miles east of Trenton. It was the scene of a sharp battle in the war of the American Revolution, in which neither side was victorious. In June 1778 the British troops, under Sir Henry Clinton, evacuated Philadelphia in order to concentrate all available forces in New York. General Washington followed in pursuit, and a battle took place at Monmouth Court House, about two miles from Freehold, the county seat. The losses of the two armies were about equal, approximately 400 on each side.

Monongahela, a city of Washington county, Pennsylvania, U.S.A., on the west bank of the Monongahela river and on the Pennsylvania and the Pittsburg and Lake Erie railways, in the south-western part of the state, at an altitude of 753 feet. It is in a mining region, producing coal, petroleum, and natural gas, with which its industries are connected. Population (1890), 4096; (1900), 5173, of whom 711 were foreign-born and 345 were negroes.

Monopoli, a seaport town and archiepiscopal see of the province of Bari, Apulia, Italy, on the Adriatic coast, 26 miles south-east of Bari by rail. Its trade has declined owing to the successful rivalry of Tarentum (Taranto), Brindisi, and Bari; but it still exports olive oil, wine, flour, fruits, soap, and lime, and imports a little timber, cattle, coal, and cotton. The port is cleared by some 180 vessels of about 100,000 tons annually. Population (1881), 13,154; (1899), 12,000.

Monroe, a city of Louisiana, U.S.A., capital of Ouachita parish, on the east bank of the Ouachita river, on the Queen and Crescent and the St Louis, Iron Mountain, and Southern railways, in the northern part of the state, at an altitude of 80 feet. It is situated in the fertile bottom-lands, and surrounded by cotton plantations and uplands covered with forests of yellow pine. The industries consist mainly of the manufacture of lumber, compressing and shipping cotton, and the extraction of cotton-seed oil. Population (1890), 3256; (1900), 5428, of whom 232 were foreign-born and 2834 were negroes.

Monroe, a city of Michigan, U.S.A., capital of Monroe county, in the south-eastern part of the Lower Peninsula, on the Raisin river, near its mouth in Lake Erie, at an altitude of 583 feet. Three railways, the Père Marquette, the Lake Shore and Michigan Southern, and the Michigan Central, pass through it. It has extensive and varied manufactures, largely of agricultural implements, flour, paper, &c. Population (1890), 5258; (1900), 5043, of whom 692 were foreign-born and 27 were negroes.

Monroe Doctrine.—That the United States should avoid entangling itself in the politics of Europe was a policy recommended by Washington. The counterpart of this, that European Powers should be prevented from taking a controlling share in the politics of the American continent, grew gradually as the importance and influence of the United States increased. It was announced in a concrete form, though not originated, by President Monroe. The threatened action of certain Continental Powers leagued together under the name of the Holy Alliance called out his declaration. Several of the South American colonies of Spain had asserted their independence. The Holy Alliance having helped into power a royalist insurrection in Spain, seemed about to use force to restore its revolted colonies also. To meet and check this movement, in his message to Congress in 1823 Monroe made the following pronouncement, which has ever since been styled the Monroe Doctrine:—

> In the wars of the European Powers in matters relating to themselves we have never taken any part, nor does it comport with our policy so to do. It is only when our rights are invaded or seriously menaced that we resent injuries or make preparations for our defence. With the movements in this hemisphere we are of necessity more immediately connected, and by causes which must be obvious to all enlightened and impartial observers. The political system of the allied Powers is essentially different in this respect from that of America. . . . We owe it, therefore, to candour, and to the amicable relations existing between the United States and those Powers, to declare that we should consider any attempt on their part to extend their system to any portion of this hemisphere as dangerous to our peace and safety. With the existing colonies or dependencies of any European Power we have not interfered and shall not interfere. But with the Governments who have declared their independence and maintained it, and whose independence we have on great consideration and on just principles acknowledged, we could not view any interposition for the purpose of oppressing them or controlling in any other manner their destiny by any European Power in any other light than as the manifestation of an unfriendly disposition towards the United States. . . . It is impossible that the allied Powers should extend their political system to any portion of either continent without endangering our peace and happiness; nor can any one believe that our Southern brethren, if left to themselves, would adopt it of their own accord. It is equally impossible, therefore, that we should behold such interposition in any form with indifference.

Earlier in the same message, while discussing negotiations for the settlement of the respective claims of Russia, Great Britain, and the United States in the north-west, Monroe also said:—

> In the discussion to which this interest has given rise and the arrangements by which they may terminate, the occasion has been judged proper for asserting as a principle in which the rights and interests of the United States are involved, that the American continents, by the free and independent condition which they have assumed and maintain, are henceforth not to be considered as subjects for future colonization by any European Powers.

With the first-quoted part of this message Great Britain was in hearty agreement.

This announcement of policy, it will be noticed, involved, firstly, a declaration aimed at foreign intervention in the political affairs of independent American states; secondly, a warning against future European colonization on the American continents. The first was avowedly based on the right of self-defence; it was a policy, not a law; it was not to constrain the minor republics, but to protect them. The second, as explained by John Quincy Adams, was intended to state the fact that the American continent was occupied by contiguous states, leaving no room for further colonization and introduction of foreign sovereignty. No legislative sanction was given to Monroe's statement of policy at the time, and in fact none was needed, for the mere announcement served to prevent foreign action in South America. Repeatedly, since 1823, efforts have been made, and have failed, to enact the principles of the Doctrine in statutory form, and repeatedly high officials of the United States have re-announced the policy. It has thus remained a policy, not a law binding to certain action. It has never formed part of the body of International Law, being unilateral. Nor has the United States bound itself by compact with the other republics on the American continent to protect them from European aggression. Thus it hesitated to send delegates to the Panama Congress in 1826, and took no part in any congress with the Latin American states until 1889.

Nevertheless, on several occasions since its conception the Monroe Doctrine has been enforced. Its spirit permeated the Clayton-Bulwer Treaty, in which Great Britain and the United States, in 1850, mutually renounced the right of colonizing, fortifying, or occupying any portion of Central America. It was enforced against Maximilian, who, by French intervention in Mexico, had been made emperor, and until the close of the American Civil War had perforce been left undisturbed. Its applicability was urged when de Lesseps's Panama Canal was thought possible of completion. Both Cuba and the Hawaiian Islands at various periods have felt its influence, the general, though not consistent policy of the United States being, while disclaiming the desire of annexation itself, to deny the right of any European Power (except Spain in Cuba's case, until 1898) to control them. And, finally, it was applied to the claims of British Guiana to Venezuelan territory by President Cleveland's message in 1895, which proposed a commission to settle the boundary and threatened war if its line were not accepted. This commission never reported, but the disputants finally agreed to arbitrate, and the British claim was in the main upheld.

Between 1823 and 1895 the development and enlargement of this policy on the part of the United States has been very striking. To prevent the overthrow of an independent republic is one thing; to interfere in the settlement of a boundary dispute between two states, also on the ground of self-defence, is quite another. Yet Cleveland's doctrine met with general acceptance, and in fact it had been in a sense anticipated by President Grant, who, in urging the annexation of San Domingo upon the United States Senate in 1870, used this language:—

> The Doctrine promulgated by President Monroe has been adhered to by all political parties, and I now deem it proper to assert the equally important principle that hereafter no territory on this continent shall be regarded as subject of transfer to a European Power.

Never having been formulated as law or in exact language, the Monroe Doctrine has meant different things to different persons at different times. It has grown with the consciousness of growth in power—a curious fact, since it is founded on the right of defending interests which must be less endangered as the United States becomes greater. It has become deeply rooted in the American heart, and a permanent part of the foreign policy of the United States. It tends to change into the principle that every portion of the American continent must be free from European control. It is still coupled, however, with the converse principle that America takes no part in European politics, as the disclaimer of the American delegates to the Peace Conference at The Hague proved.

See TUCKER'S *Monroe Doctrine.*—GILMAN'S *Life of Monroe.*—WHARTON'S *International Law Digest* (title, *Monroe Doctrine*).—SNOW'S *American Diplomacy.*—Also an article by Sir FREDERICK POLLOCK in the *Nineteenth Century and After*, 1902.

(T. S. W.)

Mons, a town of Belgium, capital of the province of Hainault, 38 miles south of Brussels. It has communication by rail with Ghent, Brussels, Charleroi, and other towns of importance. It is the centre of a rich coal district, and there are numerous sugar refineries in its vicinity. Population (communal) (1880), 24,049; (1890), 25,237; (1900), 27,015.

Montana, a north-western state of the American Union, bounded on the N. by Canada, on the E. by North and South Dakota, on the S. by Wyoming and Idaho, and on the W. by Washington, with an area of 145,310 square miles. About one-third of the state is mountainous, the remainder consisting of agricultural or grazing lands. It is no longer on the frontier, as the term was once used. Fears of Indian uprisings are gone; the Government has so systematized its management of the various tribes, by its reservations and encouragements for farming and stock-raising, that the Indians, as a rule, are content to remain within their reserves. Society has assumed a stability and permanency like that of the older states. The valleys throughout the state have been ploughed and cultivated. In manufactures, apart from the mining industry, the state has not advanced as fast as it otherwise might have done, because of the lack of skilled labour and the inability to compete with older communities.

Population.—The population in 1890 was 132,159, of whom 87,882 were males and 44,277 females. There were 89,063 native-born and 43,096 foreign-born. There were also 10,346 Indians, not included in the foregoing figures. In 1900 the population was 243,329, showing an increase during the decade of over 84 per cent. The males numbered 149,842, the females 93,487; the native-born, 176,262; the foreign-born, 67,067; the negroes, 1523; the Chinese, 1739; the Japanese, 2441; and the Indians, 11,343. There were 26 incorporated cities, towns, and villages, of which 11 had more than 2000 inhabitants, but only 4 over 5000, namely, Butte, with 30,470; Great Falls, with 14,930; Helena, the capital, with 10,770; and Anaconda, with 9453. The average number of persons to the square mile was 1·7, as compared with 0·9 in 1890, and the urban population was 28·8 per cent. of the total.

Education.—The public schools are supported by a direct tax, which may not exceed 10 mills on the dollar of the assessment of the district. There were 678 school districts in 1899; the enrolment was 37,117, and the number of teachers was 97 male and 929 female. The sum of $606,990 was apportioned to the 678 districts. The amount paid in 1899 for salaries was $511,829; the value of schoolhouses was $2,426,592. The state university at Missoula had, in 1890, 209 students and 20 instructors, the annual expenses being $58,284. A school of mines is under organization at Butte; the state agricultural college at Bozeman, in 1899, had 173 students and 14 instructors, the annual expenses being $23,500. The state normal school at Dillon had 45 students and 8 teachers, the annual expenses being $16,337.

Charities, &c.—The total number of prisoners in 1899 in the state prison at Deer Lodge was 328. In the insane hospital at Warm Springs the number of patients in 1899 was 477—male, 375; female, 102. The number of inmates in the state reform school at Miles City in 1899 was 72 (60 boys, 12 girls). In 1899 the school for deaf and dumb at Boulder had 21 pupils. On 1st December 1899 there were 51 inmates in the soldiers' home at Columbia Falls. The state orphans' home at Twin Bridges cared for 106 children in 1899. The agricultural college has issued bonds to the amount of $100,000; the normal school to the amount of $50,000; the university to the amount of $100,000; the deaf and dumb asylum to the amount of $40,000. The principal and interest on these bonds are secured by the several land grants made to the state by the U.S. Government.

Libraries.—The report of the United States Commissioner of Education for 1896 shows that in five years there was an increase of 227 per cent. in the number of volumes in Montana libraries, the total number of volumes being 86,093, exclusive of pamphlets. The largest free libraries are found at Helena, 29,966 volumes; Butte, 26,984; Anaconda, 5562; Bozeman, 8000; Missoula, 4828; Billings, 3500; Great Falls, 5148; and Dillon, 2105.

Minerals.—The principal mineral products are gold, silver, copper, and lead. The following statistics give the value of the mining industry for 1889 and 1899, the figures for the latter year being subject to slight revision:—

	Gold.	Silver.	Copper.	Lead.	Total.	Per cent. Increase over Preceding Year.
	$	$	$	$	$	
1889	3,500,000	19,393,939	13,334,970	456,975	36,685,884	3
1899	4,919,896	20,040,404	39,471,000	979,000	65,410,300	21½

Coal-mining is also a valuable industry. The total value of the coal output at the mines for 1898 amounted to $2,130,094.

Agriculture.—The agricultural products are much the same as those of the middle states, the yield, however, especially in cereals, being more abundant. The following figures show the acreage under cultivation and the yield for 1896:—

Crop.	Acreage.	Yield.
Oats . . .	64,911 acres	3,050,770 bushels
Wheat . . .	45,443 ,,	1,204,240 ,,
Barley . . .	5,701 ,,	142,525 ,,
Potatoes . . .	4,952 ,,	841,840 ,,

All grasses grow luxuriantly, and the harvest of hay from the irrigated lands is exceedingly large. In the southern valleys, on both sides of the main mountain range, both large and small fruits are grown in the greatest abundance. Fruit-growing has become a most important industry in several counties in the western part of the state. On 18th August 1894, as an inducement to the reclamation and settlement of arid lands, Congress passed the Carey Desert Land Act, which gave to the state the title to one million acres of arid lands, the title to be passed when the state should reclaim the lands. The state Legislature, by Act of 18th March 1895, formally accepted the offer, and passed an Arid Land Act, under which an irrigation commission was appointed, and provision made for securing funds for the reclamation of all the land offered. Surveys have been made for three canals in the eastern part of the state. These canals will render arable about 75,000 acres.

Stock-raising.—During 1898, owing to high prices prevailing for young stock, a smaller number of stock cattle came into the state than formerly, the total hardly exceeding 50,000 head, a falling off of more than 75 per cent. from the preceding year. During 1899, 50,000 head of young stock were shipped into the state, a considerable increase over the previous year, but still not as many as usual. In 1890, 124,035 cattle were shipped out of the state; estimating that 50,000 were consumed within Montana, the total amounted to 174,035. In 1898, 172,225 head of cattle were shipped to various markets. Estimating the home consumption at 60,000, the total was 232,225 head. The average price was estimated at $39 per head, an increase of about 5 per cent. over any previous year. In 1899, 143,498 head were shipped out of Montana, making a total of 203,498. The total assessed value of cattle in 1899 was $12,057,087. On the 1st of March 1898 there were 2,967,901 sheep assessed in the state, the valuation per head being placed at $2.52, making the total valuation $7,450,848. The number of sheep at this time was 3,146,868. The number of sheep brought in from other states from March to December 1898 was 79,277; the number of lambs, 1,217,057. The number of sheep and lambs slaughtered, sold, and shipped from March to December 1898 was 583,320. The number of pelts sold was 450,296, the price ranging from 6 cents to 9¾ cents per pound. The number of pounds of wool for the season's clip was 22,916,603, and the lowest and highest prices received by the producer were 7½ and 20 cents. In 1899 wool went as high as 22 cents. The total assessed value of sheep in 1899 was $8,302,944. Great numbers of horses—many of the very best type of driving and draught animals—are reared. The number shipped during 1899 was 35,000, and the total assessed value of horses was $3,289,726.

Railways.—The mileage of the chief lines of railways was as follows:—Northern Pacific railway, 1371 miles; Great Northern railway, 1066 miles; Great Falls and Canada railway, 133 miles; Oregon Short Line, 126 miles; Big Horn Southern, 101 miles; and Butte, Anaconda, and Pacific, 51 miles.

Banks.—There were at the end of 1899, 21 national banks, 13 private banks, and 14 state banks; their total capitalization and surplus was then $5,849,393; and the total deposits amounted to $28,732,447.

Finances.—In 1899 the assessed valuation of real property was $72,514,960; of personal, $54,610,006; and of railways, $14,992,689, giving a total of $142,117,655. On 30th November 1899 the outstanding registered general fund warrants amounted to $349,360; accrued interest (estimated), $5300; total debt, $354,660. The estimated taxes and licences due and unpaid were $357,000; cash on hand in general fund was $7957; total, $364,957; the estimated credit balance was $10,297. There was no bonded indebtedness. The rate of taxation differs in each county; the average was 24¾ mills in 1899 for state and county purposes; the tax for state purposes is limited to 2½ mills. The income is derived from this tax of 2½ mills, from licences, escheated estates, fees paid to state officers, inheritance tax, fines, &c. The income from all these sources (for general purposes, not for schools) for the fiscal year ending 30th November 1899 was $571,450; the expenses amounted to $588,727.

Manufactures.—The following table shows the manufacturing and mechanical industries as returned at the censuses of 1890 and 1900, and the percentage of increases:—

	1890.	1900.	Per cent. of Increase.
Number of establishments . .	289	1,080	273·7
Capital . . .	$4,293,794	$40,945,846	$853·6
Wage-earners, average number . .	2,386	10,117	324·0
Total wages . .	$1,652,413	$7,969,886	$ 382·3
Cost of material used	$2,375,093	$32,702,650	$1276·9
Value of products .	$5,507,573	$57,075,824	$ 936·3

The chief industry is the smelting and refining of copper; the total value of its products in 1900 was $36,387,063, or over half of that of the whole state. The smelting and refining of lead and lumber and timber products rank next in importance.

Religion.—The number of members or communicants in the chief denominations was in 1890 as follows:—Roman Catholic, 25,149; Methodist, 2425; Presbyterian, 1232; Protestant Episcopal, 1104; Disciples of Christ, 785; Baptist, 683; Congregational, 345; and Lutheran, 394.

Political Changes.—Politically Montana has been irregular since its admission as a state (8th November 1889). The Republican party was slightly in the lead in 1892, Harrison having secured the electoral vote by a plurality of 1270 votes over Cleveland, out of a total vote of 44,315. In 1896 interest in silver coinage was intense, and Bryan received 42,537 votes out of 53,217 cast. In 1900 Bryan received 37,146 votes and McKinley 25,373 votes out of a total of 63,641. The Populist party polled 15,240 votes in 1894, and 11,607 votes in 1898. The state officials elected in 1896 and 1899 were principally Democratic; in 1900 the entire Fusion (Democrat-Populist) state ticket was elected. The state has not experimented much in novel legislation. There are 24 counties in Montana. The Australian ballot system prevails.

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(W. H. H*.)

Montargis, chief town of arrondissement and an important railway junction, department of Loiret, 45 miles east by north of Orleans. A handsome modern building contains the town hall, public library, and museum. In the courtyard is a fine bronze group, "The Dog of Montargis," and in the town is a statue of Mirabeau erected 1888. The total port traffic in 1898 amounted to 162,579 tons. Population (1891), 9789; (1901), 10,517.

Montauban, chief town of department Tarn-et-Garonne, France, 411 miles south-south-west of Paris by rail. A monument to Leon Cladel was erected in 1895. Silk-mills give employment to a large number of workpeople, and the final dressing of textiles manufactured elsewhere constitutes a special industry. Population (1891), 16,732; (1901), 30,506 (comm.).

Montauban, Charles Cuillaume Marie Appollinaire Antoine Cousin de, COUNT DE PALIKAO (1796–1878), French general and statesman, was born in Paris on 24th June 1796. He entered the army as a cavalry officer, and saw much service in Algeria. His promotion was by no means rapid, and he was still but a colonel of spahis when, in 1847, he effected the long-sought capture of the famous guerilla leader, Abd-el-Kader. After rising to the rank of general of division, commanding the province of Constantine, he was appointed in 1858 to a command at home, and at the close of 1859 was selected to lead the French troops in the joint French and British expedition to China. Montauban's strategy left much to be desired, and more than once—notably at the landing near the Taku forts—the success of the allies was secured only by his yielding to the counsels of his colleague, Sir Hope Grant. After the capture of the forts the allies advanced upon Peking, scattered the huge but ill-trained Chinese army at Changkiawan and Palikao ("the Eight-Mile Bridge"), and dictated terms of peace in the capital. Montauban was made a senator by Napoleon III., and in 1862 received the title of Count de Palikao. But an indelible stain was cast upon the expedition by the plunder of the Summer Palace. Montauban himself was believed—though, as it seems, without foundation—to have acquired a vast fortune from the spoils, and on this ground the French Chamber rejected the Emperor's proposal for bestowing a large grant upon him. He remained unemployed till 1865, when he was appointed to the command of the 4th Army Corps at Lyons, in the training of which he displayed exceptional energy and administrative capacity. On the outbreak of the Franco-German war in 1870 he was not given a command in the field, but after the opening disasters of the war had shaken the Ollivier ministry he was entrusted by the Empress-Regent with the portfolio of war, and became president of the council in a new Liberal cabinet (10th August). He at once set to work with great success to reorganize the military resources of the nation. He claimed to have raised MacMahon's force at Châlons to 140,000 men, to have created three new army corps with their equipment, 33 new regiments and 100,000 *gardes mobiles*, and to have brought the neglected defences of the capital to a state of efficiency—and all this in twenty-four days. It was he who conceived the idea of sending MacMahon's army to raise the blockade of Metz. The scheme depended for its successful execution on a precision and rapidity of movement of which the army of Châlons was no longer capable. Political reasons caused the rejection of the only sound plan, to concentrate on Paris. Upon the news of the capitulation of Sedan, the majority of the deputies offered the dictatorship to Palikao; but he refused to desert the empire. He laid before the Corps Législatif a proposal to establish a council of national defence, consisting of five members elected by the deputies, with himself as "lieutenant-general of government"; but before a decision was made, the Chamber was invaded by the mob. Palikao fled to Belgium, and subsequently offered his sword to the Government of National Defence, which declined his services. On 20th July 1871 he appeared before the parliamentary commission of inquiry, and later in the same year published a defence of his administration under the title of *Un Ministère de la Guerre de vingt-quatre jours*. He again appeared in public as a witness in the action for libel brought by General Trochu against the *Figaro* in 1872. He died at Versailles on 8th January 1878. (H. SY.)

Montbéliard, chief town of arrondissement, department of Doubs, 46 miles east-north-east of Besançon by rail. It occupies a strategic position in the Gap of Belfort, and besides its ancient castle, now used for barracks, and a battery, is defended by outlying forts. A statue has been erected in memory of Colonel Denfert-Rochereau (d. 1878), leader of the defence at Belfort. Clocks and watches are made to the annual value of about £40,000. Population (1891), 8417; (1901), 9154.

See TÉNOT, EUGÈNE. *Les nouvelles défenses de la France; La Frontière*, 2nd ed. Bordeaux, 1893.

Montbrison, chief town of arrondissement, department of Loire, France, 22 miles north-west of St Étienne, on the railway from Clermont to St Étienne. It is situated on a volcanic hill overlooking the Vizezy, a right-bank affluent of the Lignon. The principal buildings are the church of Notre Dame (founded about 1220) and the 14th-century edifice known as Diana (Decana), restored in 1886, which serves as the meeting-place of an important archæological society. The town has also two hospitals and a statue of the poet de Laprade (died 1883), a native of the town. Cretonnes and other cotton fabrics and silk ribbons are manufactured, and there is considerable commerce in grain. Population (1881), 5803; (1901), 7520.

Montceau-les-Mines, town and railway station, arrondissement of Chalon-sur-Saône, department of Saône-et-Loire, France, 28 miles in direct line north-west of Macon. Its importance is chiefly due to its position as the centre of the Blanzy coal basin, in which about 10,000 persons are employed. Situated on the Canal du Centre, which is connected with the coalfield by numerous lines of railway, the total traffic in 1900 amounted to 436,487 tons. Various manufacturing establishments are in operation, including weaving and spinning factories, iron and copper foundries, and engineering workshops. Population (1901), 24,690.

Montclair, a township of Essex county, New Jersey, U.S.A. It is situated in 40° 49′ N., 74° 13′ W., on the east incline of Watchung Mountain, in the north-eastern part of the state. Owing to its sloping site, the altitude of the town varies from 217 to more than 500 feet. The street plan is irregular. The Delaware, Lackawanna and Western, and the Erie railways give direct and frequent communication with New York, of which it is a residential suburb. Population (1890), 8656; (1900), 13,962, of whom 3071 were foreign-born and 1344 were negroes.

Mont-de-Marsan, chief town of department Landes, France, 428 miles south-west of Paris, on the railway from Bordeaux to Tarbes, and at the confluence of the Midou and the Douze (=the Midouze). The local institutions comprise a lycée, female normal school, library, and hospital. The industries include distillation of resins, forges, and manufactures of drugget and of plaster. There is trade in resin, wine, brandy, oil-seeds, haricots, young pigs, mules, and horses. Population (1881), 8178; (1901), 11,604.

The town dates from the 12th century, when it was founded by Pierre, vicomte de Marsan, as the capital of his territory, though unsubstantial claims for an earlier foundation have been advanced. In the 13th century it passed to the viscounts of Béarn, but the harsh rule of Gaston Phœbus (of whose large prison some remains exist) and some of his successors alienated the loyalty of the people and induced them to favour the English. The territory was united to the French Crown on the accession of Henry IV.

Monte Carlo. See MONACO.

Montecatini, two much-frequented mineral baths of Tuscany, Italy. (1) In the province of Pisa, 5 miles west of Volterra. The water is saline, with a temperature of 78·8° F. There are also copper mines, which have been worked since the 15th century. Population, about 5000. (2) In the province of Lucca, 7 miles west by south of Pistoja, in the valley of the Nievole (see Ruskin's description in *Fors Clavigera*, vol. ii.). The springs, which number ten in all, are saline, and range in temperature from 82·4° to 86° F. The water is both drunk and used for bathing by some 40,000 visitors annually, and is exported in bottles to a great quantity. There is also a large natural vapour bath (80°–95° F.) in a grotto near by, discovered in 1849. Another attraction of the place is the gardens of Collodi, a model of Italian landscape gardening. Here the Florentines were defeated by Uguccione della Faggiuola of Pisa in 1315. Population, about 7000.

Montefiascone, a town and episcopal see of the province of Rome, Italy, built on a hill (1326 feet) at the south-east of Lake Bolseno, 47 miles by rail north-west of Rome. The cathedral (1519) is one of the earliest structures by Sammicheli. The town has in San Flaviano, built in 1030, rebuilt in the Gothic style in 1262, a curious double church; in its interior some 14th-century frescoes were discovered in 1896. In the crypt is the reputed grave of the German Bishop Fugger of Augsburg, who succumbed to over-copious libations of the local wine, known as Est, est, est. Population, about 6000.

Montefiore, Sir Moses Haim (1784–1885), Jewish philanthropist, eldest son of Joseph Elias Montefiore, a London merchant, and of Rachel, daughter of Abraham Lumbroso de Mattos Mocatta, was born at Leghorn, 24th October 1784. His paternal ancestors were Jewish merchants who settled at Ancona and Leghorn in the 17th century, whilst his grandfather, Moses Haim

Montefiore, emigrated from the latter town to London in 1758. Montefiore was educated privately, and after being articled for some time to a wholesale tea merchant he entered the Stock Exchange, his uncle purchasing for him at a cost of £12,000 the right to practise as one of the twelve Jewish brokers licensed by the City of London. Although belonging to the Sephardic or "Spanish" congregation of Jews, he married in 1812 Judith, a daughter of Levy Barent Cohen, of the "German" Jews, another of whose daughters was the wife of Nathan Mayer Rothschild, the head of the great banking firm; this relationship led to a close connexion in business between Montefiore and that house, whilst, further to cement the bond existing between the two families, his brother Abraham married Henrietta Rothschild, a sister of the financier. In 1824 Montefiore, having amassed a fortune, retired from the Stock Exchange, and during the next few years assisted in founding the Alliance Fire, Life and Marine Insurance Office, the Imperial Continental Gas Association, and the Provincial Bank of Ireland. From his forty-third year to the end of his exceptionally long and active life Montefiore devoted all his energies to ameliorating the lot of his co-religionists both in the United Kingdom and in other countries. His first pilgrimage to Palestine was undertaken in 1827, and resulted in a friendship with Mehemet Ali which was to lead to much practical good, though for the moment the visit was confined to the prosecution of fruitful inquiries and the bestowal of princely alms. Immediately on his return, Montefiore began to take an active part in the struggle which British Jews were then carrying on to obtain full political and civic rights. In 1837 he became the City of London's second Jewish sheriff, and was knighted. In 1838, accompanied by Lady Montefiore, he started on a second voyage to Palestine, in order to submit to Mehemet Ali a scheme for Jewish colonization in Syria. Though political disturbances rendered his efforts again unsuccessful, the year 1840 brought Montefiore once more before Mehemet, this time to plead the cause of some Jews imprisoned at Damascus on a charge of ritual murder. He obtained their release, and on his way back wrung from the Porte a decree giving Jews throughout Turkey the utmost privileges accorded to aliens. In 1846 the threatened reissue in Russia of an Imperial ukase (first promulgated in 1844) ordering the withdrawal of all Jews from within 50 versts of the German and Austrian frontiers, caused Montefiore to proceed to St Petersburg, where in an interview with the Tsar he succeeded in getting the ukase rescinded. On his return, Queen Victoria, on the recommendation of Sir Robert Peel, made him a baronet, to mark her appreciation of his efforts in the cause of humanity and civilization. In 1859 a case of injustice which attracted the attention of all Europe brought Sir Moses to the gates of the Vatican. A Jewish child named Mortara had been secretly baptized by its nurse and stolen from its mother, who died of grief. Cardinal Antonelli, in the name of the Pope, refused to give up the boy, who became a priest. In 1863 we find Montefiore on a mission in Constantinople to obtain from the Sultan, Abdul Aziz, the confirmation of his predecessor's decrees in favour of the Jews; in 1864 in Morocco to combat an outbreak of anti-Semitism; in 1866 in Syria, relieving the distress resulting from a plague of locusts and an epidemic of cholera; and in 1867 in Rumania, once more pleading the cause of the oppressed Jews with Prince Charles. In 1872 Montefiore was deputed by the British Jews to present to Alexander II. their congratulations on the bicentenary of the birth of Peter the Great, and was received by the Tsar with great honour at the Winter Palace. His seventh and last pilgrimage to the Holy Land was made in 1875, of which he wrote an account in his *Narrative of a Forty Days' Sojourn in the Holy Land*, published in that year. The last decade of his life was passed in comparative quiet upon his estate near Ramsgate in Kent; and there, after having received general congratulations on the completion of his hundredth year, he passed peacefully away on 28th July 1885. Sir Moses Montefiore was a strictly orthodox Jew, scrupulously observant of both the spirit and the letter of the Scriptures; in his grounds he had a synagogue built where services are still held twice a day, a college where ten rabbis live and expound the Jewish law, and a mausoleum that contains the remains of himself and of Lady Montefiore, who died in 1862. (J. A. J. DE V.)

Montefrio, a town of Spain, in the province of Granada, not far from the border of the province of Cordoba. The industries include manufactures of cotton stuffs, alcohol, and soap. The town is irregularly built, and has a modern parish church. It was an important fortress in the days of the Moorish rule, and there is a strong castle which commands the town. The population in 1897 was 10,404.

Montélimar, chief town of arrondissement, department of Drôme, France, 27 miles south of Valence, on the railway from Lyons to Marseilles. It has a communal college, library (12,000 volumes), and consultative chamber of agriculture. The industries include the manufacture of tiles and bricks, and alimentary conserves, and important saw-mills for dressed wood and parquetry. At Bondonneau, 2½ miles south-south-east, is a cold carbonated spring, utilized in a local thermal establishment. Population (1881), 8963; (1901), 13,351.

MONTENEGRO.

Enlargement of boundaries.

MONTENEGRO, or the Black Mountain (Servian *Tzrnágora;* Albanian *Mal Esiya;* the form Montenegro the Venetian variant of Montenero), though practically a free and self-governed state for more than five centuries, was for the first time formally recognized as an independent principality by the Great Powers and Turkey under the Berlin Treaty, 13th July 1878. The considerable increase of territory then accorded to the primitive little community, and the acquisition of two ports on the coast of the Adriatic, seem destined eventually to effect an important change in the character of the Montenegrins, and to modify the patriarchal customs and institutions to which they are still attached. Formerly confined to a barren tract of mountain land, and addicted exclusively to warlike pursuits, they are now in possession of rich well-watered plains, extensive pastures, and vast forests: the development of these new sources of wealth, as well as increased contact with the world of commerce, must sooner or later alter the conditions of life which have prevailed amongst them for so many centuries. The present frontier, which was not finally delimited till 1881, ascends the Boyana river from its mouth as far as Lake Shas, then follows the river Megured to the summit of Mount Bratovitza, reaching Lake Scutari at a spot opposite the island of Goritza Topal. Crossing the lake north-east to a point a little south-east of Plavnitza, and leaving the territory of the Hot and Klement tribes to the south, and the districts of Kutchka Kraina to the north, it passes north of the districts of Plava and Gusinye and reaches the western end of the Mokra Planina, where it turns to the north-west. After crossing the Lim at its junction with the Skula, it coincides with the old frontier for some distance; then reaching the Tara at Maikovatz, it follows the course of that river to near its junction with the Piva: turning southwards, it reaches the old frontier once more at Klobuk, and, passing between the district of Grahovo and the Krivoshian mountains, approaches to within a few kilometres of the Bocche di Cattaro: then, following the maritime mountain ridges for a considerable distance, it rejoins the coast a little south of Spizza. The district of Spizza was occupied by Austria subsequently to the Berlin Treaty, and the political and commercial barrier interposed between the Montenegrin hinterland and the sea was thus, unfortunately, extended. The possession of Antivari and Dulcigno will, however, considerably facilitate the future economic development of the principality, notwithstanding the inconvenient situation of these ports and their present commercial insignificance. Another probable consequence of the enlargement of boundaries will be the transference of the seat of government from the mountain village of Tzetinye (usually written Cettigne) to one of the towns in the newly-acquired territory, such as Nikshitch or Podgoritza, possessing greater advantages as a commercial and administrative centre.

Physical features.

In recent years the less known districts of the newly-acquired territory have been visited by several travellers, especially the finely-wooded tracts extending north of Nikshitch to the Dormitor mountain group; the remote region of the Vasoyevitchi, lying to the extreme east on either side of the upper Lim, has also been explored. The Dormitor district contains rich grassy uplands dotted with numerous small lakes, from which it derives its name of Yezera (the lakes); the rivers Tara and Piva flow through magnificent gorges clothed with rich forests, and unite near the extreme northern point of the frontier. In the district of the Vasoyevitchi, which surrounds the little town of Andriyevitza, is the fine double peak of Kom, and, a little to the south-west, the summit of Maglitch, commanding a magnificent view over the wooded valley of Gusinye to the great Prokletia range in Albania.[1] The contrast between the rich undulating landscape of the northern regions and the sterile calcined rocks of Montenegro proper is very remarkable. The mountains of the former districts together with those of the Brda are divided into four masses: (1) the group enclosed by the Tara and Piva rivers with Dormitor, one of the highest mountains in the Peninsula (2483 metres), Yablonov Vrkh (2168 metres), and the Vrkhove Pochoratz (2012 metres); (2) the group between the Zeta and the Moratcha with Ostri-Kuk (2300 metres), Vlasulya (2296 metres), Brnik (2091 metres), and Maganik (2018 metres); (3) the ranges between the Moratcha and Tara with Sto (2232 metres), and Gradishte (2181 metres); and (4) those between the upper Tara and the upper Lim with Kom, the second highest mountain in the country (Kom Kutchki (2448 metres), Kom Vasoyevitchki (2422 metres)), separating the districts of the Vasoyevitchi on the north-east from that of the Kutchi on the south-west, and Visitor (2114 metres), on the frontier. In Montenegro proper the only prominent summit is Lovchen (1723 metres), between Cettigne and the western frontier; its dark appearance, partly due to the shadow resting on its northern and eastern declivities during the greater part of the day, and partly to the dusky pine-woods on its upper slopes, has given a name to the whole country. In the maritime districts is the Sutorman range, with the fine pyramidal summit of Rumiya (1569 metres), overhanging Antivari. Beyond the Lim, at the extremity of the eastern frontier, is the Mokra Planina. The only extensive plains are those of Nikshitch and Podgoritza and the lowland tract between Dulcigno and the Boyana. Montenegro proper is almost absolutely waterless, the only stream being the Rieka, which probably drains the Cettigne valley by an underground outlet: its lower course is practically an inlet from Lake Scutari, and is navigable up to the town of Rieka. The scarcity of water has largely contributed to the successful defence of the country against Turkish invasion: the few springs are hidden in deep crannies among the rocks, and the inhabitants are accustomed to preserve melted snow for use during the summer. On the other hand, the Brda and north-eastern districts are abundantly watered. Lake Scutari (350 square kilometres) is among the most beautiful in Europe; its scenery may be compared with that of Lake Garda. The water is of a light green colour, and the bed shallow (average depth 2 to 3 fathoms).

Climate and natural products.

The climate generally resembles that of northern Albania; it is severe in the higher regions, and comparatively mild in the valleys, while in the maritime districts of Antivari and Dulcigno it may be compared with that of central Italy. The average temperature is about 15° (Celsius). The high basin of Cettigne (638 metres) is deeply covered with snow during the winter months, and the village capital is sometimes almost inaccessible; in summer the days are hot, but the nights are cool and frequently chilly. The alpine vegetation of the summits gives way to pine forests in the sub-alpine zone (1200 to 1800 metres): below these the beech, and then the oak, the walnut, the wild pear, and wild plum make their appearance; the fig-tree, the mulberry, and the vine grow in the middle Zeta and Moratcha valleys; the myrtle, orange, laurel, and olive in the lower Moratcha region, and more abundantly in the Tzrmnitza and maritime districts. The small patches of potato-culture among the boulders, together with the stone-built huts of the inhabitants, often roofed with shingle or straw, remind the traveller of western Ireland. The vineyards produce excellent grapes, but wine production, which might become an important industry, is at present limited to home consumption. Tobacco is now largely cultivated, especially in the neighbourhood of Podgoritza; the annual produce amounts to 250,000 kilogrammes. The leaves of the sumach (*Rhus cotinus*), which flourishes in the warmer districts, are exported for use in dye-works; the *Pyrethrum cinerariaefolium* supplies material for the manufacture of insect-powder; the fruit of the *Cornus mascula*, as well as the grape, is employed for the production of *raki*, a favourite beverage with the people. The grassy uplands of the northern and eastern districts afford magnificent pasturage; the native breed of cattle is small, but efforts are being made to improve it, and a stock-farm has been established by Prince Nicholas near Nikshitch. The horses, as elsewhere in the Balkan Peninsula, are diminutive, wiry, and intelligent. The arid rocks of Montenegro proper are infested with numerous reptiles, among them the scorpion and the dangerous *Vipera ammodytes*. Immense flocks of water-fowl haunt the upper reaches of Lake Scutari. The rivers abound with trout, tench, carp, and eels; the trout of the Moratcha are especially fine. More important from an economic point of view is the *scoranze* (*Leuciscus alburnus* : Servian *oklievi*), a kind of sardine, which supplies an article of food and merchandise to a considerable portion of the population. The fish, which enter the Rieka inlet of Lake Scutari during the winter, are taken with nets during a few weeks in the spring, when the fishing season is inaugurated with a religious service; they are salted and exported in large quantities to Trieste and the Dalmatian coast. The annual take is valued at 50,000 florins. The mineral resources of the country have not yet been investigated. Traces of iron, copper, and coal are said to exist, and a petroleum spring has been discovered.

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[1] This mountain must be distinguished from the higher Maglitch (2347 metres) on the northern frontier near the junction of the rivers Piva and Tara.

Commerce and industries. Communications.

The exports, valued at 1,179,960 florins in 1898, include cattle (large and small), smoked and salted meat known as *castradina*, cheese, undressed hides, *scoranze*, sumach, *pyrethrum*, tobacco, and wool. The imports, valued in the same year at 1,405,580 florins, consist mainly of manufactured articles, such as iron utensils and weapons, soap, candles, &c., and colonial products. An 8 per cent. *ad valorem* duty is levied on imports, and a further consumption tax of 2 per cent. The principal occupation of the people is cattle-rearing. The exportation of the animals is greatly hindered by the high tariff imposed on the Austrian frontier, which is productive of much illicit trading. Agriculture is still in its infancy, and the implements employed are of the most primitive kind. Bee-keeping is practised in the Kutchi district. There are practically no manufactures: the men disdain industrial employment, while the women are occupied by household duties or work in the fields. A brewery and a cloth factory, however, have been established at Nikshitch, a soda-water factory at Cettigne, and an olive-oil refinery at Antivari. The coarser cloth worn by the peasants is home-made; the finer kind worn by the wealthier class is imported. The progress of trade and the development of the natural resources of the country must largely depend on improved means of communication. In this direction considerable progress has already been achieved. Montenegro now possesses 180 kilometres of excellent carriage roads, admirably engineered and maintained. The remarkable zig-zag road from Cattaro to Niegush and Cettigne was completed in 1881; it has been prolonged to Rieka, Podgoritza, Danilovgrad (where a fine bridge across the Zeta was erected in 1870), and Nikshitch. Another road connects Podgoritza with its port, Plavnitza, on Lake Scutari; a third runs from Antivari to Vir-Bazar; when completed to Rieka, it will unite the sea-coast with the richest districts of the interior. The ports of Antivari and Dulcigno are insufficiently sheltered, but are capable of considerable improvement; both are places of call for the Austrian Lloyd steamers, and a regular service between the former and Bari on the Italian coast is maintained by the "Puglia" Steamship Company. The Boyana is navigable to sea-going vessels as far as Oboti (20 kilometres from its mouth), where cargoes for Scutari must be transferred to small river craft. The Anglo-Montenegrin Trading Company possesses two steamers on Lake Scutari. Postal and telegraphic communication is being rapidly extended. There are 18 post offices, and 20 telegraph stations, with 678 kilometres of wire. The telegraph, which is much used by the people (68,606 messages in 1898), will greatly facilitate the mobilization of the army. Hitherto the warriors have been summoned by stentorian couriers, who shouted from the tops of the mountains.

Area and population. Towns.

The population is usually estimated at about 230,000, or 25 to the square kilometre, the area being approximately 9000 square kilometres. According, however, to information officially furnished to the writer at Cettigne, the total number of inhabitants is 311,564, of whom 293,527 belong to the Orthodox Church, 12,493 are Moslems, and 5544 are Roman Catholics; 71,528, or 23 per cent., are literate, and 240,036, or 77 per cent., are illiterate. The official estimate of the area is 8433 square kilometres. The population was estimated as low as 160,000 by Schwartz in 1882. It is densest in the fertile eastern districts; Montenegro proper is sparsely inhabited. The Moslems have greatly decreased owing to emigration. The great majority of the people is of the Serb race; there are about 5000 Albanians, and 1000 gipsies. The principal towns are Podgoritza, the chief commercial centre (population about 5500); Dulcigno (5000); Nikshitch (3500); Cettigne (3200); Antivari (2500); Niegush (1800); Rieka (1500); Danilovgrad, founded by Prince Nicholas (1300); Kolashin, Vir-Bazar, Grahovo, and Andriyevitza. Cettigne, the seat of government, is a capital in miniature, possessing a palace, a theatre, foreign legations, public offices, a park, a hospital, a museum, a library, and a gaol. The little town, which a few years ago numbered only 1000 inhabitants, is rapidly increasing; the streets are regularly laid out and admirably kept. The palace, built in 1863, is an unpretending structure, but a new palace has been erected for the heir-apparent. Close by is the celebrated plane-tree, beneath which the prince gives audiences to his subjects, accepts their petitions, and settles their disputes. The adjacent Government buildings, and the monastery, which contains the tomb of the great *vladika*, Petar I., are fortified with towers. The prince possesses other residences at Niegush, Orialuka, Rieka, and Antivari.

National characteristics.

The Montenegrins present all the characteristics of a primitive race as yet but little affected by modern civilization. Society is still in that early stage of its development at which personal valour is regarded as the highest virtue, and warlike prowess constitutes the principal, if not the only, claim to pre-eminence. The chiefs are distinguished by the splendour of their arms and the richness of their costume; women occupy a subject position; the physically infirm adopt the profession of minstrels, and sing the exploits of their countrymen like the rhapsodists of the Homeric Age. A race of warriors, the Montenegrins are brave, proud, chivalrous, and patriotic; on the other hand, they are vain, lazy, cruel, and revengeful. They possess the domestic virtues of sobriety, chastity, and frugality, and are well-mannered, affable, and hospitable, though somewhat contemptuous of strangers. They are endowed in no small degree with the high-flown poetic temperament of the Serb race, and delight in interminable recitations of their martial deeds, which are sung to the strains of the *gûsla*, a rudimentary one-stringed fiddle. Like most imaginative peoples, they are extremely superstitious, and belief in the vampire, demons, and fairies is almost universal. The physical type contrasts with that of the northern Serbs: the features are more pronounced, the hair is darker, and the stature is greater. The men are tall, muscular, and wonderfully active, displaying a cat-like elasticity of movement when scaling their native rocks; their bearing is soldier-like and manly, though somewhat theatrical. The women, on the other hand, are short and stunted, though strong, owing to the drudgery imposed on them from childhood: they work in the fields, carry heavy burdens, and are generally treated as inferior beings. In public, and even in her own house, the wife does not dare to address her husband by his name; the husband begs to be excused should he inadvertently mention his wife in conversation. In time of war the women provide the commissariat, and carry the ammunition for their male relatives. Like the Albanians, the Montenegrins take great pride in personal adornment. The men wear a red embroidered waistcoat, over which a long plaid is sometimes thrown in cold weather; a red girdle, in the folds of which pistols and yataghans are placed; loose dark-blue breeches and white stockings, which are generally covered with gaiters; the *opanka* or *opinka*, a kind of sandal, is worn instead of boots. The head-dress is a small scarlet cap (*kapa*), edged with black, in token of mourning for the disastrous battle of Kossovo, and adorned with semicircular lines of gold braid enclosing the prince's monogram. A pale blue or green mantle is sometimes worn in addition by the chiefs. The poorer mountaineers are often dressed in coarse sacking, but all, without exception, carry arms. The women, as befits their servile condition, are generally clothed in black, and wear a black head-dress or veil; unmarried girls, however, are allowed to wear the scarlet *kapa.* The Vasoyevitch tribe retain the Albanian costume. The dwelling-houses are invariably of stone, except in the eastern districts, where wooden huts are found. As a rule, only the mansions of cattle-owners have a second storey: the ground floor, which is dark and unventilated, is occupied by the animals; the upper chambers, in which the family reside, are reached by a ladder or stone staircase. Chimneys are rare, and the smoke of the fireplace escapes through the windows (if any exist) or the open doorway. The principal food of the people is rye or maize cake, cheese, potatoes, and salted *scoranze;* their drink is water or sour milk; meat is seldom tasted, except on festive occasions, when *raki* and red wine are also enjoyed. The Montenegrins are great smokers: the men, whose dignity never permits them to carry burdens, may be seen going to market with the *chibûk,* or long pipe, slung across their backs. Family life presents few attractive features, owing to the degraded condition of the women: the mother possesses little influence over her sons, who are trained from their earliest infancy to cultivate warlike pursuits and to despise the weaker sex. Young men who are attached to each other are accustomed to swear eternal brotherhood (*pobratimstvo*); the bond, which receives the sanction of the Church, is never dissolved. The *zadruga,* or house-community, under the rule of a *stareshina,* or house-father, is found in Montenegro as in other Slavonic lands. The tribal system still exists, but possesses less significance than in Albania, owing to the centralization of authority at Cettigne. The tribe (*pleme,* pl. *plemena*) is subdivided into clans (*bratstva*).

Administration and justice.

Notwithstanding the creation of an elective Senate in 1831, the grant of a so-called constitution in 1868, and the establishment of a responsible ministry in 1874, the government is practically autocratic, the whole power being centred in the hands of the prince. The Senate, instituted by Petar II. with the object of limiting the power of the tribal chieftains, has now become merged in a Council of State, the members of which are nominated by the prince. The ministry comprises six departments: (1) The Interior, with separate sections for public works, posts and telegraphs, commerce and industry, shipping, sanitary service, and agriculture; (2) Foreign Affairs; (3) War; (4) Finance; (5) Justice; and (6) Education. The ministers have seats in the Council of State, of which the Minister of the Interior is *ex officio* president; they are nominated by the prince, and are responsible to him alone. A *Skupshtina,* or popular assembly, is summoned on rare occasions of national importance. For purposes of local administration the country is divided into ten *nahie* or departments, each governed by a "captain" or prefect (*okrûzhni kapetan*), who exercises judicial as well as administrative authority. The tribes, or *plemena,* eighty in number, are distributed among the *nahie.* Each is under an official, also styled *kapetan,* who holds a court of first instance. The *kapetans* of both categories are nominated by the prince. Rural communes, each under an elected *kmet* or mayor, exist in Montenegro as in all Slavonic countries. The *kmet* acts as justice of the peace, and there is an appeal from his decisions to the court of first instance. The commune comprises one or more of the *bratstva.* There is a High Court of Justice at Cettigne, from which there is an ultimate appeal to the prince. The local gendarmerie is under the control of the *kapetan.* The codification of the law, which had hitherto been administered according to unwritten custom, was first undertaken by Petar I. in 1796. An improved code, issued by Danilo II. in 1855, still contained many quaint enactments. The excellent code, drawn up by Professor Bogishitch, a native of Ragusa, in 1888, was revised and enlarged in 1899. It contains elements from various foreign systems scientifically adapted to national usages and requirements. Prince Nicholas and his predecessors have made great efforts to exterminate the vendetta, or blood-feud, and to put down robbery, which, if practised by means of raids across the frontier, is not condemned by public sentiment. The death penalty was first introduced by Petar I. Executions are carried out by a firing party selected from the various tribes, in order to prevent the relatives of the criminal from exacting vengeance.

Financial statistics are not published. The total receipts are stated to amount to 1,500,000 francs—the principal sources of income being the taxes on land, houses, and cattle, the monopolies of salt and alcohol, and the customs dues. The public debt is estimated at 2,500,000 francs. The contribution of Montenegro to the Ottoman Debt has not been fixed. The prince, who under the "constitution" of 1868 relinquished the control of the state revenue, enjoys a civil list of about 200,000 francs. From time to time considerable subventions have been received from Russia and Austria.

Defence.

The Montenegrin is a born warrior; his weapons, which he never lays aside, are his most precious possession, and distinction in battle is the sole object of his ambition. Brave to a fault, an unerring marksman, hardy, agile, crafty, and enduring, he has few rivals in the practice of guerilla warfare. The traditional method of fighting is by ambuscade: the enemy is enticed into some intricate defile, surrounded, and harassed by rifle-fire; then the mountaineers, throwing aside their firearms, deliver a swift attack with the *hanjar,* or yataghan, which they wield with terrific effect. Quarter is neither given nor expected; the wounded and the prisoners taken in battle are decapitated and their heads brought home in triumph; a number of these ghastly trophies adorned the parapet of a small tower near Cettigne as late as 1850. When reduced to extremity the Montenegrins often commit suicide rather than fall into the hands of the enemy, the last cartridge being reserved for this purpose; disabled comrades who cannot be removed are beheaded; in 1876 a Montenegrin offered to perform this friendly service for a Russian officer who was wounded at Klobuk. Savage methods of warfare, however, have been strongly discountenanced by Prince Nicholas and his predecessor. Till the middle of the 19th century the forces of the principality consisted of undisciplined bands of tribesmen under local chiefs, whose rivalries often proved injurious to the national cause. The nucleus of a permanent corps was created by Petar II., who formed a bodyguard of picked men known as *perianitzi,* from the feathers (*pera*) which adorned their caps. In 1853 Danilo II. ordered the enrolment of all persons capable of bearing arms, and instituted a military hierarchy of *voievodes* (generals), *sirdars* (colonels), and *kapetans;* the organization, which was based on the tribal system, was remodelled by Servian officers in 1870, when the chiefs were brought to Cettigne to receive military instruction. In the same year arms of precision were introduced: the cost and complex structure of the new weapons threatened to cause serious difficulty, but Russian aid was soon forthcoming. Since 1870 almost the whole supply of arms and ammunition has been provided by Russia. The military organization has undergone a gradual transformation under Prince Nicholas, in conformity with the changed circumstances of the country and the requirements of modern warfare. The militia organization on the tribal basis is maintained, but since 1896 a permanent battalion of 500 men has been established at Cettigne, Nikshitch, and Podgoritza, under a *komandir*, or major, 4 captains, and 15 lieutenants. It is composed of young men below the age of twenty-seven, who are drawn by lot and serve for four months; in this way a regular training is annually given to 1500 men. A permanent battery of artillery was formed in 1897, under a major, a captain, 2 lieutenants, and 18 sub-lieutenants. In time of war Montenegro can put into the field 42,000 men—the infantry is composed of 32,000 men of the first ban and 8000 of the second, or reserve; the artillery of 2000. The infantry is divided into 8 brigades, each containing from 6 to 8 battalions; the battalion is composed of a varying number of *tchete*, or companies, each of which belongs to a separate clan and has its own *bariaktar*, or standard-bearer. The younger men of the first ban are exercised in the neighbourhood of their homes on Sundays and holidays. They are armed either with the Berdan or the Moskovska (repeating) rifle. The artillery forms a brigade with 3 siege, 2 field, and 6 mountain batteries; its headquarters are at Spuzh, where the principal arsenal is situated. The *perianitzi*, whose numbers were increased by Prince Danilo, were disbanded in 1898, when a bodyguard of 3000 picked men was formed and placed under the command of Prince Mirko, Prince Nicholas's second son.

Religion and education.

The Montenegrin Church is an autocephalous branch of the Orthodox Greek communion. The *vladikas*, or prince-bishops, formerly depended on the Patriarchate of Ipek. The theocratic system of government which existed from 1516 to 1851 tended to unite the patriotic and the religious instincts of the people. Since the separation of the spiritual and temporal powers in the latter year, the see of Cettigne has been occupied by a metropolitan, styled *vladika*, who possesses a nominal jurisdiction over Scutari and the Primore, or South Dalmatian coast. There is a Roman Catholic archbishop at Antivari. The churches are small, unpretending structures, almost all exactly alike; a handsome cathedral, however, has been erected at Nikshitch. The monastic order is almost extinct; the parochial clergy, who number about 400, are only distinguishable from the laity by their beards; they wear the national costume, carry weapons, take part in warfare, and follow the ordinary avocations of the peasantry. Even the old vladikas discarded the episcopal robe, except when engaged in sacerdotal duties. The clergy are still for the most part extremely ignorant. The *Bogoslavia*, a seminary for the instruction of young priests and schoolmasters, was established at Cettigne in 1869. It is maintained by a subvention from the emperor of Russia, while the empress supports the *Zhenski Tzrnogorski Institut*, an excellently managed school for girls. In 1900 the number of pupils in the former was 45; in the latter, 70. In addition to these institutions there is a gymnasium, or high school, at Cettigne, with 4 classes (150 pupils in 1900). The revenues of the monasteries are now assigned to educational purposes, and primary instruction has been made obligatory for children over seven years of age. In 1900 there were 168 primary schools in the principality, with 180 teachers and 9756 pupils· of these 140 were maintained by the State and 28 by various communities; the Moslems and Roman Catholics have separate schools. The progress of education under Prince Nicholas has been very remarkable. In the time of his predecessor, Danilo II., who taught the sons of his chieftains in the palace, there were only 3 schools in the principality. In 1876, at the beginning of the war, there were 52 schools, with 62 teachers and 3159 pupils. The schools were closed during the war, and at its conclusion only 22 could be reopened, owing to want of funds. Elementary education was reorganized in 1878. An agricultural college has been founded at Podgoritza. Lecturers are appointed to explain to the peasants the advantages of learning. Higher education is still unobtainable, and the youth of the wealthier class complete their studies abroad.

Literature.

The Montenegrin language is practically identical with the Serbo-Croatian; it exhibits certain dialectical variations, and has borrowed to some extent from the Turkish and Italian. Existing manuscripts and printed books, chiefly psalters and gospels, bear witness to a period of literary culture among the clergy contemporaneous with the activity of the printing-press at Obod (1493–1566). The folk-songs, however, of which the first collection was made in the reign of Petar II., constitute the bulk of the national literature. The poems of that ruler are accounted among the classics of the Servian language, especially his *Gorski Vienatz*, a drama describing the massacre of the Montenegrin Moslems by their Christian kinsmen in 1702. The reigning family has produced a succession of poets; the songs of Mirko Petrovitch, the father of Prince Nicholas, and the lyrics and dramas of Prince Nicholas himself enjoy great celebrity. The *Grlitze*, or "Turtle-doves," a kind of almanac published at Cettigne by Milakovitch between 1835 and 1839, contained poems, tales, statistics, and an abridgment of the Montenegrin annals down to 1830; it was succeeded in the time of Danilo II. by the *Orlitch*, or "Eaglet." The first Montenegrin newspaper, the *Tzrnogoratz*, or "Montenegrin," founded in 1870, was prohibited on the Austrian frontier, and soon disappeared; it was replaced by the *Glas Tzrnogortza*, or "Voice of the Montenegrin," a semi-official publication, and at present the only journal in the principality.

Antiquities.

In Montenegro, as in Albania, the monuments of early civilization bear witness to Roman rather than to Greek influence. Roman remains occur in various parts of the country east of the Zeta, and early Latin churches exist at Dulcigno (*Ulcinium*) and other places. "The organization and forms of the churches, the architecture and ornamentation, point to the West and not to the East." It is evident that Latin civilization was firmly planted in Illyria before the barbarian incursions of the 6th century. Latin sepulchral inscriptions and some finely-cut marble blocks have been found at Berane, a little beyond the eastern frontier, and at Budimlye, in its neighbourhood. Especially interesting and important are the extensive ruins of *Doclea*, now known as Duklé, the birthplace of the Emperor Diocletian. The city, which received the franchise under the Flavian emperors, occupied a remarkable site at the junction of the rivers Zeta and Moratcha. The outer walls are standing in many places, and excavations carried out in 1893 by M. Rovinski and Mr J. A. R. Munro, Mr Milne, and Mr Anderson revealed a considerable portion of the ground-plan, including several streets and a forum. Among the buildings are a fine civil basilica, with a great inscription on the architrave, two small temples, an early Christian basilica, and a later church; several inscriptions, columns, richly-worked capitals and tracery, and mosaic pavements have been brought to light. At Medun there are remnants of polygonal masonry. Illyrian forts are found in many parts of the country. The ravages of the Turks have obliterated almost every trace of culture of the Middle Ages. A few ruins mark the site of the fortress of Obod, near Rieka, where the celebrated printing-press, which sent out the Gospel to all Slavonic lands, was founded in 1493: a fragment of one of the first gospels printed here is shown at Cettigne; it bears the date 1494. Other editions are preserved at Moscow and in the monastery of Tzainitza, on the Bosnian side of the frontier.

Recent history.

Shortly after the accession of Nicholas (13th August 1860), an insurrection broke out in Herzegovina, and the sympathy which the mountaineers displayed with their Christian kinsmen led to a rupture with Turkey (1862). Notwithstanding the heroic defence of Ostrog by the prince's father, Mirko Petrovitch, "the Sword of Montenegro," the war proved disastrous, owing to the superior armament and discipline of the Turkish troops, and severe terms were imposed on the principality by the convention of Scutari (31st August). During the fourteen years of peace which followed, the country suffered greatly from pestilence and famine. Within this period a series of reforms were carried out by the prince: the army was rearmed and reorganized, an educational system was initiated, and a constitution under which the prince surrendered various prerogatives to the Senate was granted. In 1869 the Krivoshians, or Serb inhabitants of the northern shores of the Bocche di Cattaro, rose against the Austrian Government: the excitement in Montenegro was intense, but the prince succeeded in checking the warlike ardour of his subjects. The revolt in Bosnia and Herzegovina in 1875 had more important consequences for the principality. On the 2nd July 1876, Prince Nicholas, in alliance with Prince Milan of Servia, declared war against Turkey and invaded Herzegovina. A victory was gained at Vuchidol (28th July) and Medun was captured; but the Servian army suffered reverses, and an armistice was arranged in November. In the following spring the determination of Russia to take the field against Turkey encouraged the Montenegrins to renew the war. The Turks succeeded in occupying Ostrog, but were subsequently repulsed; the greater part of their forces was soon withdrawn to Bulgaria, and Prince Nicholas captured successively Nikshitch, Antivari, and Dulcigno. The recovery of the seaboard, which had belonged to Montenegro in the Middle Ages, was perhaps the principal achievement of the war. The enlargement of territory stipulated for by Russia under the treaty of San Stefano (3rd March 1878) would have brought Montenegro into close contiguity with Servia, thus facilitating the eventual union of the Serb race and closing the path of Austria towards the Ægean. The Berlin Treaty (article xxviii.) gave to Montenegro Nikshitch, Spuzh, Podgoritza, Plava, Gusinye, and Antivari, but restored Dulcigno to Turkey. The resistance of the Moslem inhabitants of Plava and Gusinye to annexation led to long negotiations, and eventually the "Corti Compromise" was agreed to by a conference of the Powers at Constantinople (18th April 1880). Plava and Gusinye were to be restored to Turkey, while the Montenegrin frontier was extended so as to include the Hot and the greater part of the Klement tribes. This arrangement, which could hardly have proved successful, was not carried out by Turkey, and the Powers subsequently decided to annex Dulcigno to Montenegro in exchange for Plava and Gusinye. The Porte interposed delays, though consenting in principle, and the Albanian League (see Albania) assumed a menacing attitude. On the 28th September the fleets of the Powers under Admiral Seymour appeared off Dulcigno, and the British Government shortly afterwards proposed to occupy Smyrna. On the 11th November the Porte yielded; on the 22nd the Turkish troops defeated the Albanians, and on the 25th Montenegro obtained possession of Dulcigno. The present frontier, as already described, was shortly afterwards delimited by an international commission. With the exception of some frontier troubles, the years since 1880 have been spent in peace, and the country has advanced in prosperity under the autocratic but enlightened rule of Prince Nicholas. The relations with Turkey, the traditional foe, have improved, while those with Austria have become less friendly. In July 1893 the four-hundredth anniversary of the foundation of the printing-press at Obod was celebrated at Cettigne, several foreign universities and learned bodies being represented at the festivities. In September 1896 the bicentenary of the Petrovitch dynasty was commemorated.

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Montepulciano, a town and episcopal see of the province of Siena, Tuscany, Italy, 44 miles south-east of Siena by rail. It crowns the summit of a hill (2074 feet), and is still surrounded by mediæval walls. Amongst its noteworthy buildings are several interesting private mansions of the 16th and later centuries, the church of the Madonna, built by Antonio da Sangallo, senior, in 1518–37, the cathedral (restored in 1888), a fountain (1520), and a 14th-century town hall, with a small picture-gallery. Montepulciano is famous for its wine, and was the birthplace of Cardinal Bellarmino (1542–1621). Population (1881), 5142; (1899), 3000.

Montereau, town and railway station, arrondissement of Fontainebleau, department of Seine-et-Marne, France, 17 miles in direct line south-east of Melun, at the confluence of the Yonne with the Seine. The church is a handsome edifice dating from the 13th century, with later additions, including the façade of the Renaissance period. The Asylum Napoléon is an institution for wounded and infirm soldiers. On the right bank of the river is the Château de Surville. The industries include a large porcelain factory, the manufacture of refractive and decorative bricks, whiting, and biscuits, and carriage-building. Population (1881), 7031; (1901), 7898.

Montereau, partly of monastic and partly of feudal origin, was in the beginning of the 15th century a place of some importance. Here, on the bridge over the Yonne, the duke of Burgundy was assassinated in the presence of the Dauphin, afterwards Charles VII., in 1419. In 1438 the town was captured by Charles VII., and during the wars of religion it was several times taken and retaken. In 1814 Napoleon gained a victory at Montereau over the Würtemberg troops under Schwarzenberg, and in memory of this his statue has been erected between the two bridges.

Monterey, a city and township in Monterey county, California, U.S.A., on the southern end of the Bay of Monterey. It is about 90 miles south-south-east of San Francisco in a direct line, and 125 miles by the railway (on the coast division of the Southern Pacific railway).

The Bay of Monterey was discovered by Vizcaino in 1602, and in 1770 a mission was established here, upon the site of which is built the present Roman Catholic church. It was at Monterey, which was the capital of California prior to the Mexican war, that the commander of a U.S. frigate hoisted the American flag and proclaimed California a part of the United States (7th July 1846). Monterey has become a popular watering-place and winter resort, on account of its mild and agreeable climate and its attractive environs. Population of the town (1890), 4677; (1900), 3420 (Pacific Grove township, with a population of 1439 in 1900, having been organized from a part of Monterey township since 1890). The population of the city in 1890 was 1662, and in 1900 it was 1748.

Monterey, a city of Mexico, and capital of the state of Nuevo Leon, situated 675 miles from the city of Mexico by railway. It is a handsome and progressive city, and the commercial centre of northern Mexico. It has important manufactories, foundries, saw mills and flour mills, and 9 miles of tramways. It possesses fine public buildings and all the conveniences of modern civilization. Population, 45,695.

Montevideo, the principal city and port of Uruguay, South America, on the north side of the La Plata, 120 miles east by south of Buenos Aires. It is the capital of the department of the same name, and had in 1892 a population of 238,080, which at the end of 1899 was estimated to have become about 250,000. The percentage of the port of Montevideo in the general foreign trade of Uruguay between 1894 and 1898 was as follows:—

	1894.	1895.	1896.	1897.	1898.
Imports .	90·74	87·40	86·46	87·27	85·28
Exports .	63·48	61·68	62·78	68·78	63·66

The value of the imports and exports through the same port during the same period was:—

	1894.	1895.	1896.	1897.	1898.
Imports	[a] $21,596,203	$22,187,198	$22,072,972	$17,028,733	$21,135,967
Exports .	21,250,896	20,070,577	19,086,956	20,168,047	19,272,554

[a] $=1·034 U.S. gold currency.

In 1899, 3974 vessels of 4,105,102 tons entered the port in all—foreign, coasting, and river trade. Of the entrances in 1898, 969 steamers (1,945,884 tons) were from abroad, 35 (54,694 tons) being in ballast. Extensive port improvements in the harbour, calling for an expenditure of not less than £2,100,000, have been sanctioned, including the deepening of the channel into the harbour so as to leave 24½ feet at low water, and the constructing of a careening dock over 600 feet long and of corresponding width, with 25 feet of water on the lowest beams.

Montgomery, a town and district of British India, in the Lahore division of the Punjab. The town has a railway station, about half-way between Lahore and Mooltan. Population (1881), 3178; (1891), 5159; municipal income (1897–98), Rs.15,403. It was founded in 1864, on the opening of the railway, and called after Sir H. Montgomery, then lieutenant-governor. It has a municipal high school, with boarding-house, and two literary institutions.

The district of MONTGOMERY lies in the Bari Doab, or tract between the Sutlej and the Ravi, extending also across the latter river. Area, 5754 square miles; population (1881), 426,529; (1891), 499,521; (1901), 463,585, showing an increase of 17 per cent., due to the extension of irrigation, between 1881 and 1891, but an apparent decrease of 7·2 per cent. between 1891 and 1901; average density, 80 persons per square mile. The land revenue and rates in 1897–98 were Rs.6,35,298, the incidence of assessment being Rs.0:3:8 per acre; cultivated area, 357,029 acres, of which 318,225 were irrigated, including 136,024 from Government canals; number of police, 465; number of schools (1896–97), 168, attended by 3572 boys, being 6·8 per cent. of the boys of school-going age; death-rate (1897), 23 per thousand. The principal crops are wheat, pulse, cotton, and fodder. Camels are bred for export. The leading manufactures are of cotton and silk, and lacquered woodwork, and there are four factories for ginning and pressing cotton. The district is traversed for 82 miles by the main line of the North-Western railway, from Lahore to Mooltan; and there are 243 miles of navigable rivers. It is irrigated by the Upper Sutlej inundation canal system, and also from the Ravi.

Montgomery, a city of Alabama, U.S.A., capital of Montgomery county and of the state, on the left bank of the Alabama river, which is here navigable, in the south-east of the centre of the state, at an altitude of 162 feet. The city has a regular plan, is supplied with water by pumping by a private corporation, and is divided into six wards. It is entered by six railways, and these, with the river, give it a large commerce, principally in cotton and lumber. Its manufactures, which are of great variety, had in 1900 a total capital of $2,930,782, and employed an average number of 2359 wage-earners. The total products were valued at $5,035,190. The assessed valuation of the real and personal property of the city in 1900, on a basis of about three-quarters of the full value, was $12,555,770; the net debt was $2,050,551, and the tax-rate $22.75 per $1000. Population (1890), 21,883; (1900), 30,346.

Montgomeryshire, an inland county of North Wales, bounded on the N.W. by Merioneth, on the N. by Denbigh, on the E. and S.E. by Shropshire, on the S. by Radnor, and on the S.W. by Cardigan.

Area and Population.—The area of the ancient and administrative county, as given in the census returns, is 510,111 acres, or 797 square miles, with a population in 1881 of 65,710, in 1891 of 58,003 (of whom 28,222 were males and 29,781 females), and in 1901 of 54,892, the number of persons per square mile being 68·8, and of acres to a person 9·3. The area of the registration county is 589,846 acres, with a population in 1891 of 67,297. Between 1881 and 1891 the decrease of population was 11·68 per cent., and between 1891 and 1901, 5·3 per cent. The excess of births over deaths between 1871 and 1881 was 6886, but the decrease in the resident population was 8900. The following table gives the numbers of marriages, births, and deaths, with the number and percentage of illegitimate births, for 1880, 1890, and 1898:—

Year.	Marriages.	Births.	Deaths.	Illegitimate Births.	
				No.	Per cent.
1880	404	2200	1402	195	8·9
1890	426	1694	1244	137	8·3
1898	425	1677	1121	131	7·8

In 1891 there were in the county 179 natives of Scotland, 130 natives of Ireland, and 42 foreigners, while 31,770 persons could speak English, 16,414 Welsh, and 15,846 English and Welsh.

Constitution and Government.—The county returns one member to Parliament, and it also includes the Montgomery district of parliamentary boroughs (consisting of Llanfyllin, Llanidloes, Machynlleth, Montgomery, Newtown, and Welshpool), which returns one member. There are four municipal boroughs: Llanfyllin (1632), Llanidloes (2769), Montgomery (1034), and Welshpool (6121). The urban districts are Machynlleth (2038) and Newtown and Llanllwchaiarn (6500). Montgomeryshire is in the North Wales and Chester circuit, and assizes are held at Welshpool and Newtown alternately. The borough of Welshpool has a separate commission of the peace, but no separate court of quarter sessions. The ancient county, which is in the dioceses of Bangor, Hereford, and St Asaph, contains 59 ecclesiastical parishes or districts, and parts of 11 others.

Education.—The total number of elementary schools on 31st August 1899 was 94, of which 28 were board and 66 voluntary schools, the latter including 59 National Church of England schools, and 7 "British and other." The average attendance at board schools was 2474, and at voluntary schools 4970. The total school board receipts for the year ended 29th September 1899 were over £8412. The income under the Agricultural Rates Act was over £775.

Agriculture.—Considerably more than one-half of the total area is under cultivation, and of this about two-thirds is in permanent pasture, in addition to which nearly 156,000 acres are in hill pasturage, while about 650 acres are under orchards and 25,000 acres under woods. Of the acreage under corn crops, which since 1880 has decreased by about a sixth, more than half is under oats, about two-sevenths under wheat, and about one-fifth under barley. The acreage under green crops is very inconsiderable, pasturage being mainly depended on for the winter forage of sheep. Nearly seven-ninths of the green crop acreage is under potatoes, and a little more than one-fifth is under turnips. Cattle are largely kept, specially for dairy purposes, and as a sheep-pasturing county it ranks after Brecon and Merioneth. The following table gives the larger main divisions of the cultivated area at intervals of five years from 1880:—

Year.	Total Area under Cultivation.	Corn Crops.	Green Crops.	Clover.	Permanent Pasture.	Fallow.
1880	252,961	50,743	11,061	24,966	161,866	4322
1885	257,061	49,411	11,187	27,422	166,404	2637
1890	266,363	46,682	11,097	30,280	175,482	2759
1895	270,783	43,100	10,551	29,706	185,787	1507
1900	273,889	40,274	9,518	30,941	192,099	1004

The following table gives particulars regarding the principal live-stock for the same years:—

Year.	Total Horses.	Total Cattle.	Cows or Heifers in Milk or in Calf.	Sheep.	Pigs.
1880	13,835	62,906	21,965	325,980	19,417
1885	14,827	68,902	23,692	339,997	22,575
1890	14,891	67,519	23,673	376,673	25,614
1895	15,793	69,950	22,562	367,856	27,141
1900	15,695	73,273	23,760	433,145	22,521

Industries and Trade.—According to the report for 1898 of the chief inspector of factories (1900), the total number of persons employed in factories and workshops in 1897 was 2142, as compared with 2063 in 1896. In 1899, 9371 tons of limestone were raised. Zinc has almost ceased to be raised, but barytes is mined in some quantities. The following table gives particulars of the production of lead and slate in 1895 and 1899:—

Year.	Lead.		Slate.	
	Tons.	Value.	Tons.	Value.
1890	617	£5775	1412	£3222
1899	616	6476	2191	5993

AUTHORITIES.—*Collections, Historical and Archæological, relating to Montgomeryshire* (issued by the Powysland Club). London, 1868.—*Pedigrees of Montgomeryshire Families* (published by the same club). London, 1888.—WILLIAMS. *Montgomeryshire Worthies.* Newtown, 1894.—Guide-books to North Wales. (T. F. H.)

Montignies-sur-Sambre, a town of Belgium, in the province of Hainaut, 25 miles east of Mons, with a station on a branch of the line from Charleroi to Namur. There are coal-mines in its vicinity, and the town has blast-furnaces, rolling-mills, and machine and nail factories. Population (1880), 13,326; (1900), 18,440.

Montluçon, a town of France, capital of an arrondissement of the same name in the department of Allier. It lies on both banks of the Cher, and is an important railway junction of the lines Bourges–Moulins and Mont St Sulpice–Tours–Auzances of the Orleans railway. Its close proximity to the coalfields of Commentry has greatly favoured its industrial development, which in the last few years has made rapid advances. The chief articles of manufacture are cutlery, bronze goods, and linen; in addition there are tanneries and iron forges. Population (1891), 24,911; (1901), 35,062.

Montoro, a town of Spain, in the province of Cordoba, on the river Guadalquivir. The population in 1897 had increased to 12,734. The progressive spirit of the inhabitants is shown by the well-kept streets, electric light, water conveyed by an aqueduct from mountains several miles away, public fountains, schools for both sexes, an institute, 184 oil mills, and markets and fairs where many agricultural products and much live stock are brought from the fertile country around. Much timber is also brought from the woods in the hills. The churches of St Bartholomew, with a fine spire, San Juan de la Cruz, and San Sebastian are good specimens of Spanish church architecture of the Renaissance.

Montpelier, a city of Vermont, U.S.A., capital of Washington county and of the state, on the Winooski river, and the Central Vermont and the Montpelier and Wells River railways, in the northern half of the state, at an altitude of 484 feet. It is prettily laid out on a hilly picturesque site, and is well built. Its principal industry is the quarrying of granite in the neighbourhood. Its manufacturing establishments in 1900 employed an average number of 1019 wage-earners, and had products valued at $1,591,958. Population (1890), 4160; (1900), 6266.

Montpellier, chief town of department Hérault, France, 490 miles south-south-east of Paris, on the railway from Bordeaux to Cette. The modern church of St Roch contains a statue of its patron, and a monument has been erected to Planchon, who did much to improve the vineyards of the surrounding district. The Palais des Facultés was opened in 1890, and the theatre rebuilt in 1883. Some 1500 students attend the university. There is a municipal library, containing 120,000 volumes and 10,000 prints and engravings. Population (1881), 45,397; (1891), 58,380; (1901), 75,950.

Montreal, a city of Hochelaga county, Quebec, and the largest city in the Dominion of Canada, situated on an island of the same name at the confluence of the Ottawa and St Lawrence rivers. The observatory in the grounds of M'Gill University stands at a height of 187 feet above the level of the sea in 45° 30′ 17″ N. and 73° 34′ 40·05″ W.—the most accurately determined position in America. The city is advantageously situated at the head of ocean navigation—the channel below the city permitting the passage of vessels drawing 27½ feet at low water—and at the eastern terminus of inland navigation, the enlarged St Lawrence canals furnishing a 14-feet waterway to the head of the Great Lakes. It is on the Grand Trunk, Canadian Pacific, Intercolonial, Canada Atlantic, New York Central, Central Vermont, and Delaware and Hudson railways, and during the season of navigation several lines of well-appointed steamers maintain communication with Liverpool, Glasgow, Bristol, Manchester, and the principal ports on the gulf and river St Lawrence and the Great Lakes. The Montreal Street (110 miles), Park and Island (36 miles), and Belt Line (12 miles) electric railways afford rapid and easy communication with all parts of the city, suburbs, and neighbouring towns. The famous Victoria bridge having proved inadequate to the traffic, and having been designed for maximum loads of less than one-half the present requirements, was replaced by the Victoria Jubilee bridge, opened in December 1898. The new structure consists of 24 spans of pin-connected "through" steel trusses, each 254 feet long, and one of 348 feet over the steamboat channel, carrying two tracks for steam railway trains and electric cars, with roadways on each side for vehicular traffic and foot passengers. The Canadian Pacific railway crosses the St Lawrence at the foot of Lake St Louis, about 6 miles above the city. The charities are numerous, and include 8 hospitals—5 Protestant and 3 Roman Catholic—orphanages, houses of refuge, deaf and dumb asylums, &c. There are 65 Protestant churches and chapels, 27 Roman Catholic, 2 synagogues, and 26 convents and monasteries. In 1898 the Roman Catholic committee controlled 17 elementary and 4 model schools, 12 academies and 3 colleges, with 871 teachers and 18,398 pupils; the Protestant committee controlled 12 elementary schools and 3 academies, with 251 teachers and 9103 pupils. McGill University, the foremost educational institution in the province, embraces the faculties of arts, law, medicine, applied science and comparative medicine, and veterinary science. In addition to the four affiliated theological colleges—Presbyterian, Diocesan, Wesleyan, and Congregational—three others, Morrin, Stanstead, and Vancouver, are affiliated in arts. Later additions to the university are the chemistry and mining, the physics and the engineering buildings, and the Royal Victoria College for women, all built and equipped on a scale of great completeness by wealthy citizens. Laval, the Roman Catholic university, includes the faculties of theology, law, medicine, and arts. There are two normal schools, a high school, two affiliated medical colleges—one with Laval and the other with Bishops College, Lennoxville,—the Jesuit college, and the seminary of St Sulpice. The city is the seat of the head offices of the Grand Trunk and Canadian Pacific railways, and of six banks—Montreal, Merchants', British North America (in Canada), Molsons, Jacques Cartier, and Hochelaga—with a total paid-up capital of $27,000,000. It contains many flourishing industries, including manufactories of steam engines, boilers, printing-presses, musical instruments, boots and shoes, tobacco, rubber, paper, rope, glass, carriages, wooden ware, paints and drugs; also iron and brass foundries, rolling-mills, flour mills, distilleries, and breweries. The harbour is spacious; there are fine stone docks, and extensive enlargements and improvements are in progress, including an elevator with a capacity of 3,000,000 bushels and three high-level piers, each 825 feet long and 300 feet wide. In the year ending 30th June 1890 the exports from the port were $31,660,216; in 1900–01, $59,708,154; in 1889–90 the imports were $45,934,406; in 1900–01, $64,372,300, and duty collected $9,018,660. In the year 1901, 742 sea-going vessels of 1,453,048 tons cleared for sea, and 8450 coasting vessels of 1,683,186 tons departed; total tonnage, 3,136,234 tons. In 1899 the exports of wheat totalled 13,588,098 bushels; horned cattle, 71,488; sheep, 48,073; horses, 6462; cheese, 146,285,909 ℔; and butter, 28,068,280 ℔. The clearances at the clearing-house amounted in 1897 to $601,185,000, and in 1901 to $889,479,000. The total assessment in 1885 was $72,877,834; in 1890, $123,891,140; and in 1902, $188,000,000; exemptions increased from $14,675,316 in 1885 to $38,000,000 in 1899; total expenditure in 1901, $3,131,920; and total receipts, $3,570,880. In 1883 Hochelaga (population, 5000), in 1884 St Jean Baptiste (8700), in 1887 St Gabriel (7800), and in 1893 St Denis ward were annexed. Population (1881), 140,747; (1891), 216,644; (1901), 267,730; or, if the adjoining suburbs of St Henri, St Cunegonde, Westmount, &c., are included, about 335,000. (J. WH*.)

Montreuil-sous-Bois, town, arrondissement of Sceaux, department of Seine, France, 4 miles east of Paris, on the slope and summit of a hill, about 1 mile north of Vincennes. Montreuil is now specially noted for its extensive peach orchards, covering about 590 acres and yielding annually from 12 to 15 millions of peaches. The manufactures include paint and varnish, oils, glue, soap, patent leather, and chemicals. Gypsum is quarried. Population (1891), 23,891; (1901), 31,773 (comm.).

Montrose, a royal and parliamentary burgh (Montrose group) and seaport of Forfarshire, Scotland, at the mouth of the South Esk, 30¾ miles north-east of Dundee by rail. Ropeworks and chemical works are amongst the minor industrial features. 551 vessels of 94,462 tons entered in 1888; in 1900, 440 vessels of 51,521 tons. Imports were valued at £220,401 in 1888, and £173,221 in 1900; exports, £102,443 in 1888, and £19,106 in 1900. A new park was laid out in 1890. A museum, the infirmary, and a memorial hall have been enlarged; the new market has been converted into a public hall, and a railway viaduct built over the Esk. A Roman Catholic chapel and an additional public school have been erected. Population (1891), 12,428; (1901), 12,401. (See FORFARSHIRE for fishing statistics.

Montserrat, one of the presidencies of the Leeward Islands, British West Indies. The population in 1881 was 10,083, in 1891 it was 11,762, and in 1901 it was 12,215. The death-rate is 25·77 per thousand. The mean shade temperature at an elevation of 400 feet is 78° to 79° F. The rainfall varies from 40 to 80 inches per annum according to situation. In 1900 the average rainfall at seven stations was 42·68 inches. Montserrat is considered one of the most healthy islands in the West Indies, being remarkably free from epidemics. The chief products are sugar and molasses, lime-juice and essential oils produced from limes. Arrowroot, coffee, and cocoa are also exported. The island offers special facilities for growing citrus fruits. It is well watered, and possesses good roads. Nearly all the lime-trees, covering about 1000 acres, principally in the northern part of the island, were uprooted by a violent hurricane on 7th August 1899. The value of the imports for the three years ending 1880 averaged £26,390; those of 1899 were valued at £14,265. The exports for the same periods were £32,963 and £12,893. The revenue in 1900 was £6664, and the expenditure £9597, the deficiency being covered by grants from the British exchequer. The public debt was £11,400. The total tonnage of vessels entered and cleared during 1900 was 198,730 (185,350 steam, 13,380 sailing). Education is nominally compulsory. In 1899 there were 7 Anglican schools with 4681 scholars, 3 Wesleyan with 672, 1 Roman Catholic with 113, and 2 undenominational with 511. Montserrat has a legislative council consisting of the governor and 6 nominated members, 3 official and 3 unofficial.

Monza, a town of the province of Milan, Lombardy, Italy, 11 miles north-east of Milan by rail. It has a polytechnic school (1889), and is the seat of a commercial court of arbitration. Population (1881), 17,000; (1899), 12,000.

Moody, Dwight Lyman (1837–1899), American evangelist, was born at East Northfield, Massachusetts, 5th February 1837. In 1855, while a salesman in the shoe trade in Boston, he was "converted," and at once became active in religious work. He continued this religious activity on his removal to Chicago in 1856, and in 1860 gave up business to devote himself to evangelizing. In 1865 he became president of the Chicago Young Men's Christian Association, and wielded a large influence also in other cities. He first became widely famous through a series of evangelistic meetings in Great Britain, held jointly with Ira D. Sankey, in 1873. After that he held similar meetings from time to time in all the important cities of the United States, visiting Great Britain again in 1881, 1883, and 1899. It is estimated that he addressed over 50,000,000 persons during his life. Beginning with a small school for girls in 1879, he developed at his home in Northfield, Mass., the Mount Hermon School for boys, the Northfield Seminary for boys, and the school for Christian workers, while, in addition, great religious conferences were held at Northfield during the summer months. During the twenty years preceding his death, which took place at Northfield on 22nd December 1899, Moody devoted his summers to this work of religious education. Moody was a man of strong physical constitution and even temperament. He had no academic training, and his theology was that of the orthodox Church of the early middle century; but there was no sectarianism in his work, and he co-operated with men whose theological opinions he could not accept, such as Henry Drummond, George Adam Smith, and Henry Ward Beecher. The elements that constituted his strength were a rugged simplicity and absolute sincerity.

Moon.—Since the publication of the earlier volumes (ninth edition) of this Encyclopædia, a new method of working out the inequalities in the motion of the moon produced by the disturbing action of the sun has been developed and is being prosecuted to a successful conclusion. The establishment of the principle on which the method is based is due to George W. Hill. We recall that when the co-ordinates of the moon are expressed algebraically in terms of the elements of the moon's motion, they appear as an infinite series, proceeding according to the powers of four quantities, namely: e, the moon's eccentricity; i, the inclination of its orbit; $\acute{e}$, the eccentricity of the earth's orbit; and m, the ratio of the moon's mean motion to that of the earth. Of these four quantities, the first three belong to the class of elements, while the fourth may be considered as a measure of the disturbing action of the sun, as this would vanish only when the ratio m was zero. In the usual methods of treating the problem of perturbations, the investigator starts from an approximate solution in which the disturbing force vanishes, while the elements have arbitrary values. This method is justified by the general rule that, in all the ordinary cases of perturbations, the disturbing force is very small compared with the elements, and therefore a series developed in powers of that force converges very rapidly. But it happens that, in the case of the motion of the moon disturbed by the sun, the action of the sun is so considerable that the terms of the series depending on powers of m converge less rapidly than those depending on the elements. This fact suggested to Hill the idea of not starting with the elliptic orbit of the moon round the earth, but with an orbit of infinitesimal eccentricity, lying in the plane of the ecliptic, combined with a circular orbit of the earth round the sun. Supposing all the three elements we have mentioned to vanish, the only variable quantity on which the motion would depend would be the difference between the longitudes of the sun and moon. The co-ordinates of the moon relative to the earth can then be developed in a series, proceeding according to the sines and cosines of multiples of this angle. This series converges so rapidly that a few terms will suffice for a solution. Hill then assumes the orbit of the moon to have an infinitesimal eccentricity, and by an extremely ingenious process, involving the computation of a determinant with an infinite number of elements, he determines the motion of the moon's perigee numerically. His celebrated papers on this subject may be found in the Stockholm *Acta Mathematica* and the *American Journal of Mathematics*. A similar method can be applied to the motion of the moon's node, assuming the inclination of the orbit to be infinitesimal. This has been successfully done by P. H. Cowell in a paper in the *American Journal of Mathematics*, vol. xviii.

The further development and application of the method requires the terms depending on the eccentricity of the sun to be taken into account, and the terms depending on the powers and products of the moon's eccentricity and inclination to be determined. This most laborious part of the work is being carried on by Professor Ernest W. Brown, F.R.S., an Englishman resident at Haverford College, Pennsylvania. The results of Professor Brown's work, so far as yet reached, lead to grave doubts of the numerical precision of the previous theories of the action of the sun on the moon. In the case of Delaunay's theory, this lack of precision was a necessary result of the slowness with which his series in powers of m converge. It has generally been supposed that Hansen's numerical theory—so called because purely numerical values of the four elements in question are introduced from the beginning—was free from the error arising through the slow convergence of the series used by Delaunay. But this may now be doubted. In the important case of the parallactic equation of the moon—an inequality by which the solar parallax can be determined—it seems very probable that Hansen's result is seriously in error, and that the value of the solar parallax to be deduced in this way will be appreciably smaller than that which has been derived from Hansen's numbers. Most remarkable has been Professor Brown's success in determining from pure theory the motion of the moon's perigee and node. The results he has worked out and published in the *Memoirs* of the Royal Astronomical Society accord with observations to a degree that was never before possible. His results are not, however, as yet quite definitive.

In the article in vol. xvi. of this work (p. 801) mention was made of Airy's numerical theory, which unfortunately was not brought to a conclusion by its author. The present writer inclines to the opinion that Airy's method is, so far as its general idea is concerned, a practical one, at least for the inequalities of short period, and that its execution—perhaps in a more rigorous way than its author worked it out—is one of the desiderata of lunar theory.

At the present time the most important problem connected with the moon's motion is that of the possible inequalities produced by the action of the planets, or by other causes than the action of the sun. The most complete works on this subject are those of Hill and Radau. The former published a very exhaustive determination of the inequalities due to the deviation of the earth from a spherical form (*Astronomical Papers of the American Ephemeris*, vol. iii.). Radau has essayed a complete and exhaustive redetermination of the inequalities produced by the action of the planets. It is suggestive and remarkable that neither he nor Hill has discovered any new inequality of such magnitude and period as to account for the observed deviations of the moon from its theoretical place, as they are indicated in the article in vol. xxv. on ASTRONOMY (*q.v.*). Their results accord in the main with those of previous investigators, and up to the year 1902 the cause of the observed changes of long period in the moon's mean motion remains the greatest enigma in gravitational astronomy. (S. N.)

Moon, Sir Richard, 1st Baronet (1814–1899), English railway administrator, was the son of a Liverpool merchant, and was born on 23rd September 1814. The history of his life is practically the history of the London and North-Western railway for the period in which he lived. When he first became a member of the board in 1847, the company had just come into existence by the amalgamation of the London and Birmingham, the Manchester and Birmingham, and the Grand Junction lines, and it was during his long connexion with it—first as director and then (from 1862 to 1891) as chairman—that its system was developed substantially into what it is now. The Chester and Holyhead, the Lancaster and Carlisle, and many smaller lines were gradually added to it, either by leasing or by complete absorption, and finally in 1877 an Act was obtained consolidating all into one homogeneous whole. Throughout his career, Sir Richard Moon's powers of organization and his genius for what may be called railway diplomacy were of the greatest advantage to the company, and to him it owes in very large measure the commanding position it now enjoys. A striking feature about it is the extent to which its engines and trains are to be seen even in what might be expected to be the most private portions of other companies' lines; it was in great part Moon's prescience that secured for it the numerous running powers which it now exercises (not to mention many that are not exercised at present, though they would be if occasion required), and which contribute so much to the strength of its strategic position. An extremely hard worker himself, he expected equal diligence of his subordinates; but energy and capacity did not go unrewarded, for he made promotions, not by standing or seniority, but by merit. It thus came about that under him the North-Western was looked up to as affording a model of railway management, and the staff he trained has supplied many successful administrators to railways in all parts of the world. Sir Richard Moon, who was created a baronet in 1887, died on 17th November 1899. (H. M. R.)

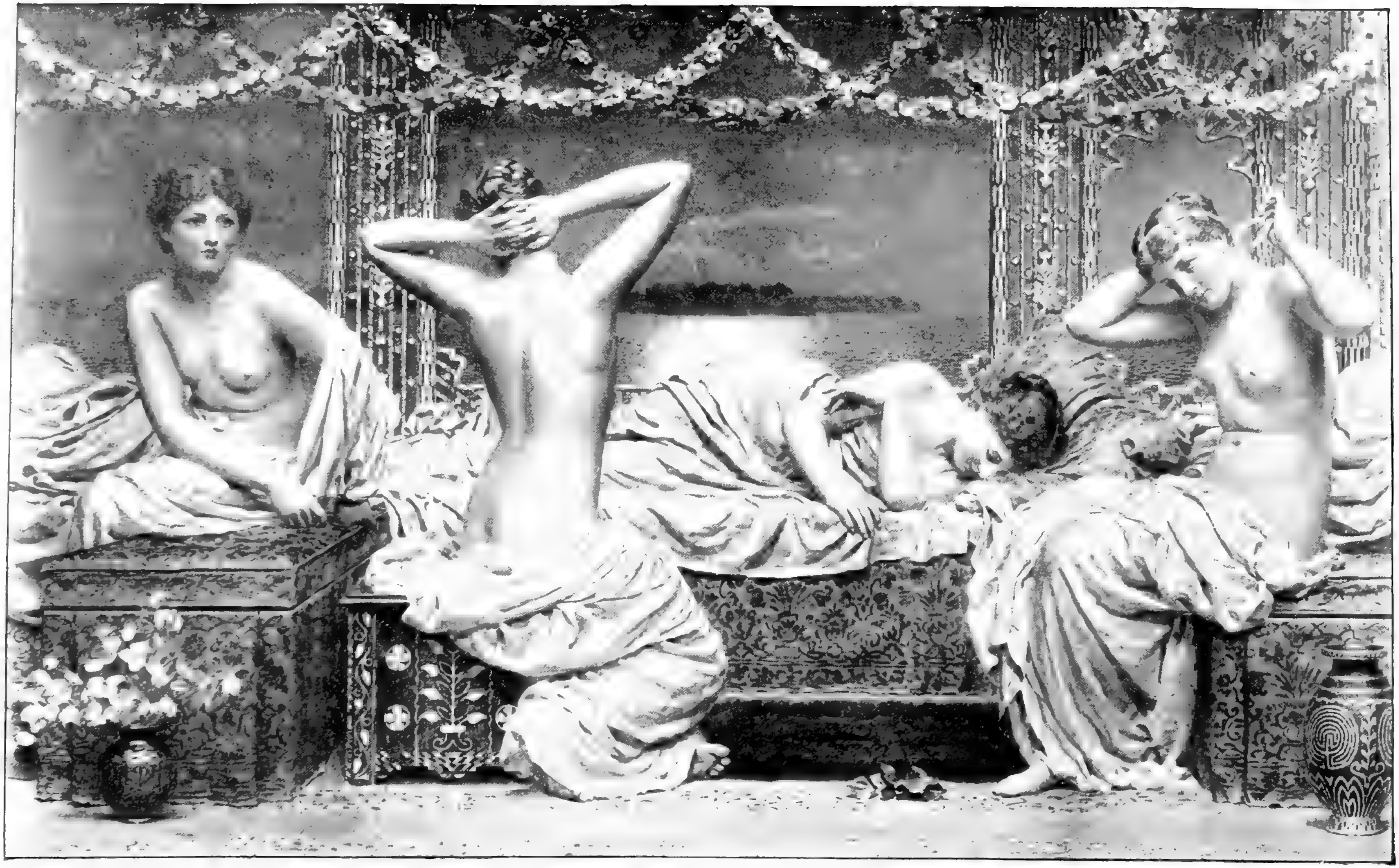
Moore, Albert Joseph (1841–1893), English decorative painter, was born at York on 4th September 1841. He was the youngest of the fourteen children of the artist, William Moore, of York, who in the first half of the 19th century enjoyed a considerable reputation in the North of England as a painter of portraits and landscape. In his childhood Albert Moore showed an extraordinary love of art, and as he was encouraged in his tastes by his father and brothers, two of whom afterwards became famous as artists—John Collingham Moore, and Henry Moore, R.A.—he was able to begin the active exercise of his profession at an unusually early age. His first exhibited works were two drawings which he sent to the Royal Academy in 1857. A year later he became a student in the Royal Academy Schools; but after working in them for a few months only, he decided that he would be more profitably occupied in independent practice. During the period that extended from 1858 to 1870, though he produced and exhibited many pictures and drawings, he gave up much of his time to decorative work of various kinds, and painted, in 1863, a series of wall decorations at Coombe Abbey, the seat of the earl of Craven; in 1865 and 1866 some elaborate compositions, "The Last Supper," and "The Feeding of the Five Thousand," on the chancel walls of the church of St Alban's, Rochdale; and in 1868, "A Greek Play," an important panel in tempera for the proscenium of the Queen's Theatre in Long Acre. His first large canvas, "Elijah's Sacrifice," was completed during a stay of some five months in Rome at the beginning of 1863, and appeared at the Academy in 1865. A still larger picture, "The Shunamite relating the Glories of King Solomon to her Maidens," was exhibited in 1866, and with it two smaller works, "Apricots" and "Pomegranates." In these Albert Moore asserted plainly the particular technical conviction which for the rest of his life governed the whole of his practice, and with them he first took his place definitely among the most original of British painters. Of his subsequent works the most notable are "The Quartette" (1869), "Sea Gulls" (1871), "Follow-my-Leader" (1873), "Shells" (1874), "Topaz" (1879), "Rose Leaves" (1880), "Yellow Marguerites" (1881), "Blossoms" (1881), "Dreamers" (1882), "Reading Aloud" (1884), "Silver" (1886), "Midsummer" (1887), "A River Side" (1888), "A Summer Night" (1890), "Lightning and Light" (1892), "An Idyll" (1893), and "The Loves of the Winds and the Seasons," a large picture which was finished only a few days before his death. He exhibited, as well, many smaller pictures and drawings in pastel and water colours at the Royal Academy, the Grosvenor Gallery, the New Gallery, and in the galleries of the Royal Society of Painters in Water Colours, of which he was elected an associate in 1884. It has been matter for frequent remark and surprise that Albert Moore was never elected into the Royal Academy; there was certainly no lack of ability on the part of the artist to account for the neglect. He died on 25th September 1893, at his studio in Spenser Street, Westminster. Several of his pictures are now in public collections; among the chief are "Blossoms," in the National Gallery of British Art; "A Summer Night" in the Liverpool Corporation Gallery (see Plate); "Dreamers," in the Birmingham Corporation Gallery; and a water-colour, "The Open Book," in the Victoria and Albert Museum, South Kensington.

The main idea that governed Albert Moore's practice was a deliberate and intentional disregard of dramatic subject. In all his pictures, save two or three produced in his later boyhood, he avoided any approach to story-telling, and occupied himself exclusively with decorative arrangements of lines and colour masses. The spirit of his art is essentially classic, and his work shows plainly that he was deeply influenced by study of antique sculpture; but he was not in any sense an archæological painter, nor did he attempt reconstructions of the life of past centuries. Artistically he lived in a world of his own creation, a place peopled with robust types of humanity of Greek mould, and gay with bright-coloured draperies and brilliant-hued flowers. As an executant he was careful and certain; he drew finely, and his colour-sense was remarkable for its refinement and subtle appreciation. Few men have equalled him as a painter of draperies, and still fewer have approached his ability in the application of decorative principles to pictorial art. (A. L. B.)

Moore, Henry (1831–1895), English painter, was the ninth son of William Moore, of York, and was born in that city on 7th March 1831. His artistic education was chiefly supervised by his father, but he also attended the York School of Design, and worked for a short time in the Royal Academy Schools. He first exhibited at the Academy in 1853, and was a constant contributor to its exhibitions till his death. At the outset of his career he occupied himself mostly with landscapes and paintings of animals, executed with extraordinary detail in imitation of the prevailing taste of the Pre-Raphaelite Brotherhood; but in 1857, while on a visit to the West of England, he made his first attempts as a sea-painter. His success in this branch of practice was immediate, and it had the effect, as years went on, of diverting him almost entirely from landscapes to marine subjects. Among his most important canvases must be reckoned "The Pilot Cutter" in 1866, "The Salmon Poachers" in 1869, "The Lifeboat" in 1876, "Highland Pastures" in 1878, "The Beached Margent of the Sea" in 1880, "The Newhaven Packet" (bought by the Birmingham Corporation), and "Catspaws off the Land" (bought by the Chantrey Fund Trustees; see Plate) in 1885, "Mount's Bay" (bought by the Manchester Corporation) in 1886, "Nearing the Needles" in 1888, "Machrihanish Bay, Cantyre," in 1892, "Hove-to for a Pilot" in 1893, and "Glen Orchy," a landscape, in 1895. He was elected an associate of the Royal Society of Painters in Water Colours in 1876, and a full member in 1880; an associate of the Royal Academy in 1885,

"Catspaws off the Land." By Henry Moore.

(From a Photograph by Eyre and Spottiswoode.)



"A SUMMER NIGHT." By ALBERT MOORE.

(By permission of the Corporation of Liverpool.)

and an academician in 1893; and at Paris, in 1887, where he exhibited "The Newhaven Packet" and "The Clearness after Rain," he received a *grand prix* and was made a knight of the Legion of Honour. He died at Margate on 22nd June 1895. His works are marked by admirable appreciation of nature, and by a rare understanding of wave-form and colour and of the subtleties of atmospheric effect; and as a sea-painter he may fairly be regarded as almost without a rival. (A. L. B.)

Moquegua, a coast department in the extreme south of Peru, divided into three provinces, Moquegua, Tacna, and Arica, of which the principal towns bear the same names. It has an area of 22,516 square miles, with a population in 1896 of 42,694. The port of Arica is in the hands of the Chilians, in accordance with the terms of the treaty of peace of 1884.

Moradabad, a city and district of British India, in the Rohilkhand division of the North-West Provinces. The city is on the right bank of the river Ramganga (655 feet above the sea), and has a station on the Oudh and Rohilkhand railway. Population (1881), 67,387; (1891), 72,921; (1901), 75,176; municipal income (1897–98), Rs.68,476, mostly derived from octroi; incidence of taxation, nearly 12 annas per head; registered death-rate (1897), 57·2 per thousand. It makes a specialty of inlaid metal-work in brass and tin, and of the weaving of chintz. There is a large trade in country produce. It is a cantonment for a native regiment. The municipality consists of twenty-three members, of whom eighteen are elected, with the magistrate as *ex officio* chairman. There are two high schools, twenty printing-presses, most of which issue vernacular newspapers, and two cotton and hemp-pressing factories.

The district of MORADABAD lies east of the Ganges and west of the native state of Rampur. Area, 2282 square miles; population (1881), 1,155,173; (1891), 1,179,398; and (1901), 1,192,348, showing an increase of 2 per cent. between 1881 and 1891, continuous since 1872, and of 1.1 between 1891 and 1901; average density, 522 persons per square mile. Mahommedans are more numerous than in any other district of the province, forming more than one-third of the total. The land revenue and rates are Rs.17,50,496, the incidence of assessment being R.1 : 2 : 7 per acre; cultivated area (1896–97), 740,735 acres, of which 107,147 were irrigated from wells, &c.; number of police, 3150; number of vernacular schools, 120, with 4820 pupils; registered death-rate (1897), 42·2 per thousand. The principal crops are wheat, rice, millet, pulse, sugar-cane, and cotton. There are no Government canals. The main line of the Oudh and Rohilkhand railway traverses the district from south to north, with branches towards Aligarh and Rampur. A third branch from Moradabad city towards Delhi was commenced in 1898, which will cross the Ganges at Gurmukhteswar by a bridge of eleven spans of 200 feet each.

Morar, town of Central India, in the native state of Gwalior, 3 miles east of Gwalior city. Population (1881), 24,022; (1891), 24,518. It was formerly a British military cantonment and residence of a political agent, but in 1886, when the fortress of Gwalior was restored to Sindhia, the troops at Morar were withdrawn to Jhansi, and the extensive barracks were likewise made over to Sindhia. It has a high school and dispensary.

Moratalla, a town of Spain, in the province of Murcia, in a mountainous district 40 miles north-west of Murcia. The streets are narrow and very irregular, but the town contains a good hospital, a theatre, and a large 17th-century parish church. There are manufactures of rough cloth, alcohol, and soap. Population (1897), 11,848.

Moravia (German *Mähren;* Bohemian or Czech, *Morava*), a margraviate and crownland in the Cisleithan part of the Austro-Hungarian Monarchy. In 1880 the population was 2,153,407, and in 1890 it was 2,276,870, or 266 per square mile. Of these 70·03 per cent. were Slavs of the various subdivisions of the Czech race, 29·4 per cent. Germans, and the balance Slavs of other races; 95·3 per cent. were Roman Catholics, 2·7 per cent. Protestants, and 2 per cent. Jews. The proportion of females to males was 1094 to 1000. The population in 1900 was 2,435,081. In 1896 the marriage-rate was 7·92, the birth-rate 37·40, or, excluding still-births, 36·32, and the death-rate 25·24 per thousand. Of the births, 10·86 per cent. were illegitimate. Moravia is represented in the Reichsrath by 43 members, of whom 7 are returned by the universal suffrage curia; the Germans have a small majority. In the Diet the Germans are also in the majority with 55 members, the Czechs being represented by 45. The educational institutions are a polytechnic (at Brünn, with about 350 students), two theological seminaries, 48 gymnasia and *real*-gymnasia, 2556 elementary schools, and 146 continuation schools and establishments for technical education, &c. There has been a great reduction in the number of illiterates, who amounted to 54 per cent. of the Moravian recruits of 1870. They had fallen to 10·4 per cent. of the whole population in 1880, and to 6·9 in 1890. In 1898, 221 periodicals and newspapers were published (128 Czech, 88 German, and 5 polyglot). Half of the population is engaged in agriculture and forestry, a third in mining and industry, and 6·84 per cent. in trade and transport. Agriculture is prospering, particularly in those branches connected with the industries of the crownland, such as the cultivation of the beetroot (30 per cent. of the entire Austrian crop) and barley. Large quantities of wheat, rye, oats, potatoes, turnips, clover, legumes, flax and hemp, &c., are also grown. There is a considerable export of vegetables to Vienna. In the period 1880–90 pigs show the largest increase (from 205,970 to 322,239), while the number of sheep (80,706) shows a reduction of nearly half. Horned cattle numbered 677,807 (+32,600), and horses, 126,131 (+3273). The production of coal (15 million metric centals in 1898) has more than trebled, while that of lignite (1½ million metric centals) is over two and a half times as much as in 1881. The only other minerals are iron ore (109,150 metric centals), lead (360), and graphite (72,850). There were in 1898, 136 breweries and 495 distilleries, 54 sugar refineries (199,440 tons of sugar), and 6 state tobacco factories. The manufacture of woollens, silks, cotton goods, and linen is carried on in about 2000 factories, employing over 150,000 hands. According to the census of 1890, Moravia had 18 per cent. of the factories, 17 per cent. of the hands, and 16 per cent. of the motive power in Austria, thus taking the second place, after Bohemia, for industrial enterprises on the largest scale. It possessed in 1898, 1220 miles of railway, 9·9 per cent. of the total length in Austria, 7083 miles of roads, and 164 miles of waterway, of which, however, only 20 miles are navigable by boats. In the same year there were 646 post and 260 telegraph offices, with 2478 miles of line and 8410 miles of wire. Politically, the current history of Moravia is subordinate to that of the adjoining crownland of Bohemia (*q.v.*), inhabited by the same race. The Moravians, whose slight local peculiarities have almost disappeared, are on somewhat better terms with their German neighbours than their compatriots in Bohemia. In the mining districts strikes of exceptional violence have occurred.

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(Æ. O'N.)

Moravian Brethren ("The Church of the United Brethren").—This community progresses steadily, its chief characteristics being well maintained: close attention to education, strict discipline of life, and an extraordinary missionary zeal. Recently there has been a still stronger tendency towards decentralization. The three Home Provinces have now a greater independence, as the "Directing Board of the Unity," which has its seat at Berthelsdorf, near Herrnhut, only interferes in local affairs when principles are at stake. The Home Provinces now elect their own bishops. Statistics for 1899:—

	Communicants.	Total.	Congregations.
1. British Province . . .	3,371	6,095	42
2. German ,, . . .	6,294	8,159	25
3. American ,, (Northern) .	11,776	17,857	89
4. ,, ,, (Southern) .	3,041	5,092	15
5. Bohemian Mission . . .	394	627	
6. Foreign Missions . . .	32,446	95,424	131

7. Leper Home at Jerusalem, 48 inmates.

8. Sunday Schools (half in Mission field), 36,000 scholars, 3200 teachers.

9. Bishops (Home Provinces) .	20	Missions .	5
10. Presbyters ,, .	141	,, .	40
11. Deacons ,, .	104	,, .	144

See Hutton. *Short History of the Moravian Church.* London.—Bishop Schweinitz. *History of the Ancient Church of the United Brethren.* (G. E. N.)

Morbihan, a department on the west coast of France, washed by the Atlantic Ocean.

Area, 2739 square miles. The population increased from 521,614 in 1881 to 557,934 in 1901. Births in 1899, 14,974, of which 704 were illegitimate; deaths, 10,791; marriages, 3934. There were in 1896, 754 schools, with 76,000 pupils, and the illiterate constituted 20 per cent. of the population. Out of 1,012,700 acres in 1896 of cultivated land, 671,840 acres were plough-land, and the rest divided between meadow and woodland. The wheat crop of 1899 was valued at £344,000; rye, £437,000; buckwheat, £263,000; oats, £216,000; potatoes, £201,000; natural pastures, £200,000; hemp, in harl and in seed, £32,000; cider-apples, £212,000. The live stock included 37,820 horses, 257,980 cattle, 58,700 sheep, and 51,240 pigs. The industry in metals in 1898 produced 15,200 metric tons of steel, valued at £176,000. Sardine fishing employs many hands, and is one of the sources of wealth to the department. Vannes, the capital, had 23,375 inhabitants in 1901.

Moreau, Gustave (1826–1898), French painter, was born in Paris, 6th April 1826. His father was an architect, who, discerning the lad's promise, sent him to study under Picot, a second-rate artist but clever teacher. The only influence which really affected Moreau's development was that of the painter Chassériau (1819–1857), with whom he was intimate when they both lived in the Rue Frochot, and of whom we find reminiscences even in his later works. Moreau's first picture was a "Pietà" (1852), now in the cathedral at Angoulême. In the Salon of 1853 he exhibited a "Scene from the Song of Songs" (now in the Dijon Museum) and the "Death of Darius" (in the Moreau Gallery, Paris), both conspicuously under the influence of Chassériau. To the Great Exhibition of 1855 he sent the "Athenians with the Minotaur" (in the Museum at Bourg-en-Bresse) and "Moses putting off his Sandals within sight of the Promised Land." From October 1857 till September 1859 he travelled in Italy, and has left a record of the journey in a few water-colour sketches. On his return he painted "Tyrtæus" (1860), and undertook to decorate the church at Decazeville in the Aveyron. "Œdipus and the Sphinx," begun in 1862, and exhibited at the Salon of 1864, marked the beginning of his best period, during which he chose his subjects from history, religion, legend, and fancy. In 1865 he exhibited "Medea and Jason" and "The Young Man and Death"; in 1866, the "Head of Orpheus" (in the Luxembourg Gallery); "Hesiod and the Muse," a drawing; and "The Peri," a drawing; "Prometheus" (in the Moreau Gallery); "Jupiter and Europa," a "Pietà," and "The Saint and the Poet," in 1869. After working in obscurity for seven years, he reappeared at the Salon in 1876 with "Hercules and the Hydra," "Saint Sebastian," "Salome Dancing" (presented to the Luxembourg by M. Hayem); and in 1878 with "The Sphinx's Riddle solved," "Jacob," and "Moses on the Nile." Moreau exhibited for the last time at the Salon of 1880, when he contributed "Helen" and "Galatea"; to the Great Exhibition of 1889 he again sent the "Galatea" and "The Young Man and Death." He took prize medals at the Salon in 1864, 1865, 1869, and 1878. He was made knight of the Legion of Honour in 1875, and officer in 1883. He succeeded Delaunay as professor at the École des Beaux Arts, and his teaching was highly popular. When he died, 18th April 1898, he bequeathed to the State his house, containing about 8000 pictures, water-colours, cartoons, and drawings, which form the Moreau Gallery, one of the best organized collections in Paris, arranged by M. Rupp, his executor and, with Delaunay and Fromentin, his closest friend.

See Ary Renan. *Moreau.* Paris, 1900.—Paul Flat. *Le Musée Gustave Moreau.* Paris, 1900. (H. Fr.)

Morecambe, or Poulton-le-Sands, a watering-place of Lancashire, England, on Morecambe Bay, 4 miles west-north-west of Lancaster by rail. A new west pier with pavilion has been constructed at a cost of £50,000. A lofty pyramidal tower with summit platform was built in 1890. It is surrounded by ornamental grounds and contains an entertainment hall. Amongst other recent buildings are a Roman Catholic church (1895) and a Wesleyan chapel (1897). The Winter Garden with its connected buildings was reconstructed in 1897 at a cost of £100,000. There is regular steam communication with Dublin and the north of Ireland. Population of urban district (Poulton, Bare, and Torrisholme) (1881), 3931; (1901), 11,798.

Morelia, a city of Mexico and capital of the state of Michoacan de Ocampo. A tramway line connects it with the station of the Central railway; 234 miles west of Mexico city. Population (1895), 33,890.

Morelli, Giovanni [Ivan Lermolieff] (1816–1891), Italian patriot and critic, was born at Verona on 16th February 1816. He was educated first at Bergamo, the home of his mother, who had removed thither on the death of her husband; and then at Aarau in Switzerland. At the age of eighteen he commenced his university career at Munich, being debarred as a Protestant from entering any Italian college, and became the pupil of Ignatius Döllinger, the celebrated professor of anatomy and physiology. Natural philosophy and medicine were the studies to which he specially devoted himself, but he was also keenly interested in all scientific and literary pursuits. At Munich, and later at Erlangen, Berlin, and Paris, his brilliant gifts and independence of thought and judgment attracted the attention of the most distinguished men of the day. In Paris he became intimate with Otto Mündler, and his intercourse with that eminent art critic was not without its effect in determining the direction of his future studies; and, during a summer spent in Switzerland, he formed a friendship with Louis Agassiz, whose teaching made a deep and lasting impression upon him. On his return to Italy in 1840 he became associated in Florence with that band of patriots who were strenuously labouring for the deliverance of their country from the oppressive Austrian rule. He took an active part in the war of 1848, and was subsequently chosen by the provisional Lombard Government to plead the cause of Italian unity before the German Parliament assembled at Frankfort. In 1860, in recognition of the great services rendered to his country by Morelli, Victor Emmanuel named him a citizen of the Sardinian kingdom, and in the following year he was elected deputy for Bergamo to the first free Italian Parliament. He was a staunch supporter of Cavour, and, though never a leading politician, exercised a considerable influence over the most prominent statesmen of the Right, who valued his sound judgment, integrity, moderation, and foresight. One of his first acts after his election was to draw the attention of Parliament to the urgent need of reform in the administration of matters relating to the fine arts. In consequence of his representations, a commission was appointed with the object of bringing under Government control all works of art which could be considered public property. The commission, of which Morelli was named president, began its work in Umbria and the Marches, and he appointed as his secretary G. B. Cavalcaselle, who was then engaged in collecting materials for a work on Italian art. According to one who knew Morelli well, much that Cavalcaselle then learned from his chief was embodied in the well-known *History of Painting*, which was published in 1864 in conjunction with Sir Joseph Crowe.

The immediate result of Morelli's first labours in the Marches was the passing of the law, which bears his name, strictly prohibiting the sale of works of art from public and religious institutions. He also endeavoured to bring about reforms in the management and organization of public galleries; but though he was repeatedly urged to accept the post of director of all these institutions, he declined any such appointment, confident that in an unofficial capacity he could better serve the cause of art. In 1873 he was named a senator of the kingdom of Italy, having voluntarily resigned his seat in the Lower House owing to the increasingly democratic tendencies of the Chamber. In Rome, the seat of the Government since 1870, he spent several months of each year; but his settled home was Milan, whither he had removed from Bergamo in 1874. Here he published some of his researches into the history of Italian art. In order to be free to speak his mind unreservedly, he determined to adopt a pseudonym and to write in German. His first contributions, a series of articles on the Borghese Gallery, were published in Lützow's *Zeitschrift für bildende Kunst* between the years 1874 and 1876. Posing as an art-loving Russian, who puts forth his opinions with the utmost diffidence, he adopted the pseudonym of Ivan Lermolieff—an anagram of his own name with a Russian termination—and described his essays as *Ein kritischer Versuch*, translated from the Russian by Johannes Schwarze, this time a Germanized form of Morelli. The originality of the method recommended by the author for studying art, the general soundness of his critical opinions, and the many new (and apparently correct) attributions suggested for pictures in the Borghese Gallery and elsewhere, attracted the attention of all students of art; but failure attended every attempt to discover the identity of the Russian critic. In 1880 Morelli published a small book under the same pseudonym, entitled, *Die Werke italienischer Meister in den Galerien von München, Dresden, und Berlin*. The appearance of this volume, which was cast in so original a form that it was altogether unlike anything which had preceded it in the realm of art scholarship, created an extraordinary sensation. The daring opinions expressed by the author struck at the roots of all existing art criticism, and were often diametrically opposed to the views of the most renowned art historians of the day. The importance of the work could not be denied, and in spite of determined opposition and searching and bitter attacks, it gained general recognition as a standard work which no serious student of art could ignore. It inaugurated a new and more scientific method of criticism, and marks an epoch in the art studies of the 19th century. The book was translated into English in 1883, with Morelli's own name upon the title-page, and a few years later into Italian. In the decade between 1880 and 1890 he contributed three articles to German periodicals: *Perugino oder Raffael, Raffaels Jugendentwickelung, Noch einmal das Venezianische Skizzenbuch.* Being addressed to critics who had challenged his opinions, they are somewhat polemical in character, but contain a mass of information, more especially about drawings. He also wrote a skit on art connoisseurship in Europe, intending to publish it in English as the reflexions of an American on the follies of art critics in the Old World; but he never carried out his intention, though some portion of the MS. was embodied in the first part of his *Critical Studies.* This volume, the first of a series of three which, under the title of *Kunst kritische Studien*, was to contain all Morelli's contributions to art literature, was published in 1890. The first part, cast in dialogue form, contains a detailed exposition of his method. Then follow the *Borghese Gallery*, a reissue of his former articles with many important additions, and *The Doria Gallery*, an entirely new contribution. The second volume deals with the galleries of Munich and Dresden, and is a revised edition of the first two parts of the original book of 1880; but here again copious additions rendered it practically a new book. The third volume was to treat of the Berlin Gallery, and was also to contain an exhaustive account of the drawings of Italian masters, but it was destined never to be carried out. Morelli was taken seriously ill towards the middle of February 1891, and was found to be suffering from heart disease and other complications; a fortnight later he died at Milan, on 28th February. His collection of drawings by the old masters he bequeathed to his pupil, Dr Frizzoni, and his pictures, over one hundred in number, to the city of Bergamo, where they are now exhibited as the Galleria Morelli in two rooms of the Accademia Carrara. A striking half-length portrait by Lenbach, who presented it to his friend in 1886, forms part of the collection. In memory of Morelli a bronze bust of him by a Milanese artist has been placed in the Brera; but his features are more worthily presented in a second portrait by Lenbach and in a lifelike pastel sketch executed by the Empress Frederick in 1884, when he was her guest at Baveno. After the death of Morelli the first two volumes of his *Critical Studies* were published in English, Sir Henry Layard, one of his most intimate friends, contributing to the first a biographical sketch of the author; and the fragmentary MS. of the third volume was published in German by Dr Frizzoni, under whose editorship an Italian translation of the first volume has also been issued.

Morelli found art criticism uninspired, unscientific, and practically worthless. To be of any real value he held that historical, documentary, and traditional knowledge respecting works of art was only of secondary importance as compared with the evidence to be derived from the study of the pictures themselves. He contended that art criticism must be conducted on scientific principles and follow a strict course of inductive reasoning. A painting should be subjected to a searching analysis, and its component parts and minutest details submitted to methodical and exact investigation. Æsthetic considerations had their value, but they had been given an undue weight, to the neglect of other factors of equal or even greater force. Before his day critics had been mainly guided by the subjective impression produced upon them by the work of art as a whole, while the form—that is, the individual and component parts which contribute to the unity of the whole, and through which the spirit of the master finds expression—was entirely ignored.

The study of the individual parts and forms was, in his estimation, of the highest importance, for they were not mere incidents, but the outward and visible seal of an artist's character stamped upon his work, and obvious to all who had eyes to see. By diligent observation of the forms the rudiments of the language of art might be mastered, and the first step taken towards initiating a methodized system of study. The education of a critic consists chiefly in learning to compare, and Morelli soon recognized the value of systematic comparison in the study of art. By the combined methods of critical analysis and comparative observation, he found the clue he had so long been seeking. Studying one day in the Uffizi, it suddenly struck him that in a picture by Botticelli containing several figures the drawing of the hands was remarkably similar in all; that the same characteristic but plebeian type, with bony fingers, broad square nails, and dark outlines, was repeated in every figure. Turning to the ears, he observed that they also were drawn in an individual manner, and that in the numerous figures in which the ear was visible the same typical form recurred. Having noted these fundamental forms, he proceeded to an examination of other works by this painter, and found that the same forms were exactly repeated, together with other individual traits which seemed distinctive of the master; the characteristic type of head and expression, the drawing of the nostrils, the vitality of movement, the disposition of drapery, harmony of colour (where it had not been tampered with by the restorer), and quality of landscape. In all Botticelli's true works the presence of these and other characteristics proclaimed their genuineness. In paintings where the forms and types were those of the painter, but where vitality, movement, and all deeper qualities were absent, Morelli recognized works executed from the master's cartoons; while in pictures where neither types nor forms responded to the test, and where only a general family likeness connected them with Botticelli, he discerned the productions of pupils and imitators. After applying his method to the works of Botticelli, he proceeded to examine those of other Florentine masters, and afterwards of painters of other Italian schools, everywhere meeting with results to him not less convincing. If the drawing of the hand and ear were not always conspicuous, there were other peculiarities of this language of form to aid in the identification of a master: the treatment of the hair, as in Piero dei Franceschi; the indication of the sinews, as in Foppa; the drawing of the eye, as in Liberale da Verona; the modelling of the eyelid and upper lip, as in Ambrogio de Predis; the form of the feet, as in Luini. In short, all apparently insignificant details were of importance in his plan of study, for to him they were like the signature of the master. He held them to be of far greater value for purposes of identification than the general external aspect of a picture and its supposed technical qualities and colouring; for, after having been exposed for centuries to countless processes of cleaning, repainting, and varnishing, pictures, as a rule, retain but little of their original aspect, and it is only in the forms that the master's personality may still be recognized.

This is a brief outline of Morelli's method from its purely practical and mechanical side, but he did not overlook those deeper qualities to which the vague designation of "spirit" in a work of art is given. Only he maintained that side by side with the psychological study of it must ever be practised a close and systematic study of the form; for, to quote his own words, "it is only through unremitting study of the form that we may gradually attain to understanding and recognizing the spirit which gives it life." (C. J. F*.)

Morelos, a state of Mexico, bounded by the Federal district on the N., by the state of Mexico on the W., N.W., and N.E., by Puebla on the E. and S.E., and by Guerrero on the S. and S.E., with an area of 2774 square miles. The population in 1879 was 159,160, and in 1900 it was 161,697. Though small it is progressive, and one of the richest agricultural states in the Republic. The principal products are sugar-cane, rice, maize, coffee, and wheat. The sugar-cane products in 1897 were valued at $5,800,000. Its fruit exports are also very large. The Interoceanic railway traverses the state from north-east to south-west. The state is divided into six districts. The capital, Cuernavaca, had 8747 inhabitants in 1895. Amongst other towns are Yautepec (6756), Morelos (or Cuautla) (5538), Jonacatepec de Leandro, Jojutla de Juarez, and Tetecala de la Reforma.

Morgan, John Pierpont (1837-——), American banker and capitalist, was born 17th April 1837, at Hartford, Conn. He was the son of Junius Spencer Morgan, a partner of the London banker and philanthropist, George Peabody. He received his education at the English High School, Boston, and the University of Göttingen, engaged in banking in New York, and in 1864 organized the firm of Dabney, Morgan and Co. In 1871 he united with Anthony Drexel of Philadelphia to form the firm of Drexel, Morgan and Co., of which he became in 1893 the senior partner. In 1895 the name of the firm was changed to J. P. Morgan and Co. In 1860 he was made American representative of George Peabody and Co. of London, and ultimately became the head of J. S. Morgan and Co., its successor, as also of Morgan, Harjes and Co. of Paris, and Drexel and Co. of Philadelphia. He has been especially successful in the reorganization of a number of bankrupt American railways, among them the Erie, Philadelphia, and Reading; New York and New England; Southern; Northern Pacific; and Baltimore and Ohio. In 1895 a large part of the $65,000,000 United States Government bond issue was taken by his firm. Being in command of huge financial resources, Mr Pierpont Morgan became the prime mover in the organization of the principal great Anglo-American and American commercial combinations which came into existence at or about the opening of the 20th century. His enterprise was notably employed in connexion with the formation of the United States Steel Corporation (which took over Mr Andrew Carnegie's business and others), the harmonization of coal and railway interests in Pennsylvania, and the purchase first of the Leyland line of Atlantic steamers, and then (1902) of other British companies (including the "White Star"), and the formation of a huge Atlantic shipping combination; and his name became a household word in connexion with similar schemes of gigantic commercial amalgamation. Among his benefactions were $1,000,000 to the lying-in hospital of New York, $500,000 to the New York trade schools, and $1,000,000 to Harvard University. He also bought works of art on a princely scale, his picture purchases including the famous (recovered) "Duchess of Devonshire" by Gainsborough, and the Colonna Raphael. He married in 1865 Frances Louise Tracy of New York City.

Morier, Sir Robert Burnett David (1826–1893), British diplomatist, was born at Paris on 31st March 1826. He was descended from a family of diplomatists of Huguenot origin, the best known of whom were his father David, consul-general for France and minister at Bern, and his Uncle James, the author of *The Adventures of Hajji Baba*. After a somewhat defective private education, he came up to Balliol College, Oxford. Here he attracted the notice of Jowett, under whose influence his brilliant but wayward mind obtained the discipline of which it stood in need. The relation of tutor and pupil developed into a friendship of rare warmth. Writing towards the close of his life, Jowett, who inspired more devoted friendships than any other man of his time, spoke of Morier as his kindest and best friend for forty-five years, and his correspondence teems with discussions between the two friends on every topic of the day. On leaving Oxford, Morier at first obtained an appointment in the Education Department, but resigned in 1852, and in the following year became attaché at Vienna. In the succeeding years he was attached in turn to almost every court in Germany. Restless in temperament and unconventional in method, he plunged into the vortex of German politics to a degree that did not always accord with the traditions of diplomacy. The most important years of his career in Germany were from 1866 to 1871, when he was secretary of legation at Darmstadt. Here he became a trusted adviser of the crown princess, and through her acquired an intimate friendship with the crown prince (afterwards the Emperor Frederick III.), whose antagonism to Bismarck's reactionary policy met with cordial support from Morier's sturdy Liberalism. Bismarck, already jealous of British influence at court, honoured Morier with a hatred not lessened by the fact that Morier's knowledge of German politics was unrivalled outside Germany. On leaving Darmstadt, Morier became chargé d'affaires, first at Stuttgart and then at Munich, and in 1876 was appointed minister at Lisbon. From 1881 to 1884 he was minister at Madrid, and distinguished his term of office by the negotiation of an important commercial treaty. In December 1884 he became ambassador at St Petersburg, and almost immediately had to face the alarming situation created by the Russian advance to Penjdeh. Thanks to his efforts, a war that at one moment seemed inevitable was averted. His great popularity at the Russian court contributed towards a marked improvement in the relations between the two countries. Bismarck took alarm at the lessening influence of Germany over Russia, and, always relentless in his hatreds, tried to procure Morier's downfall. The *Kölnische Zeitung* declared in December 1888 that Morier had made use of his position at Darmstadt during the Franco-German war to betray the movements of the German troops to Marshal Bazaine. The authority for this charge was an alleged declaration made by Bazaine to the German military attaché at Madrid. Bazaine had died in September, but Morier had heard rumours in July of the charge brought against him, and had procured from Bazaine a written denial, which he now published in *The Times*. Apart from this, it was clearly shown that Morier could not have transmitted the information by the alleged date, and that Bazaine, according to the testimony of his own books and of other officers, received the information in question by reports from the front. As a matter of fact, Morier was an ardent champion of the German cause. His correspondence with Jowett shows the latter vainly endeavouring to convince his friend that the French were in the right. Public opinion everywhere, except in the German Conservative press, attributed the charge to political motives. This was confirmed by Bismarck's subsequent attempt to implicate Morier in the Geffcken case—a fresh instance of the Chancellor's bitterness against the Emperor Frederick and all his friends. The international importance of the affair was shown in the following February, when a grand ball given by Morier was attended by the Tsar and the whole Imperial family. Morier's failing health caused him, at his own request, to be appointed Lord Dufferin's successor at Rome in 1891; but it was felt that he could not be spared from St Petersburg, and there he remained till forced to find a milder climate. It was then too late, and he died at Montreux in Switzerland on 16th November 1893. (H. SY.)

Morison, James Augustus Cotter (1832–1888), British author, was born in London on 20th April 1832. His father, who had made a large fortune as the inventor and proprietor of "Morison's Pills," settled in Paris till his death in 1840, and Cotter Morison thus acquired not only an acquaintance with the French language, but a profound sympathy with France and French institutions. In later life he resided for some years in Paris, where his house was a meeting-place for eminent men of all shades of opinion. He was educated at Highgate Grammar School and Lincoln College, Oxford. Here he fell under the influence of Mark Pattison, to whom his impressionable nature perhaps owed a certain over-fastidiousness that characterized his whole career. He also made the acquaintance of the leading English Positivists, to whose opinions he became an ardent convert. Yet he retained a strong sympathy with the Roman Catholic religion, and at one time spent several weeks in a Catholic monastery. One other great influence appears in the admirable *Life of St Bernard* which he published in 1863—that of his friend Carlyle, to whom the work is dedicated, and with whose style it is strongly coloured. Meanwhile he had been a regular contributor, first to the *Literary Gazette*, edited by his friend John Morley, and then to the *Saturday Review* at its most brilliant epoch. In 1868 he published a pamphlet entitled *Irish Grievances shortly stated.* In 1878 he published a volume on *Gibbon* in the "Men of Letters" series, marked by sound judgment and wide reading. This he followed up in 1882 with his *Macaulay* in the same series. It exhibits, more clearly perhaps than any other of Morison's works, both his merits and his defects. Macaulay's bluff and strenuous character, his rhetorical style, his unphilosophical conception of history, were entirely out of harmony with Morison's prepossessions. Yet in his anxiety to do justice to his subject, he steeped himself in Macaulay till his style often recalls that which he is censuring. Against this power of sympathy, which Mr Frederic Harrison calls the greatest of Morison's gifts, must be put a want of robustness, sometimes amounting to hypercriticism, as in his remarks on Macaulay's poetry. It was this over-refinement, coupled with delicate health, that kept him from committing to paper his researches on the history of French institutions. These researches formed the chief occupation of his life, and would, as his friends believed, have obtained from the world a recognition of powers which his published works did not adequately reveal. His brief sketch, *Mme. de Maintenon: une étude* (1885), and some magazine articles, were the only fruits of his labours in French history. Towards the close of his life he meditated a work showing the application of Positivist principles to conduct. Unfortunately, failing health compelled him to abandon the second or constructive part: the first, which attempts to show the ethical inadequacy of revealed religion, was published in 1887 under the title of *The Service of Man.* Though containing many impressive passages, and animated by a lofty spirit, it can only be regarded as a restatement of familiar arguments, and bears marks, in a certain want of proportion, of the haste with which it was completed; but it was widely read, and made his name known to a larger public. He died in London on 26th February 1888. (H. SY.)

Morlaix, chief town of arrondissement, department of Finistère, France, 52 miles north by east of Quimper, on the railway from Paris to Brest. The tobacco factory employs about 100 men and 700 to 800 women, and the output of tobacco amounts annually to over 5,000,000 ℔. The total port traffic in 1899 amounted to 53,289 tons. Population (1891), 13,259; (1901), 16,086.

Morlanwelz, a town of Belgium, in the province of Hainaut, 15 miles east of Mons by rail. There are foundries, forges, and other iron industries in the town, and coal-mines in the vicinity. Population (1890), 7307; (1900), 7895.

Morley, a municipal borough (1885) in the Morley parliamentary division of Yorkshire, England, 4 miles south-south-west of Leeds, on the Great Northern and London and North-Western railways. The gas works were taken over by the corporation in 1898, and extensive waterworks were completed in 1894. A new town hall was opened in 1895; a park, for which the ground was presented by Lord Dartmouth, has been laid out; public baths have been erected, and other important improvements effected. The chief industries are connected with woollen cloth, machinery for the treatment of wool, coal and stone. The town figures in Domesday Book. Population (1891), 21,068; (1901), 23,636.

Morley, Henry (1822–1894), British man of letters, was born in London on 15th September 1822. After unhappy experiences at English schools, he was sent to the Moravian school at Neuwied, whose system strongly influenced his subsequent theories of education. It was intended that he should follow his father's profession of medicine, and in 1844 he bought a share in a practice at Madeley, Shropshire. Plunged into debt by his partner's dishonesty, he set up a small school for young children at Liscard, near Liverpool. His principle was to abolish all punishment, to make his pupils regard their work as interesting instead of repellent, and to form their character by appealing exclusively to higher motives. This scheme, carried out with much ingenuity, proved a complete success. Meanwhile he had devoted his spare time to writing. He long cherished the ambition of making his mark as a poet, and in 1845 published *The Dream of the Lilybell*, followed in 1848 by *Sunrise in Italy*. His muse was fluent, but wanting in distinction, and it was fortunate for his reputation that necessity compelled him to turn to other pursuits. His contributions to magazines on sanitation and other subjects attracted the notice of Charles Dickens, on whose invitation in 1851 he settled in London as a regular contributor to *Household Words*. He was also on the staff of the *Examiner*, which he edited from 1861 to 1867. Meanwhile he had devoted much research to a life of *Palissy the Potter* (1852), which was at the same time a picture of life in mediæval France. Encouraged by its favourable reception, he followed it up with lives of *Jerome Cardan* (1854) and *Cornelius Agrippa* (1856), and subsequently of *Clement Marot* (1870). His dramatic criticisms were reprinted in 1866 under the title of *The Journal of a London Playgoer, 1851–1866*. In 1857 he was appointed evening lecturer in English literature at King's College, and in 1865 became, in succession to David Masson, professor of English literature at University College, London. Deciding to devote his lifework to this subject, he published in 1864 the first volume of a monumental history of English literature entitled *English Writers*, which he eventually carried in eleven volumes down to the death of Shakespeare. He was indefatigable as a popularizer of good literature. After editing a standard text of Addison's *Spectator*, he brought out a vast number of classics at low prices in Morley's Universal Library, Cassell's National Library, and the Carisbrooke Library. His introductions to these display his characteristic tendency to dwell on the ethical rather than the literary merits of his authors. His ready speech, retentive memory, earnest purpose, and bright style made him perhaps the most popular lecturer of his day, and the influence exerted by his countless lectures all over the country was second only to that of his cheap reprints. His teaching work at University College was marked by equally extraordinary success. In 1882 he accepted a post that made great calls on his time and energy—the principalship of University Hall. This institution was partly a place of residence for students of University College, and partly the home of Manchester New College. During this time he rendered further services to the cause of education in London not only by his work on the council of University College, but by his advocacy of a teaching university for London. In 1889 he resigned the principalship of University Hall and his professorship at University College, and retired to Carisbrooke, Isle of Wight, intending to devote his leisure to the completion of the great task of his life, *English Writers*. But with his work only half achieved he died on 14th May 1894. (H. SY.)

Morley, John (1838-——), English statesman and author, was born at Blackburn, 24th December 1838, being the son of Jonathan Morley, surgeon. He matriculated at Lincoln College, Oxford, in 1856, and after taking his degree in 1859 came up to London with the determination of seeking distinction by literature. He almost immediately became editor of the moribund *Literary Gazette*, which not all his ability could preserve from extinction. Gradually, however, he became known as a philosopher and a Radical, and as one of the ablest and most incisive contributors to the literary and political press of the day. His sympathies as a thinker seem to have been at this time chiefly with Positivism, though he never embraced Comte's doctrine in its hierarchical aspects; but he acquired a reputation as an agnostic, which became confirmed in the popular mind when he somewhat aggressively spelt God in one of his essays with a small "g." In 1868 he was editor for a short time of the daily *Morning Star*, which came to an end in 1870. In 1867 he succeeded Lewes in the editorship of the *Fortnightly Review*, which he conducted with brilliant success until 1883, when he was elected to Parliament; he then assumed in exchange, but not for long, the lighter duties of the editorship of *Macmillan's Magazine*. He had been connected with Messrs Macmillan since the commencement under his editorship, in 1878, of the "English Men of Letters" series, a collection of biographies of various merit, in which nothing is better than the editor's own contribution in his *Life of Edmund Burke*. Since 1880 he had been the editor of the *Pall Mall Gazette*, which was then turned into a Liberal paper (see NEWSPAPERS); and he succeeded in ably maintaining the high character with which it had started under Mr Greenwood. In 1883 Mr Morley, who had twice unsuccessfully attempted to enter Parliament, was returned for Newcastle-upon-Tyne at a bye-election. The prestige thus acquired led to his presiding over a great Liberal congress at Leeds in the same year; and, although the platform never seemed his natural element, the literary finish of his style and the transparent honesty of his reasoning rapidly gained him a prominent position in the House of Commons. When, in February 1886, Mr Gladstone returned to office as a Home Ruler, Mr Morley, who had never before held any public appointment, filled one of the most important posts in the Cabinet as Secretary for Ireland. He had always expressed his sympathy with the Irish Nationalist movement. He had no opinions to recant, no pledges to explain away. He is credited with an especial influence over Mr Gladstone in the matter of Home Rule, and in particular with having kept him steady in the Bill of 1886 to his original purpose of entirely separating the Irish from the British legislature, a provision which pressure from their own party afterwards compelled both Mr Morley and Mr Gladstone to abandon. After the severe defeat of the Gladstonian party at the general election of 1886, Mr Morley led a life divided between politics and letters until Mr Gladstone's return to power in 1892, when he resumed his former office. He had been re-elected for Newcastle in circumstances entirely honourable to himself, a determined attempt having been made to exclude him in consequence of his resistance to an Eight Hours' Labour Bill, of which he disapproved as an undue interference in principle with the rights of adult labour. His constituents showed their appreciation of his integrity by returning him with a majority of 1739; but the resistance to his views on the labour question went on in his constituency, and was assisted by Mr Cowen's persistent campaign in the principal Newcastle newspaper against the general lines of Mr Morley's somewhat doctrinaire and anti-Imperialistic views on politics. The result was that, at the election of 1895, he lost his seat, but soon found another in Scotland, for the Montrose Burghs. He had during the interval taken a leading part in Parliament, but his tenure of the chief secretaryship of Ireland was not a success. The Irish gentry, of course, made things as difficult for him as possible, and the path of an avowed Home Ruler installed in office at Dublin Castle was beset with pitfalls. In the intestine disputes which agitated the Liberal party during Lord Rosebery's administration, and afterwards, Mr Morley sided with Sir William Harcourt, and was the recipient and practically co-signatory of his letter resigning the Liberal leadership in December 1898. Mr Morley's activities were again turned to literature, the political views most characteristic of him, on the Boer war in particular, being practically swamped by the overwhelming predominance of Unionism and Imperialism. His occasional speeches, however, denouncing the Government policy towards the Boers and towards the war, though not representing the popular side, always elicited a respectful hearing, if only for the eloquence of their language and the undoubted sincerity of the speaker.

JOHN MORLEY.
(*From a photograph by Elliott and Fry.*)

As a man of letters Mr Morley's place will be determined by his monographs on *Voltaire* (1872), *Rousseau* (1873), *Diderot and the Encyclopædists* (1878), *Burke* (1879), and *Walpole* (1889). Burke as the champion of sound policy in America and (as Mr Morley deems) of justice in India, Walpole as the pacific minister understanding the true interests of his country, fired Mr Morley's imagination. His *Life of Oliver Cromwell* (1900) revises Gardiner as Gardiner revised Carlyle. The *Life of Cobden* (1881) is an able defence of that statesman's views rather than a critical biography or a real picture of the period. Mr Morley's contributions to political journalism and to literary, ethical, and philosophical criticism are numerous and valuable. They rarely evince any striking originality of thought, but possess great individuality of character. As in letters, so in politics. A philosophical Radical of a somewhat mid-19th-century type, and highly suspicious of the later opportunistic reaction (in all its forms) against Cobdenite principles, he yet retained the respect of the majority whom it was his usual fate to find against him in English politics by the indomitable consistency of his principles and by sheer force of character and honesty of conviction and utterance. After the death of Mr Gladstone Mr Morley was engaged till 1902 upon his biography. Among the Coronation honours of 1902, he was nominated an original member of the new Order of Merit; and in July 1902 he was presented by Mr Carnegie with the late Lord Acton's valuable library.

Morley, Thomas (1557–1603), English musical composer, was born in 1557, as may be gathered from the date of his motet, "Domine non est," composed "aetatis suae 19 anno domini 1576," and preserved in Sadler's Part-Books (Bodleian Library). He was a pupil of William Byrd, but nothing is known as to his origin and very little as to the incidents of his career. In the account of the entertainments given at Elvetham by the earl of Hertford in 1591 in honour of Queen Elizabeth, it is stated that there was "a notable consort of six Musitions," whose music so pleased the queen "that in grace and favour thereof, she gave a newe name unto one of their Pavans, made long since by Master *Thomas Morley*, then Organist of Paules Church." This statement, however, lacks corroboration, and if Morley ever held the post, he must have done so for a very short time. On 5th July 1588 he was admitted Mus. Bac. at Oxford. Four years later (24th July1592) he entered the Chapel Royal, where he successively filled the offices of epistler and gospeller. From the dedication to his first book of canzonets it seems that in 1595 Morley was married. His wife's Christian name was Margaret, and before her marriage she apparently held some post in the household of Lady Periam, wife of the Lord Chief Baron of the Exchequer. On 11th September 1598 Morley received a licence for twenty-one years to print ruled music-paper and song-books in English, Latin, French, or Italian. His rights under this grant were assigned by him to various publishers. In Burgon's *Life of Gresham* it is stated (ii. 465) that the registers of St Helen's, Bishopsgate, show that Morley lived in that parish. This is inaccurate, and there is no proof that the family of the same name residing in St Helen's between 1594 and 1600 was related to the composer. In the preface to his *Plaine and Easie Introduction to Practicall Musicke* (1597), Morley gives as one of his reasons for undertaking that work that he led a solitary life, "being compelled to keepe at home," presumably owing to ill-health. On 7th October 1602 his place in the Chapel Royal was filled up, and on 25th October 1603 administration of his goods was granted to his widow. This document (*Act Book*, 1603, fol. 171) describes him as "late parishioner of St Botolph's near Billingsgate," but the registers of that parish contain no entries relating to him. Morley was incontestably one of the greatest of the Elizabethan composers. His madrigals, canzonets, and ballets are as remarkable for their beauty as they are for their admirable workmanship, and his *Introduction to Practicall Musicke*, in spite of its frequent obscurity, is an invaluable source of information as to the state of musical science in England at the end of the 16th century. His works are: (1) *Canzonets to Three Voices* (1593, 2nd edition, 1606; 3rd edition, 1631; German Translations: Cassel, 1612, and Rostock, 1624); (2) *Madrigals to Four Voices* (1594, 2nd edition, 1600); (3) *First Book of Ballets to Five Voices* (1595. An Italian edition appeared in London in the same year, 2nd edition, 1600; German edition, Nuremberg, 1609); (4) *First Book of Canzonets to Two Voices* (1595; 2nd edition, 1619); (5) *Canzonets or Short Little Songs to Four Voices, selected out of Italian Authors* (1597); (6) *Canzonets to Five and Six Voices* (1597); (7) *A Plaine and Easie Introduction to Practicall Musicke* (1597; 2nd edition, 1608; 3rd edition, 1771); (7) *Madrigals to Five Voices, selected out of Italian Authors* (1598); (8) *The First Book of Consort Lessons, made by divers authors, &c.* (1599; 2nd edition, 1611); (9) *The First Book of Airs to Sing and Play to the Lute with the Base Viol* (1600); (10) *The Triumphs of Oriana to Five and Six Voices, composed by divers several authors* (1601). Besides the above, services, anthems, motets, and virginal pieces by Morley are to be found in various collections, both printed and manuscript.

(W. B. S*.)

Mormon Church.—The most conspicuous events in the history of the Church of Jesus Christ of Latter-day Saints (*i.e.*, the "Mormon" Church) since 1880 concern polygamy. The Morrill Act of 1862 for the suppression of polygamy in the territories was inoperative owing to certain defects in the law, which made conviction uncertain, and to lack of strong public demand for its enforcement. From time to time other laws of increasing stringency were enacted to the same end. These measures were finally amended and supplemented by the Edmunds-Tucker Act of March 1887, which became a law without the President's signature. By it polygamy and cohabitation with more than one woman as wife were prohibited; persons were disfranchised who could not, or would not, swear that they were guiltless of these offences; woman suffrage, permitted in Utah by Act of Legislature in 1870, was forbidden; the Mormon Church and the Perpetual Emigration Fund Company were disincorporated; the property of these organizations was declared forfeited to the Federal Government, the proceeds to be devoted to the public schools—property actually in use for worship and similar purposes being exempt. Vigorous prosecutions of offenders were at once instituted. The Mormons were at great expense in attacking the validity of the Act, but its constitutionality was sustained by both state and federal supreme courts. Many of the most notable polygamists and eminent authorities of the Church escaped prosecution by hiding —in local slang, by "going on the underground." The property confiscated in the territory of Utah amounted in value to about $1,000,000. The legislature of the territory of Idaho also struck at polygamy in 1885 by the "Test Oath Act," which disfranchised all persons belonging to any organization that should teach or encourage polygamy or unlawful cohabitation. A similar law was for a short time in force in Arizona. In July 1887, John Taylor, president of the Mormon Church, died while in concealment in a small town near Salt Lake City, Utah. The apostles administered the affairs of the Church until April 1889, when Wilford Woodruff, the senior apostle, succeeded to the presidency. The rigid enforcement of the law did at last what the Acts designed to accomplish. On 24th September 1890 President Woodruff issued the famous manifesto in which he said: "Inasmuch as laws have been enacted by Congress forbidding plural marriages . . . I hereby declare my intention to submit to those laws, and to use my influence with the members of the Church over which I preside to have them do likewise . . . and I now publicly declare that my advice to Latter-day Saints is to refrain from contracting any marriage forbidden by the law of the land." On the 6th of October following, the general conference of the Church approved the manifesto, and by resolution asserted that "we accept his declaration concerning plural marriage as authoritative and binding." These utterances were accepted as made in good faith, and prosecutions at once ceased. Most of the polygamists desisted from cohabiting with their plural wives, and, excepting a few cases, apparently not sanctioned by the Church authorities, no further polygamous marriages have since then taken place. Between 1852, when the doctrine of polygamy was first openly promulgated, and 1890, about 10 per cent. of the adult male members of the Mormon Church took plural wives, practically every man occupying a position of eminence or authority being a polygamist. In all, about 1200 persons were convicted of polygamy or unlawful cohabitation in the territories of Utah, Idaho, and Arizona. The usual penalty was a fine of $300 and confinement in the penitentiary for six months. Under the "test oaths" nearly 12,000 were disfranchised. On the 4th of January 1893, in response to a petition from the officials of the Church, pledging the membership thereof to faithful obedience to the laws against polygamy, &c., and begging amnesty, the President of the United States, Benjamin Harrison, issued a general pardon to all liable to the penalties of the Edmunds-Tucker Act, who had abstained from offending since the 1st of November 1890. On the 25th of September 1894 President Cleveland also granted full amnesty to all who were under political disability for violating the anti-polygamy laws, and who had been law-abiding since the 1st of November 1890. One of the conditions on which Utah was admitted to statehood in 1896 was that polygamy should be prohibited by an article in the state constitution, repealable only with the consent of the United States and of the people of the state. Although the practice of polygamy has been suspended by the Mormon Church, the doctrine is still a valid one. That polygamous relations were not entirely abandoned by individual Mormons is shown by a few convictions since 1890, and in the passing of an Act by the first state legislature in 1896 legitimizing all children born of plural wives previous to the 1st of January 1896. In March 1896 the escheated property of the Church still in possession of the United States Government, amounting to $285,000, was restored. About $450,000 in the aggregate had been previously restored in instalments. The remainder had been consumed in fees and other expenses of managing. The Emigration Fund Company was never reorganized. The Church as a whole was not again incorporated, its legal business being transacted by its president as "Trustee-in-trust for the body of religious worshippers known as the Church of Jesus Christ of Latter-day Saints." Each "ward," or administrative unit, has been incorporated, its executive head being known as "bishop."

On the 6th of April 1893 the Mormon temple in Salt Lake City was completed and dedicated. Work on this building had been in almost continuous progress for forty years. The cost was approximately $3,000,000. There are three other temples in Utah, in Logan, Manti, and St George respectively, which though costly are smaller and less elaborate. These edifices are not used for public assemblies of any kind, but are arranged for the secret performance of the sacred rites of baptism, of marriage, of baptism in behalf of dead ancestors and friends, and of "endowment," or the higher ordinances of the Church.

President Woodruff died in 1898, and was succeeded in office by Lorenzo Snow. President Snow died in October 1901, and was succeeded by Joseph F. Smith, nephew of Joseph Smith, the founder of the Church. Missionary activity has always been one of the most important policies of the Church. Most of the male members are expected to spend a season away from home preaching the tenets of the Mormon faith. Two years is the usual term. Missionaries to foreign countries, who must learn a new language, often remain three years or even longer. Zealous and efficient men frequently serve more than one term. These missionaries are usually young men, who pay their own expenses, even buying the tracts, pamphlets, and books they distribute. In 1901 nearly 2000 Mormons were in the mission field, a few of whom were women. Formerly a person when "called" must go, regardless of financial or family considerations. The system is maintained partly to gain converts and partly as a discipline to the missionaries. At the beginning of the 20th century the growth of the Church through converts did not seem so great, proportionally, as at some previous times. The missionary work is thoroughly systematized. There are fourteen organized "missions," viz., the Eastern States (United States), the Northern States, the Southern States, the South-western States, California, Great Britain, Switzerland, Germany, the Scandinavian countries, Hawaii, Australia, New Zealand, and Samoa. In 1901 Japan was added. Until about 1892 most converts from nearly all parts of the world, the Pacific Islands being the chief exception, emigrated to Utah or adjacent states and territories, where work and an opportunity to make comfortable homes were provided. Since then the policy, in general, has been to encourage converts to remain at home and so form centres for spreading the influence of Mormonism and for lessening the difficulties of missionaries in their travelling work. Emigration has been greatly assisted by the Perpetual Emigration Fund Company. This society, organized in 1849, incorporated in 1851, and dissolved in 1887, provided means, in whole or in part, to indigent converts for transportation to Utah, the aid being regarded as a loan to be repaid whenever the assisted immigrant should become financially able. Over 50,000 persons have received benefits from the company.

The looked-for Zion of the Mormons, where the final "gathering" shall be, is not Utah but western Missouri, the city of Independence being regarded as the centre. The principal administrative divisions of Mormondom, where the Church is fully organized, are known as "Stakes of Zion," the figurative name being suggested by the stakes that hold a tent firm. There are about fifty of these "stakes" in the western part of the United States, in Alberta, Canada, and in Mexico. In 1901 the Church had about 300,000 members, of whom 200,000 lived in Utah, where they constituted about three-fourths of the entire population of the state; 60,000 were found in neighbouring states, and 40,000 were distributed in other parts of America, and in Europe and the Pacific Islands. Public schools, although early established in the Mormon settlements of Utah, were slow of development. In 1888 President Woodruff began active measures to institute Church schools. In a few years a well-organized system was in operation, under control of the general Church board of education. Many of the "stakes" support academies, which when completely developed will conduct full high school courses. Three institutions, the Brigham Young Academy at Provo, the Brigham Young College at Logan, and the Latter-day Saints' University at Salt Lake City (until 1901 known as the L. D. S. College), attempt college work and offer degrees. These were founded prior to 1888, but were put under the control of the general board. In some communities where the Mormons are in considerable majority these Church academies supply the place of public high schools.

The industrial policy of Mormons is summed up in the word "co-operation." It was the aim of the early leaders in Utah to make their people self-reliant and independent of non-Mormons. The virtue of mutual helpfulness was therefore inculcated. Companies of settlers were sent to the richest valleys of the inter-mountain region wherever the soil could be most easily irrigated. Each company was selected with care to include artisans of all the indispensable crafts, and the people, closely bound by common ties, lived like members of a family. They enclosed great tracts of land for the use of the community, appropriated the water of convenient streams, and exchanged products and labour. President Young tried to provide that each family in towns should own at least an acre, and each family in farming districts fifteen or twenty acres. He believed that a comparatively small estate well cultivated was better than a large farm badly cared for. People were taught to shun debt, and mortgages were almost unknown. The result of this was shown in 1900, when 60 per cent. of the families in towns and cities lived in their own homes, and 91 per cent. of the farmers tilled their own soil. On their arrival, Mormon immigrants were made up into new companies for settlement, or were distributed among the older places according to the needs of the several communities. Men of almost every skilled trade were found among the early inhabitants of Utah. In caring for the poor the Church was a vast labour exchange, and kept in touch with the industrial necessities of every locality, and wherever men needed work or work needed men, the want was supplied. Home production of everything requisite was encouraged by President Young, and under his influence a great variety of industries was fostered. The building of a railway through Utah in 1869 made possible the competition of cheaper and better goods from the East, and many promising enterprises perished. For twenty years after the settlement of Utah, barter was the chief means of exchange, and, as it permitted readier local transactions and compelled the Mormons to be less dependent on Gentiles (*i.e.*, non-Mormons), the system was encouraged long after it might have been supplanted by a more extensive use of money. The existence of precious metals was early discovered in Utah. But fearful that a mining mania would result in utter neglect of farming, with consequent distress, if not famine and starvation, Mormons were practically forbidden to open mines. Mining was therefore developed almost wholly by Gentiles, and for many years was carried on by them.

Until three years after the Mormons reached Utah there were no shops in the territory. The most flourishing stores were first conducted in Salt Lake City by Gentiles, who, possessing capital and credit, had a monopoly and practised extortion. These merchants did nothing for the improvement of the town, and spent their money elsewhere. This eventually led to the establishing of co-operative companies in nearly every settlement, the shares of which were widely distributed in small lots among great numbers of holders in the different communities. The prices of goods were made reasonable, and all profits beyond a certain percentage were devoted to the erection of new and substantial store buildings and to other enterprises, which gave work to the people and tended to improve the towns. The Church authorities used their utmost power to further these concerns. At one time there existed no fewer than 200 of them, but they gradually grew less popular, and individual firms and merchants, not always Mormon, opened businesses, and by 1880 controlled the bulk of the trade. Some of the co-operative shops closed. Others consolidated, until in 1900 they did not exceed 60. The shares, too, generally gravitated into the hands of comparatively few, and were even sold to Gentiles. The co-operative establishments conducted business on such conservative lines and with such punctilious regard for all obligations that no concerns in the country enjoyed higher credit in the commercial world. The most successful of these establishments is the Zion's Co-operative Mercantile Institution in Salt Lake City, organized in 1868, incorporated in 1870 for twenty-five years, and reincorporated in 1895 for fifty years. The original capital was $220,000, which has been increased to $1,077,000, partly by stock dividends representing cash accumulations. From the date of its founding to June 1901 it has paid over $2,550,000 in dividends. The net transactions amount to $4,000,000 per year. Besides maintaining mercantile departments in which nearly every commodity is sold, the company engages in the manufacture of shoes and of clothing. It has branches in Provo and Ogden, Utah, and Idaho Falls, Idaho. Its stockholders number 600.

With the opening of many rich mines and the building of railways, isolation has become no longer possible. Population has rapidly increased, and life has grown more complex, and whatever was socially or economically distinctive among Mormons has slowly disappeared.

(G. M. M.)

Morocco (El Maghrib el Aksa, "The Farthest West," *i.e.*, of the Mahommedan world), bounded on the N. by the Mediterranean, on the E. by Algeria, on the S. (indefinitely) by the Sahara, and on the W. by the Atlantic as far south as Wad Draa. It is the only North African state retaining its independence, and therefore presents peculiarly interesting features. The climate is good, and produces a hardy race. Shielded by the Atlas from the hot winds of the Sahara, the coast of the Atlantic offers great attractions to those suffering from chest complaints. Tangier is already a recognized health-resort, and Mogador and Rabat await development as such. Rain falls only between September and April; on the Atlantic coast it is brought by the south-west wind, and on the Mediterranean sometimes also by the east wind, or *sharki*, otherwise dry and somewhat trying to invalids. The wonderfully temperate climate of Mogador is due in a great measure to trustworthy trade-winds. In Tangier and Mogador the summer heat is rarely oppressive, never injurious, as the thermometer seldom rises over 80° F. or sinks below 40°, although inland the extremes are much greater; and while on the plains or in low-lying cities the heat grows intense, snow gleams on the Atlas all the year round.

Three races inhabit Morocco, and members of two others are continually introduced. The aboriginal Berbers occupy the mountainous districts, where they still maintain a degree of independence. The plains are for the most part occupied by Arabs, introduced in the 11th and 12th centuries, or by the mixed race to which the majority of the dwellers in towns belong, called by foreigners "Moors" from the old Latin "Mauri." The third race is the Jewish, of which the original stock dwells inland, speaking Arabic and Berber, the majority of the more modern arrivals, expelled from Europe, having remained in the ports, where they still speak Spanish. The slave trade with the western Sudan maintains a small proportion of negroes, intermarriage with whom has produced bronzed types, for both Berbers and Arabs are white-skinned. On the coast there are small colonies of Europeans, chiefly engaged in trade. The largest of these colonies, principally Spanish, is found in Tangier. The most widely spoken language is Berber, varying in dialect, but the language of the Government and creed is Arabic, for the religion of the empire is Islám, the Moors being among the strictest followers of Mahommed. The divisions of the East are unknown, and their tenets include the principal teachings of both Shias and Sunnîs, but, as employing the Máleki ritual, they must be classed with the latter. Recognizing their own Sultan as Amir el Mû'minîn (Commander of the Faithful) and Khalîfa of God on earth, they acknowledge no other claimant, and have few dealings with the Turks, whom they consider corrupt. They have not yet given way extensively to strong drink, and the use of tobacco is also frowned upon and forbidden by law. The Moors are bigoted even when friendly.

Population.—The number of the population has never been known, and while so large a portion of the empire remains unexplored, statistics must be represented by conjecture. Estimates in this case vary from five to ten millions, the majority of whom are pastoral and agricultural. There are only three great inland cities, each of which in turn serves as metropolis—Fez, Mequinez, and Marrákesh. The towns next in importance are the seaports of Tangier, Mogador, Casablanca (Dar el Baida), Azammûr, Mazagan, Saffi, Salli-Rabat, Laraiche, and Tetuan. On the Mediterranean shore, along the coast of Er-Rîf, the Spaniards have for centuries possessed Ceuta, Peñon de Velez, Alhucemas, and Melilla; in 1848 they appropriated the Zaffarine Islands. Inland the only other important cities are the sacred towns of Zarhôn, Sheshráwan, and Wazzán (the last-named of which alone is open to Europeans), and the minor towns of El Kasar, Sifrû, Täza, Dibdû, and Oojda in northern Morocco (once the kingdom of Fez); Damnát, El Klá, Sidi Rahal, Zettát, and Amzmiz in central Morocco (once the kingdom of Marrákesh); Tarudant, Agadîr Ighîr, Ilîgh, Tiznît, and Glîmîn in southern Morocco (once the kingdom of Sûs), and the districts of Tafîlált and other Saharan oases beyond the Atlas.

History.—The history of the Moorish empire commences with the settlement near the Roman ruins of Volubilis in A.D. 788 of Idrees the elder, one of the fugitive descendants of Mahommed, during the struggles between rival claimants of the khalifate. Islám had then been established in these parts for eighty years, but Idrees and his son, Idrees II., the builder of Fez, extended its influence, uniting the Berbers into a kingdom. Their line controlled a limited portion of northern Morocco for nearly two centuries, in part supplanted by the Miknásà in 917, until displaced by the Magháwà in 988. These two dynasties were exterminated in 1067 by Yûsef I. (bin Tashfîn), founder of the Murábti ("Almoravide") dynasty of Berbers, who added the remainder of Morocco, most of Spain and Portugal, and Tlemçen. In 1147 their power was overthrown by a religious leader, 'Abd el Mû'min, at the head of the Muwáhhadi—*i.e.*, Unitarian—horde ("Almohades"), under whom the Moorish empire reached its zenith at the close of the 12th century. It then included, in addition to the Murábti realm, what now are Algeria, Tunisia, and Tripoli, extending to the frontier of Egypt, which they were prevented from occupying by the rise of Saladin. Before the middle of the 13th century they had been driven out of Spain, and had lost all but what is now known as Morocco, whence, between 1217 and 1269, they were ousted by the Beni Marîn ("Marinides"). These retained nominal power for three hundred years, but during their third century they became so enfeebled that all continuous record is lost. A branch of the same family, known as the Watási, reigned in northern Morocco (kingdom of Fez) from 1471 to 1548, when the whole country passed into the hands of the Sa'adi Shereefs, who had occupied southern Morocco (kingdom of Marrákesh) since 1521. Their rule lasted but a century, for between 1630 and 1668 they were gradually replaced by another family of Shereefs, the Filáli, which is the ninth and reigning dynasty. Of this line the Sultan reigning in 1902—Mulai ("my lord") 'Abdul 'Azîz IV.—was the fourteenth. He succeeded his father, El Hasan III., in 1894, at the age of fourteen, the empire being governed for the first seven years by a regent. His Shereefian Majesty, or The Lofty Portal ("Sublime Porte"), as he is officially styled by Europeans and natives respectively, is married and has sons.

The Sultan and his court.

An excellent sketch of the Sultan Mulai 'Abdul 'Azîz and of his court was given in *The Times* of 10th June 1901, by a correspondent who wrote from Tangier on 12th May, *à propos* of the special embassy which was being sent to congratulate King Edward VII. on his accession to the throne. We give the following extract from that article:—

"Mulai Abdul Aziz succeeded to the throne on the death of his father, the late Sultan Mulai Hasan, in 1894. At the time of his father's death young Abdul Aziz was in Rabat with his mother, a Circassian lady, and it was there that he was proclaimed. Mulai Hasan died during a punitive expedition in the central provinces of his country; but, owing to the extraordinary capability of Si Ahmed Ben Musa, the chamberlain, his Shereefian Majesty's death was concealed from the world, and for two days even the palanquin-bearers imagined that they were carrying a living, though ill, Sultan, and never suspected that their burden was a corpse. Two days were sufficient for the wily chamberlain. It gave him time to proclaim young Abdul Aziz in Rabat, and to lay the foundations of his plans by which he afterwards became Vizier and practically Sultan, while the real holder of the title was kept hidden away in the palace. But Mulai Abdul Aziz had an elder brother, Mulai Mohammed, who had been Viceroy of the South, and who by his generosity—with other people's money—and by his libertine ways was extremely popular with the general public. A rising in his favour occurred, but the iron will of the Vizier Si Ahmed crushed it, and even to-day (1901) the prisons are full of the tribesmen who rose, while Mulai Mohammed himself lives in confinement in Mekinez. The Vizier died in 1900, still in possession of his great influence, and leaving to be confiscated by his royal master a huge fortune, amounting, it is said, to some millions sterling, every penny of which had been squeezed and extorted from the wretched population of the country. His death gave Mulai Abdul Aziz, then some nineteen years of age, an opportunity of emerging from his almost enforced seclusion and of exercising his authority, for up till this period his identity had been entirely overshadowed by that of his powerful and cruel Vizier. Since the death of Si Ahmed he has certainly come forward, and the northern blood inherited from his Circassian mother has rendered him not a little susceptible to European influence, though possibly not to his own advantage. The Moorish Sultanate is so essentially a religious one, depending upon that descent from the Prophet which confers the title of Amir el-Mumenin—Commander of the Faithful—that any change in the *régime* of the court would at once raise the antagonism of the large and fanatical religious faction. At present these progressive tendencies have done little more than interest his Shereefian Majesty in European inventions. He rides a bicycle, photographs, and enjoys the cinematograph. So lavish has he been in obtaining all the newest inventions and toys of Europe that one trading Jew alone, who brought him a real circus to the capital, has received some £20,000 of the country's revenue, drawn from the custom-house of Mázagan. It is the custom, unfortunately, for Oriental monarchs to hoard their private fortunes and to draw upon the resources of their country for their private amusements. In appearance Mulai Abdul Aziz is tall and well-built. In bearing he is very dignified. On public occasions, in his loose white robes, he looks, and is, a Sultan. His life is one of great simplicity. He rises at dawn and prays at the regular stated intervals throughout the day. His food is simple, and eaten, according to the custom of his country, without knife and fork.

"The position of a Sultan of Morocco never allows him to come into actual touch with his subjects, and the principal power therefore rests with the Grand Vizier. The present (1901) holder of this important office, though he prefers to call himself the Minister of War, is a young and energetic man, Kaid Mehedi el Menebhi, who was in former days an understudy of Si Ahmed. His influence is all-powerful, and it was through his agency that, in April 1901, the elderly Haj Mukhtar, the nominal Grand Vizier, a refined and honest old man, who had done all in his power not to be appointed, was sent a prisoner to Fez, while all his property was confiscated. He knew a year before, when he received his appointment, what his fate would be. Such falls from power are of everyday occurrence in Morocco. No man knows his fate until the fatal day arrives, and the writer has been the guest of a great local governor, whose stables were full of splendid horses, and who was served by a horde of attendants and servants—and within a month he has given in charity a loaf of bread to the same governor's son, begging in the streets, while the father lay dying in prison. The son of another great official, whose wedding attracted thousands of tribesmen, and whose generosity was unsurpassed, was met by the writer within a year loading the baggage mules of a European envoy amongst the muleteers of the Sultan's army. No complaint, no despondency—merely the recognition that the wheel of fortune had turned!

"It is a picturesque court, that of the Sultan of Morocco. The great palace squares and courtyards, topped with the iridescent green-tiled roofs, the miles of fortified gardens, the high windowless walls, all present an appearance of unfathomable mystery. Seldom, indeed, do men penetrate within, for the precincts are sacred to the rule of women. Even the ministers of the Great Powers, on their periodical embassies to the Moorish court, see little more than the outside walls and the great green gates. At private audiences with the Sultan the visitor is led through tangled vine-clad gardens to some little summer-house, rich in exquisite plaster-work and tiles, half-ruined, perhaps, and yet a gem, where, under a ceiling gorgeous in colours and gilding, sits the almost pathetic figure of the Sultan. The Grand Vizier stands by his master's side, and without the doorway, out of sight of their sovereign, are seated half a dozen soldiers awaiting orders. And all around the tall dark cypresses shoot up their pillar-like forms. Very different is the public reception of the accredited ministers of Europe—very different and more humiliating. The Sultan is mounted, seated on horseback under his umbrella of state, surrounded by his courtiers and preceded by his officers of state. His led horses champ their bits and wave their marvellous manes and tails, and the sun glitters on the lances of the spear-bearers and the gold-embroidered saddles. The empty green-and-gold brougham, part of all processions, creaks and groans as it is brought into position, and in front of it all, bare-headed in the bright sunshine, and on foot, stand the envoys of the emperors and kings of Europe. A blare of trumpets, a banging of salutes, and the Sultan and his procession disappear through the great palace gates, and the reception, as picturesque as it is humiliating, is over.

"The Sultans of Morocco usually divide their time between their southern and northern capitals, Marrakesh and Fez respectively. They are great undertakings, these flittings of Sultans, for, with their army, their court, and their hangers-on, the imperial party often numbers some 30,000 or 40,000 persons. His Shereefian Majesty's progresses through the country leave poverty, destitution, and famine behind them, for, like locusts, they eat up everything. The one hope for Morocco lies in its young Sultan. He has already shown signs of a desire for the improvement of his country."

Government.—The Moorish government is a limited autocracy, the theoretical power of the sultan or emperor being greatly circumscribed by the religious influences which in a measure support him, and by the unpaid official proletariat with which he is surrounded, whose intrigues, in conjunction with those of European Powers, effectually check all progress. There is no regular assessment for taxation, but such organized spoliation as may be required for public or private ends. Centring in a group of wazeers, the administration radiates through despotic local governors to sheikhs and an unpaid police.

Army.—A half-organized army, service in which is partly hereditary, partly forced, is periodically employed in collecting taxes at sword-point, and in "eating up" the provinces; with it the Sultan goes forth to war each summer, spending the winter in one of his capitals. He has no army adequately trained for effective defence, and the "Armstrongs" at Tangier and "Krupps" at Rabat are useless by themselves. The only approach to a regular army consists of certain hereditary troops, the Bokhárà (black), the Udàïa (mulatto), the Ashragah and Ashrárdah (white), and the Gaïsh, who form a body of police, Makhháznîa (mixed), all of whom are horsemen. The infantry (Askárîa) are mostly rough, ill-trained levies, summoned each year for military expeditions against recalcitrant tribes; they are of varying numbers, only a small portion being well trained under an English instructor and French and Italian military missions. No accurate estimate can be formed of the total available forces, and the arms are of every pattern. There is no navy.

In these circumstances it is surprising to find that foreigners enjoy protection and liberty wherever the Sultan's writs run, that is to say, on the plains, but it is still more surprising to find that by treaties of long standing they are enabled to secure protection for natives having charge of their interests, without which trade would be impossible. The desire for this protection from rapacity induces the natives to offer premiums for such employment, and this in its turn leads to abuses unavoidable without further regulation, although much has been done towards this end since the Madrid Convention which met in 1881 for the purpose of discussing this question. Foreigners leaving the beaten tracks (there are no roads) are required to employ a policeman (*makhâzni*) to guard their persons and to prevent their attempting exploration. All the Powers are represented in Tangier by diplomatic and consular officials, who exercise independent jurisdiction over their respective fellow-subjects, to the frequent confusion of justice. The evidence of non-Mahommedans is not accepted in Moorish courts, where venality reigns, and unprotected Jews suffer constant injustice, besides daily indignities, for which they repay themselves by superior astuteness.

Education.—The level of education could hardly be lower, although most males have an opportunity of learning at least to recite or read the Koran, if not to write. Only traders trouble about arithmetic. Youths who desire to pursue their studies attend colleges in Fez or elsewhere to acquire some knowledge of Mahommedan theology, logic, composition, and jurisprudence, beyond which information is considered superfluous. The intellectual accomplishments of the Moors of the Middle Ages have been greatly over-estimated. The stars of their brightest period in Spain were Jews or Spaniards, who were sometimes persecuted for attainments which have, by strange perversion, shed a lustre on their persecutors, to whose creed they only adhered by compulsion. The social condition of Morocco is that of all Mahommedan countries unaffected by the influences of Christendom, such as Upper Egypt, Central Asia, and Arabia, but even in Morocco it is becoming corrupted rather than improved by intercourse with Europeans on the coast.

Produce.—The natural products remain almost entirely undeveloped. Numerous attempts have been made of late years to obtain concessions for mining and other exploitation, but in all the Government sees further complications with Europe: if, by wholesale bribery, any grant is obtained, a nullifying clause is inserted, or the first occasion is seized to raise anew insuperable obstacles. Agriculture, being in native hands, is less restricted, but so many difficulties are placed in the way of exportation, that the most prolific cereals are raised in quantities hardly exceeding the local demand, and falling short of it in years of drought. Periodical famines are the result. The breeding of horses or cattle, and the rearing of birds for European markets, suffer in the same way, but increase in spite of restriction and heavy dues. One of the most promising developments of recent years has been the growing supply of chickens, eggs, and fruit to Europe, even to England. The fisheries also are capable of great expansion, and are at present almost entirely in the hands of Portuguese and Spaniards.

Manufactures.—The manufactures are few, and the most famous—leather—is now either exported undressed to Marseilles or Philadelphia, or is counterfeited by machinery in London or Paris. With the exception of a few slippers and shawls supplied to Moors established in the Levant, its manufactured exports consist principally of carpets, rugs, trays, arms, and "curios" for decorative purposes. For home use the Moors do much spinning, weaving, and dyeing, chiefly of wool; but although it is possible to dress superbly in native-made articles, every year sees an increasing importation of Manchester and Yorkshire goods, rivalled by the cheaper products of Barcelona and Austria, in the last case with great success. Next to "cottons," the import upon which most duty is paid is green tea, transhipped in London; then come sugar of French, Belgian, or English manufacture, and candles from the same sources. Hardware follows, but machinery holds a very low place.

Commerce.—The commerce is almost entirely shared thus: Great Britain, one-half; France, one-quarter; Germany and Austria, one-tenth; and Spain, one-twentieth. The fluctuation in its volume is so slight that it may almost be regarded as stationary. Everything depends upon the state of the crops, and this in turn depends upon the rainfall, but even a good year is sometimes to a great extent wasted by internal dissensions. The average annual export trade of the empire may be reckoned at rather under £1,000,000 sterling, and the average import trade as rather over that sum, the figures having stood in 1873, with phenomenal crops, at £1,553,446 and £934,478 respectively, and at an average during succeeding years of about £900,000 and £1,000,000 respectively. At the same time, in the absence of adequate banking facilities, the amount of specie exported and imported ranges out of all proportion to the difference between these figures, and the constant variations in exchange and currency are serious impediments. But none of the figures supplied can be regarded as more than approximate, by reason of the meagreness and imperfection of the records available, and the constant evasion of customs dues by bribery and false invoices—not to mention ordinary smuggling—so that the actual bulk of the trade is greater than it here appears. The following are the official returns of exports and imports for the year 1900:—

Ports.	Exports.	Imports.	Totals.
Tangier . . .	£386,274	£481,356	£867,630
Tetuan	4,360	33,586	37,946
Laraiche . .	47,033	114,693	161,726
Rabat	20,071	95,440	115,511
Dar el Baida . .	397,730	291,289	689,019
Mazagan	360,577	281,690	642,267
Saffi	143,438	83,073	226,511
Mogador	407,592	246,231	653,823
Total	£1,767,075	£1,627,358	£3,394,433
Share of Great Britain	£534,478	£888,251	£1,422,729

Communication.—The facilities for communication with the outside world have become greatly extended. Regular and more frequent steamship services now link Morocco with London, Antwerp, Hamburg, Lisbon, Cadiz, Gibraltar, Malaga, Barcelona, Marseilles, Genoa, Oran, Malta, Alexandria, the Canaries and Madeira, Rio Janeiro and Montevideo, and, by transhipment at Gibraltar—only three hours from Tangier—with all great ports, East and West. The tourist traffic in particular has grown exceedingly, but shows itself still in its infancy. Great Britain, Spain, France, and Germany have postal agencies, and run competing courier mails along the coast, while Great Britain and Spain have laid telegraphic cables from Gibraltar and Tarifa respectively to Tangier; but the extension of wires inland, save for telephones and electric light, is still prohibited. At the same time the means of internal communication remain unimproved. Travelling in the interior is what it was a thousand years ago. Several courier services have indeed been established to inland towns, but rather as a speculation in postage stamp issues than for public benefit, though some have now been taken over by foreign postal authorities.

Finance.—Banking is rarely resorted to, except in underground hoards, though a few enlightened natives know the value of British Consols, and the local Jews continue to transact financial operations with convenience to their clients and considerable satisfaction to themselves, in the manipulation of the exchange and the calling in or pouring out of debased Spanish coinage. One innovation has been the repeated issue of a Moorish coinage of corresponding denominations, minted in France and Germany, and the introduction on the coast of Spanish copper. Moorish weights and measures continue to vary from town to town, but in the foreign trade the decimal system has almost entirely superseded the native chaos. Credit is allowed by European houses at their peril, and in some lines profits are cut ruinously fine or done away with altogether by dishonest practices, many arising out of the long credit in vogue.

Missions.—The most striking sign of the times in Morocco has been the almost concurrent though independent introduction of the press and evangelical missions. The Franciscans had for six and a half centuries done brave work in the country, since the founder of their order offered himself for that task in 1214, and many of them, including several British and Irish missionaries, had suffered martyrdom, but they have long abandoned attempts to convert the Moors. The London Jewish Society was established in Mogador in 1875, and since 1883 various Protestant agencies have commenced operations, and now support between them some ninety missionaries, male and female, including doctors and nurses.

The Press.—Journalism is entirely foreign, and was introduced in 1883, at the same time as the printing-press, Spanish, French, and English newspapers being established in quick succession. These have done much to make the true state of Morocco known.

Attempts to establish Hebrew and Arabic papers have hitherto failed. The late Sultan even went so far as to set up a lithographic establishment in Fez, from which a valuable series of Arabic theological, legal, and historical works have been issued, but most noteworthy of all is the publication in Cairo in 1895 of an Arabic history of Morocco, in four volumes, by a native of Salli, Ahmad bin Khalîd en-Násiri. Other forward steps have been taken in the production of several important volumes on the country, and in serious attempts to explore the Atlas. The vicomte de Foucauld has attained the first place by his intrepid journeys as a Jew through the forbidden regions, and by his workmanlike geographical records; the late Joseph Thomson did good work in the Great Atlas, though within a limited area; the vicomte de la Martinière has excavated some of the Roman remains; and Mr Walter B. Harris made a bold journey to Tafîlált. An equally important service was rendered by the compilation by Sir R. Lambert Playfair and Dr Robert Brown of an invaluable *Bibliography of Morocco* containing over 2000 entries.

Authorities.—Besides the works named in the ninth edition, the principal contributions to the history are:—**Native**:—Ibn 'Abd el Hákim, embracing the period from A.D. 690 to 750 (tr. Jones). Göttingen, 1858. — 'Abd el Wáhid el Marrákeshi (1149–1224), tr. E. Fagnan in the *Revue Africaine*, 202–7. 1891.—*Raôd el Kartás* (788–1326), tr. Baumier. Paris, 1860.—El Makkári (710–1500), tr. Gayangos. London, 1840.—El Ufráni (1631–1812), tr. Houdas. Paris, 1889; and En-Násiri, not yet translated (710–1894). Cairo, 1895.—**Foreign**:—Mouëtte. *Histoire des Conquestes de Mouley Archy*, &c. Paris, 1683.—De el Puerto. *Mission Historial de Marruecos.* Seville, 1708.—Busnot. *Histoire du Regne de Muley Ismaïl.* Rouen, 1714.—Mas Latrie. *Traités de Paix*, &c., 3 vols. Paris, 1866–72; and *Relations et Commerce de l'Afrique Septentrionale.* Paris, 1886.—Mercier. *Histoire de l'Afrique Septentrionale*, 3 vols. Paris, 1888–91.—Meakin, Budgett. *The Moorish Empire, a Historical Epitome*, London, 1899, which contains critical notices of all important books on Morocco. **Geography**:—Leo Africanus. *Della Descrizione dell' Affrica.* Venice, 1526; tr. John Pory, London, 1600; ed. Dr Robert Brown for the Hakluyt Society, 1896.—Marmol Carvajal. *Descripcion General de Affrica.* Granada, 1573.—Urrestazu, F. de A. de. *Viajes por Marruecos.* Madrid, 1877.—Bonelli, Captain E. *El Imperio de Marruecos.* Madrid, 1882.—De Cuevas, Th. *Estudio . . . de Laraiche.* Madrid, 1884.—Erckmann, Captain. *Le Maroc Moderne.* Paris, 1885.—Pezzi, Rafael. *Los Presidios Menores de Africa.* Madrid. 1893.—Meakin, Budgett. *The Land of the Moors.* London, 1901. **Travel**:—Lenz, Oscar. *Timbuktu*, &c., 2 vols. Leipzig, 1884 (Fr. tr. also).—De Foucauld. *Reconnaissance au Maroc.* Paris, 1888.—Thomson, Joseph. *Travels in the Atlas*, &c. London, 1889.—Martinière, H. de la. *Journeys in the Kingdom of Fez.* Paris, 1889.—Harris, W. B. *Tafilet.* London, 1895. **Ethnology**:—Pellow, Thos. *Captivity and Adventures.* London, 1736; ed. Dr Robert Brown, London, 1890.—Host, G. *Efteretninger om Marokos og Fes.* Copenhagen, 1779.—Jackson, James G. *An Account of the Empire of Morocco.* London, 1809.—Meakin, Budgett. *The Moors.* London, 1902. **Language**:—Lerchundi, Rev. José. *Rudimentos del árabe . . . de Marruecos.* Madrid, 1878; Tangier, 1891; and *Vocabulario Español-Arábigo.* Tangier, 1892. English translation of the former by J. MacIver MacLeod. Tangier, 1900.—Meakin, Budgett. *An Introduction to the Arabic of Morocco* (Vocabulary, &c.). Tangier, 1890.—Baldwin, Miss C. W. *Morocco-Arabic Dialogues.* Tangier, 1892. (B. M*.)

Morocco City, the name sometimes erroneously applied to Marrákesh (*q.v.*).

Moron, a village in the province of Puerto Principe, Cuba, near the north coast, 250 miles east-south-east of Havana. It was noted as the terminus of one of the defensive *trochas* of the Spanish generals. Population (1899), 2084.

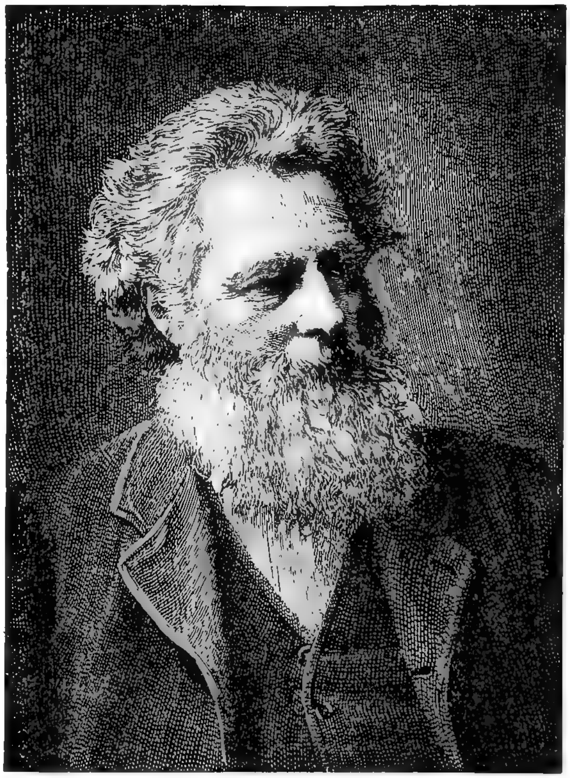
Morphy, Paul Charles (1837–1884), American chess champion, was born at New Orleans in 1837, and his skill in chess attracted attention while he was still a boy. In 1857 at the New York Chess Congress he defeated the leading amateurs, and in 1858 gave an exhibition of blindfold playing. He showed his skill in London, Birmingham, and Paris, and defeated the greatest masters of the day, remaining abroad for this purpose till 1859. He then returned to the United States and took up the legal profession; but he had put too great a strain upon himself, and besides having to give up chess, his mental condition was permanently impaired, and he died without fulfilling his early promise in 1884. Morphy's name, however, became a household word as the first, and perhaps greatest, of the modern feat-performing chess champions.

Morrill, Justin Smith (1810–1898), American financier, was born at Strafford, Vt., on the 14th of April 1810. After a common school education and a business career, he was elected to Congress as an anti-slavery Whig in 1855. Becoming a Republican, he remained in the House of Representatives till 1867, and was then elected to the Senate, where he represented Vermont till his death on 28th December 1898, thus fulfilling the longest continuous service in Congress since the foundation of the government. His career was that of a hard-working and useful, rather than a brilliant member. His special interest lay in the field of industry and finance. The tariff of 1861 was largely his work and took his name, and all subsequent tariff and fiscal legislation was impressed with the influence he exerted as a member, in the House, of the Committee on Ways and Means, and in the Senate, as member and for a time chairman of the Committee on Finance.

Morris, a city of Illinois, U.S.A., capital of Grundy county, on the north bank of the Illinois river, and on the Chicago, Rock Island, and Pacific railway, in the north-eastern part of the state, at an altitude of 518 feet. It is in a coal-mining region, has varied manufactures, and is a shipping point for grain. Population (1890), 3653; (1900), 4273.

Morris, Sir Lewis (1833–——), British poet, eldest son of Lewis Edward William Morris and Sophia, daughter of John Hughes of Carmarthen, was born at his father's house, Penbryn, in 1833. He was educated at Sherborne School and Jesus College, Oxford, where he took a first class in Moderations in 1853, and a first in *Literæ Humaniores* in 1855. He won the Chancellor's prize for an English essay in 1858, was called to the bar in 1861, and elected hon. fellow of his old college in 1877. He practised for twenty years as a conveyancing counsel, retiring from active legal work in 1881. He was energetic on behalf of educational movements in Wales, and contested Welsh constituencies in the Liberal interest, but without success. Sir Lewis Morris was knighted in 1896, and became also a Jubilee-medallist and Knight of the Redeemer of Greece. Comparatively late in life, Sir Lewis Morris made his appearance as a writer of verse with three series of miscellaneous poems, called *Songs of Two Worlds*, published respectively in 1872, 1874, and 1875. These little volumes proved him to have a refined taste and a gentle metrical fluidity, which soon won for his work considerable popularity. In 1876 and 1877 he made an important venture with *The Epic of Hades*, an attempt to re-tell the stories of Hellenic mythology with a certain modern and allegorical setting. This work, though it is not without false sentiment and artistic infelicities, contains his best verse and has passages of force and effect. His later work follows much too closely upon the influence of Tennyson, from which he is never altogether free; but his earnest didacticism, genial optimism, and evident sincerity have given his work a thoroughly wholesome influence.

Morris, William (1834–1896), English poet and artist, third child and eldest son of William Morris and Emma Shelton, was born at Elm House, Walthamstow, 24th March 1834. His grandfather was a respected tradesman in Worcester, and his father, who was born in that town in 1797, came up to London in 1820, and entered the office of a firm of discount brokers, in which he afterwards assumed a partnership, and married Emma Shelton, of a well-reputed Worcester family. They moved to Walthamstow shortly before the birth of the subject of this memoir. As a child William Morris, the poet, was delicate but studious. He learnt to read very early, and by the time he was four years old was familiar with most of the Waverley novels. When he was six the family moved to Woodford Hall, where new opportunities for an out-of-door life brought the boy health and vigour. He rode about Epping Forest, sometimes in a toy suit of armour, became a close observer of animal nature, and was able to recognize any bird upon the wing. At the same time he continued to read whatever came in his way, and was particularly attracted by the stories in the *Arabian Nights* and by the designs in Gerard's *Herbal*. It is not unlikely that the first seeds of later tastes were sown in these associations. He studied with his sisters' governess until he was nine, when he was sent to a school at Walthamstow. In his thirteenth year his father died, leaving the family well-to-do; the home at Woodford was broken up, as being unnecessarily large; and in 1848 William Morris went to Marlborough, where his father had bought him a nomination. Marlborough College was at that time in a state of considerable confusion, following upon an unmethodical start with numbers rapidly outgrowing accommodation. Discipline was relaxed, and games were disorganized. Morris was at the school three years, but got very little good from it, beyond a taste for architecture, fostered by the school library, and an attraction towards the Anglo-Catholic movement. He made but slow progress in school work, and at Christmas 1851 was removed and sent to a private tutor for a year. In June 1852 he matriculated at Exeter College, Oxford, but, owing to the college being full, did not go into residence till January 1853. Morris found Oxford in a state of mental and spiritual lethargy, and never acknowledged much advantage from its educational side. The typical "don" was always an object of dislike with him, and he thought the Oxford curriculum forced and lacking in expansiveness. But he at once made friends who stood him in good stead all his life, foremost among whom were Edward Burne-Jones, who was a freshman of his year, and a little Birmingham group at Pembroke. They read together theology, ecclesiastical history, mediæval poetry, and, among moderns, Tennyson and Ruskin. They studied art, and fostered the study in the long vacations by tours among the English churches and the Continental cathedrals. Moreover, Morris began at this time to write poetry, and many of his first pieces, afterwards destroyed, were held by sound judges to be equal to anything he ever did. Both Morris and Burne-Jones had come to Oxford with the intention of taking holy orders, but as they felt their way they both came to the conclusion that there was more to be done in the direction of social reform than of ecclesiastical work, and that their energies would be best employed outside the priesthood. So Morris decided to become an architect, and for the better propagation of the views of the new brotherhood a magazine was at the same time projected, which was to make a speciality of social articles, besides poems and short stories. At the beginning of 1856 the two schemes came to a head together. Morris, having passed his finals in the preceding term, was entered as a pupil at the office of George Edmund Street, the well-known architect; and on New Year's Day the first number of *The Oxford and Cambridge Magazine* appeared. The expenses of this very interesting venture were borne entirely by Morris, but after the issue of No. 1 he resigned the formal editorship to his friend Fulford. Many distinguished compositions appeared in its pages, but it gradually languished, and was given up after a year's experiment. The chief immediate result was the friendship between Rossetti and Morris which sprang up from a successful attempt to secure the former as a contributor. In the summer of 1856 Street removed to London, and Morris accompanied him, working very hard both in and out of office hours at architecture and painting. But Rossetti persuaded him that he was better suited for a painter, and after a while he devoted himself exclusively to that branch of art. It was in the summer that the two friends visited Oxford, and finding the new Union debating-hall in course of construction, offered to paint the bays. Seven artists volunteered help, and the work was hastily begun. Morris worked with feverish energy, and, on finishing the portion assigned to him, proceeded to decorate the roof. The work was done too soon and too fast, the colours began to fade at once, and are now barely decipherable; but the broken designs, so long as any vestige remains, will always be interesting as a relic of an important æsthetic movement, and as the first attempt on Morris's part towards decorative art. Early in 1858 Morris published *The Defence of Guenevere*, which was almost unnoticed by contemporary criticism, but is now recognized as one of the pearls of Victorian poetry. Its mediævalism, picturesque and haunting, its unfailing artistic intuition, and its dim, harmonious colouring, as of some exquisite tapestry, are features peculiar to Morris's best work.



WILLIAM MORRIS.
(*From a photograph by Elliott and Fry, London.*)

On 26th April 1859 Morris married Jane Burden, a beautiful Oxford girl, who had sat to him as a model, and settled temporarily at 41 Great Ormond Street, London. Meanwhile he set about building for himself at Upton a house which was to be the embodiment of all his principles of decorative art. Furniture, decorations, household utensils, and every article of daily use were specially designed, and in the summer of 1860 the house was ready for occupation. The furnishing of it had suggested a fresh activity; Morris now determined to embark upon decoration as a career. A small company was formed, consisting of Rossetti, Webb, Burne-Jones, Madox Brown, Faulkner, and Marshall, and in January 1862 started business under the title of Morris, Marshall, Faulkner and Co., with offices at 8 Red Lion Square. The prospectus set forth that the firm would undertake church decoration, carving, stained glass, metal work, paper hangings, chintzes, and carpets. The business, after inevitable vicissitudes, flourished, but the "house beautiful" at Upton proved to be unhealthily situated. Serious illness obliged the family to remove to town, and in November 1865 they resettled at 26 Queen Square, Bloomsbury. Morris was now unceasingly busy, but he found time also for literature. In June 1867 he published *The Life and Death of Jason*, which was at once successful; and in April 1868 the first two parts of *The Earthly Paradise.* The rest of this wonderful storehouse of poetic romance appeared in two volumes in 1869 and 1870. In the following year he was again looking for a country house, and lighted upon Kelmscott manor house, in the Upper Thames valley, which he took at first in joint-tenancy with Rossetti, and used principally as a holiday home. Hither he would retire from the cares of business, and take up the country life which was always his particular delight. In 1872 appeared *Love is Enough*, structurally the most elaborate of his poems for its combination of the epic and dramatic spirits; and in the autumn he began to translate the shorter Icelandic sagas, to which his enthusiasm had been directed by two inspiring journeys to Iceland. Business worries, however, interrupted him; it was found necessary to reconstruct the company owing to its having grown out of proportion with the existing division of profit and labour. Long negotiations ensued, and in March 1875 the old firm was dissolved. Morris now became sole manager and proprietor, although the other members of the old firm continued, in varying degrees, to give him the advantage of their assistance and advice.

Meanwhile the epic mood had possessed Morris very strongly, and, in addition to his work upon the sagas, he had actually finished and (in 1875) published a verse translation of the *Æneid*, which is interesting rather for its individuality than for any fidelity to the spirit of the original. Morris's cast of thought was too essentially mediæval to accord well with classicism. In the following year appeared *Sigurd the Volsung*, a version full of heroic vigour, movement, and vitality, but somewhat too lengthy and incoherent in design to preserve the epic interest intact to the British taste. This splendid burst of poetic activity, however, had raised him to a place among the first poets of his time; and in 1877 an attempt was made to induce him to accept the professorship of poetry at Oxford. But he felt himself lacking in the academic spirit, and wisely declined. Mention should be made at this time of a fresh outlet for his energy, furnished by his foundation in 1877 of the Society for the Protection of Ancient Buildings, which sprang into being as a practical protest against a scheme for restoring and reviving Tewkesbury Abbey. He began, too, to take an active interest in politics over the Eastern Question, but his enthusiasm was at the moment a flash in the pan. Finding that events were going against his judgment, Morris, as was so often the case with him, shrugged his shoulders and broke free from the movement. It was never a part of his character to adapt himself to development; if things went awry, he was always apt to lose interest.

Still, although he found it hard to sit close to a definite party, Morris continued to be spasmodically interested in political movements. During the next few years, indeed, the interest gained ground with him steadily. After the general election of 1880 he finally abandoned the Liberal party, and drifted farther and farther into Socialism. For ten or twelve years the movement had been gaining ground in England, and the Social Democratic Federation was formed in 1881. In January 1883, within a week of his election to an honorary fellowship at Exeter, Morris was enrolled among its members. Thenceforward for two years the cause of Socialism enjoyed not only the advocacy of his spare time, but the thought and energy of all his working hours. For it he even neglected literature and art. In March 1883 he gave an address at Manchester on "Art, Wealth, and Riches"; in May he was elected upon the executive of the Federation. In September he wrote the first of his *Chants for Socialists*, designed to proclaim that "the lower classes must demand a higher standard of life for themselves, for the good of the whole world, and for the regeneration of the conscience of man." About the same time he shocked the authorities by pleading in University Hall for the wholesale support of Socialism among the undergraduates at Oxford. He was now heart and soul in the movement; he had sold some of the treasures of his library to enrich its funds, and was giving it his brain and heart. Nevertheless, the Federation began to weaken. Internal dissensions harassed it. At the franchise meeting in Hyde Park in 1884 it was unable to get a hearing. Morris, however, had not yet lost heart. At the very end of 1884 the Socialist League was founded, and in February 1885 a new organ, *Commonweal*, began to print Morris's splendid rallying-songs. Still, differences of opinion and degree prevented concerted action; and when after the Trafalgar Square riots in February 1886 Morris remonstrated with the anarchic section, he was denounced by the advanced party, and ever afterwards was regarded with suspicion. In 1889 he was deposed from the management of *Commonweal*, and gradually lost all confidence in the movement as an active force. In November 1890 he left the League. The paper went from bad to worse, grew eventually treasonable, and saw its publisher condemned to eighteen months' imprisonment. This was the end of *Commonweal*, and with it the League also fell to pieces.

Long before that time, however, Morris had returned to the paramount interests of his life—to art and literature. When his business was enlarged in 1881 by the establishment of a tapestry industry at Merton, in Surrey, Morris found yet another means for expressing the mediævalism that inspired all his work, whether on paper or the loom. In 1887 he published his translation of the *Odyssey*, which had many of the qualities and defects of his *Æneid*, and is much more interesting as an experiment than valuable as a "Homeric echo." He then added another to his many activities; he assumed a direct interest in typography. *The House of the Wolfings* in 1889 was the first book in which, aided by the Chiswick Press, he tried to beautify the art of modern printing; and in the same year, in *The Roots of the Mountains*, he carried his theory a step farther towards perfection. Some fifteen months later he added a private printing-press to his multifarious occupations, and started upon the first volume issued from the Kelmscott Press, his own *Glittering Plain.* For the last few years of his life this new interest remained the absorbing one. A series of exquisite books, which gain in value every year, witnesses to the thorough and whole-hearted fashion in which he invariably threw himself into the exigencies of his life-work.

The last years of his life were peacefully occupied. He was sounded as to whether he would accept the Laureateship upon the death of Tennyson, but declined, feeling that his tastes and his record were too remote from the requirements of a Court appointment. His last piece of work, the crowning glory of his printing-press, was the

Kelmscott Chaucer, which had taken nearly two years to print, and fully five to plan and mature (see BOOK-PRINTING for a facsimile of a page). It was finished in June 1896, and before it was in his hands he already knew that his working day was over. His vigour had been slowly declining for some time, and he sank gradually during the autumn, dying on the 3rd October 1896. He was buried in Kelmscott churchyard, followed to the grave by the workmen whom he had inspired, the members of the league which he had supported, the students of the art guild he had founded, and the villagers who had learnt to love him.

Essentially the child of the Gothic revival, he had put an ineffaceable stamp on Victorian ornament and design, his place being that of a follower of Ruskin and Pugin, but with a greater practical influence than either. In house decoration of all kinds—furniture, wall-papers and hangings (which he preferred to paper), carpet-weaving, and the painting of glass and tiles, needlework, tapestry —he formed a school which was dominated by his protest against commercialism and his assertion of the necessity for natural decoration and pure colour, produced by hand work and inspired by a passion for beauty irrespective of cheapness or quickness of manufacture.

The truest criticism of William Morris is that attributed to his friend, Mr Swinburne, who said that he was always more truly inspired by literature than by life. His own modest claim to be "the idle singer of an empty day" is often quoted in criticism of him, but it is entirely inadequate. Morris was never idle, nor was his day, either in literature or in art, in any sense empty. But what he clearly lacked, in life no less than in art, was a direct and sincere sympathy with ordinary humanity. His Socialism, though it made a brave show at times, was at heart a passionate enthusiasm for an inaccessible artistic ideal. Morris, indeed, was not primarily interested in men at all, but in objects. His poetry deals, it is true, with the human passions, but the emotion is always seen as in a picture; he is more concerned with the attitude of the group than with the realization of a character. He had very little adaptability in dealing with his fellows; the crowd, as a crowd, carried his enthusiasm, but he was unable to cope with the individuals that composed it. Many of his colleagues bear witness to his generosity and magnanimity, but as a general principle he certainly lacked the wider humanity. This is the one failing of his art: it is also the shortcoming of his poetry. Granted this, there is left an immense amount that will always make demands upon an undivided admiration. The spirit of beauty breathes in every line; a sense of music and of colour is everywhere abundant; the reader moves, as it were, under a canopy of apple-blossom, over a flower-starred turf, to the faint harmony of virginals. Nor does the poet lack power and vigour when an adventurous story is to be told. The clash of arms breaks upon his pagan paradise with no uncertain sound; he is swift in narrative, breathless in escapade. And over all hangs the faint atmosphere of mediævalism, of an England of green gardens and grey towers, of a London "small and white and clean," of chivalry and adventure in every brake. The critic has also to remember the historical value of Morris's literary influence, following upon the prim domesticities of early Victorian verse, and breaking in upon Tennyson's least happy phase of natural homeliness. The period of *Enoch Arden* was one of the least inspiring in modern literature, and it was due not a little to Morris's fine sense of romantic beauty and glamour that the later years of the Victorian age were rescued from commonplace utilitarianism, and dominated by higher issues of art and higher forms of artistic impulse.

See the *Life and Letters*, in 2 vols. (Longmans), by J. W. MACKAIL. (A. WA.)

Morristown, a town of New Jersey, U.S.A., capital of Morris county, in the northern part of the state, at an altitude of 328 feet, at the intersection of the Delaware, Lackawanna and Western, the Rockaway Valley, and the Whippany River railways. The American army, under Washington, had its headquarters here in the winters of 1776–77 and 1779–80. Population (1890), 8156; (1900), 11,267.

Mortara, a town of the province of Pavia, Lombardy, Italy, an important railway junction in the angle between the Ticino and the Po, 32 miles by rail south-west of Milan. It has fine churches, with pictures by Gaudenzio Ferrari and other artists, and also a technical school. It stands in the midst of a rice-growing region, and has iron-works and manufacture of hats and cheese. Here the Austrians defeated the Piedmontese in 1849. Population, 5100.

Mortlake, a village in the Kingston parliamentary division of Surrey, England, on the Thames, about 6½ miles west of London by rail. It has been associated with the Oxford and Cambridge yearly boat-race since 1845. Population of parish (which includes East Sheen) (1881), 6330; (1891), 7714; (1901), 7774.

Morton, John Maddison (1811–1891), English playwright, was born at Pangbourne, 3rd January 1811, his father, Thomas Morton (1764–1838), being also a well-known dramatist. His name lives as the author of *Box and Cox* (1847), but he also wrote a number of other farces. In later life, however, he failed to maintain his success, and eventually he became a Charterhouse pensioner, and died 19th December 1891.

Morton, Levi Parsons (1824——), Vice-President of the United States 1889–93, was born at Shoreham, Vt., on the 16th of May 1824. After an academic education he went into business. He was uniformly successful as a merchant in Hanover, N.H., and at Boston; and in 1863 he founded a banking house in New York, which has become one of the strongest in the country, and of which, till his retirement, he was the head. With little previous activity in politics, he was elected to Congress as a Republican in 1878, and again in 1880. In 1881 he was appointed minister to France, where he served till 1885. Three years later he was nominated for the Vice-Presidency on the ticket with Benjamin Harrison, and was elected. In 1894 he was elected governor of New York by a majority of more than 150,000 over his Democratic competitor, Mr Hill. His two years' service as governor terminated his political activity. Since 1896 he has lived in retirement.

Morton, Oliver Perry (1823–1877), American politician, was born in Wayne county, Indiana, on the 4th of August 1823. He received a college education, and began the practice of law in 1847. In early life a Democrat, he joined the Republican party at its formation, and was elected lieutenant-governor of Indiana in 1860. The governor-elect having resigned, Morton took his place in January 1861, and displayed in connexion with the demands of the Civil War a remarkable degree of vigour and resourcefulness. After a second term as governor, he was sent to the United States Senate, in which he served from 1867 till his death. Prior to the Presidential election of 1876, he laboured strenuously but in vain for the enactment of a law regulating the electoral count. When for lack of such a law the dispute arose as to the method of counting the votes, he took a leading part in the controversy; and though he opposed the Bill creating the Electoral Commission, he served as a member of that body. He died at Indianapolis on 1st November 1877.

Morvi, a native state of India, in Kathiawar, within the Gujarat division of Bombay, situated south of the Gulf of Cutch and the Little Rann. Area, 821 square miles; population (1881), 89,964; (1891), 105,335. The estimated gross revenue is Rs.11,25,390 a year, of which Rs.3,36,530 was expended on public works in 1897–98; tribute, Rs.61,559. The chief, whose title is Thakor Saheb, is a Jareja Rajput, of the same clan as the Rao of Cutch. A steam tramway, constructed at the cost of the state, runs from Rajkot through Morvi town to the seaport of Wawania, and also to Wadhwan (94 miles). Owing to long-standing disputes with the state of Cutch, the collection of customs duties at Wawania is under British management.

The town of MORVI is situated in 22° 49′ N. and 70° 53′ E., on the river Machhu, 22 miles from the sea and 35 from Rajkot. Population (1881), 15,353; (1891), 16,325. Its high school had 364 pupils in 1896–97. There is a cotton mill, with 36 looms and 1664 spindles. The state printing-press issues a gazette.

END OF SIXTH VOLUME.